OPERATION MANUAL

Tightening Checker

Tightening Checker®

TC01

YANMAR

Revision History

Date	Description
January 2025	First edition
January 2026	Company name change and other revisions

Introduction

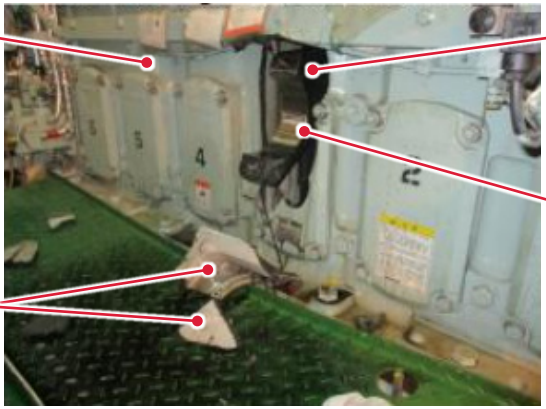
Thank you very much for purchasing Tightening Checker® TC01.
The major cause of many maritime accidents is human error. Especially for engines, it is reported that human error often causes accidents during maintenance work. Among them, accidents that damage an engine caused by insufficient tightening of connecting-rod bolts, so attention must be paid.
This product measures the electrical resistance of the connecting-rod cap to check for tightening failures (forgetting to tighten) of connecting-rod bolts on engines manufactured by Yanmar Power Solutions Co., Ltd. (hereafter referred to as “our company”). We hope that the correct use of this product will help prevent human errors including accidents damaging peripheral components due to connecting-rod bolts.
This product is a supplemental device to assist customers in performing engine maintenance work at their own responsibility and to detect tightening failures of connecting-rod bolts.
This product is not guaranteed to reliably detect tightening failures of connecting-rod bolts or inadequate maintenance work, or to prevent the occurrence of accidents.
In order to take full advantage of this product and use it for as long as possible, please handle this Operation Manual (hereafter referred to as “this manual”) carefully and keep it with you at all times when working with this product.
Please note that the specifications of this product are subject to change, and any changes that may affect the usage of this product will be announced on our website.

Before using this product, please read this manual, which describes precautions for use and methods for handling, and use this product correctly.

Improper use may result in personal injury or equipment damage. Before operating this product, thoroughly read this Operation Manual and make sure you fully understand the contents. Keep this manual in the case of this product so that it can be retrieved whenever necessary.

Example of accidents that damage an engine caused by insufficient tightening of connecting-rod bolts

The connecting-rod cap and bolts blew off and the cylinder block (the largest component in the engine) was damaged by the blown components. The cylinder block had to be replaced and it was necessary to pay for the repair. In addition, the opportunity to carry cargo was lost and the possibility of reputation damage arose. In some cases, human casualties could have occurred.



Trademarks

Tightening Checker® is a registered trademark of Yanmar Power Solutions Co., Ltd. All other trademarks and registered trademarks are trademarks or registered trademarks of their respective owners.

Notes and requests regarding this Operation Manual

Do not reproduce the contents of this manual, in whole or in part, without permission. Please note that the contents of this manual are subject to change without notice. Although every effort has been made to ensure the accuracy of the information contained in this manual, if you find any errors or omissions, contact our company. If you lose or damage this manual, contact our company.

Safety indications (warning labels)

This manual contains information and precautions necessary to operate this product safely and to keep it in a safe condition. Read the following safety instructions carefully before using this product.

Hazard level notations

In this manual, the severity of the risk and the level of danger are indicated using the following classification system.

⚠ DANGER

Indicates an imminently hazardous situation that, if not avoided, will result in serious injury or death.

⚠ WARNING

Indicates a potentially hazardous situation that, if not avoided, could result in serious injury or death.

⚠ CAUTION

Indicates a potentially hazardous situation that, if not avoided, could result in minor injury or potential risk of damage and malfunction to the equipment or other items.

Other notations

Symbols apart from the safety notations are displayed as follows.

IMPORTANT

Indicates information or other content that is particularly important to know for operation and maintenance purposes.

Note Indicates other supplemental information and references.

Symbols

The symbols used in this manual are as follows.

Symbol	Description
	Indicates an action that must not be done.
	Indicates “mandatory” items that must be done.
*	Explanation is given at the bottom.
p.	Indicates a reference.
[ ]	Key names are enclosed in [ ].

Symbols on the device

The symbols used in this manual are as follows.

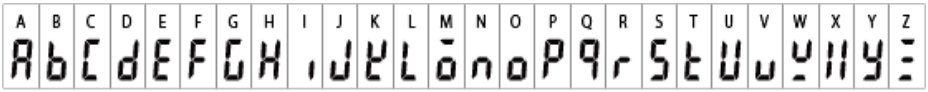
Symbol	Description
	Indicates hazard level notations. If this symbol is shown on the device, refer to the relevant section of the Operation Manual.
	Indicates a fuse.
	Indicates direct current (DC).

Symbols related to standards

Symbol	Description
	Indicates conformity with the regulations for the disposal of electronic and electrical equipment in EU member countries (WEEE Directive).
CE	Indicates that this product complies with the regulations indicated by the EU Directive.

Display in screen

In this product, alphanumeric characters appear as follows.



Warranty and liability coverage

Warranty

This product is warranted for a period of one year from the date of purchase.
In case of malfunction to this product or accidents during transportation, contact our company.

Disclaimer

This product is a supplemental device to assist customers in performing engine maintenance work. This product is not guaranteed to reliably detect improper tightening of connecting-rod bolts or other maintenance defects, or to prevent the occurrence of accidents.
We shall not be liable for any damages incurred by the customer with respect to this product, including but not limited to the following items, except in the case of intentional or grossly negligent conduct on our part.

- Conditions of use, environment, handling, method of use, or application other than those described in this manual, or by carelessness or negligence on the part of the customer
- Deformation, damage, malfunction, or other defects of this product caused by handling methods, modifications, or installation of parts not permitted by this manual
- Deformation, damage, malfunction, etc. caused by external factors such as fire, earthquake, flood, lightning, other natural disasters, pollution, or intentional or negligent acts of a third party
- Malfunction that could have been avoided if the periodic inspection, maintenance, and replacement of consumable parts such as cords, etc., described in this manual had been properly performed
- Malfunction caused by expanded deformation or wear that could have been detected by normal care but was left unattended

Definition of operators

Operators of this product are engine maintenance service technicians, supervisors, and inspectors.
Because of the risk of electric shock, heat generation, fire, and arcing due to short-circuit, persons unfamiliar with the use of electrical measuring instruments should use this product under the supervision of a person experienced in electrical measurement.

Table of Contents

1 For Safe Operation

In order to use this product safely and to take full advantage of its functions, observe the precautions described in this manual.
If you have any questions, please contact any of the contact points listed in “9 Yanmar Dealers and Sales Offices (p. 52)”.

IMPORTANT

- **This product is a device to detect tightening failures of connecting-rod bolts and should not be used for any other purpose.**
- **Sparks may be generated at the moment when the probe comes into contact with the object to be measured or at the moment when it is removed. Do not use this product in an environment where explosive gas (hydrogen, etc.) is generated.**
- **Do not use this product in the crankcase after shut-down until the temperature inside the crankcase has decreased sufficiently and the oil mist has disappeared.**
- **Do not use this product with the front panel removed. If a problem occurs with this product, contact the dealer from which you purchased it without removing the front panel.**
- **Do not change the resistance meter settings. Since the resistance meter has been set appropriately for the functions of this product, if it is changed or reset, it will not be able to make proper measurements. If you change or reset the settings, contact the dealer from which you purchased this product.**

IMPORTANT

- **When using this product, follow the rules regarding the use of equipment, etc., specified for each work environment.**
- **This product is intended for indoor use. Maintain the operation environment with a temperature of 0°C to 40°C, humidity of 80% RH or less (no condensation), and pollution degree of 2, and at an altitude of less than 2,000 m.**
- **This product is a precision instrument that measures micro-resistance at the μΩ level and therefore requires periodic calibration. (Two years or less is recommended.)**
- **Perform an operation check at least once every three months and also always at the beginning of a series of measurement operations (refer to "3.3 Operation check", p. 26. It is possible to check the integrity of this product, including the remaining battery level. (Example of timing of implementation: during inventory period, crew changeover period, etc.)**
- **This product is a supplemental device to detect connecting-rod bolt tightening failures. If any failure is detected by using this product, be sure to tighten the connecting-rod bolt as described in the operation manual of the relevant engine.**
- **When you transfer this product, be sure to also transfer this manual to the next owner and have him or her keep it with this product.**

1.1 Confirmation before using

Before using this product, inspect it for any malfunction that may have occurred during storage or transportation and check its operation. If any damage is found, contact the dealer from which you purchased this product.

DANGER

Before using this product, check the probe and cable for any tears in the coating or exposed metal. If any damage is found, replace it with the one specified by us as it may cause an electric shock hazard.

1.2 Installation of this product

Be sure to observe the following precautions when installing this product.

⚠ CAUTION

To avoid damage or accidents of this product, do not install it in the following places.

- **Places exposed to direct sunlight or high temperature**
- **Places where corrosive or explosive gases are generated**
- **Places exposed to water, oil, chemicals, solvents, etc.**
- **Places subject to high humidity or condensation**
- **Places where strong electromagnetic waves are generated or near electrically charged objects**
- **Places with high levels of dust**
- **Places near induction heating devices (high frequency induction heating device, IH cooking device, etc.)**
- **Places with a lot of mechanical vibration**

IMPORTANT

Accurate measurements may not be possible near locations where strong magnetic fields are generated (e.g., transformers, large current paths), or near locations where strong electric fields are generated (e.g., radio equipment).

1.3 Handling of this product

Observe the following precautions when handling this product.

⚠ WARNING

- **Do not wet this product or perform measurement with your hands wet. This may result in electric shock.**
- **Do not modify, disassemble, or repair this product. This may result in fire, electric shock, or injury.**

⚠ CAUTION

- **Do not place this product on an unstable stand or on a tilted surface. If this product falls or tips over, it may cause injuries or product damage.**
- **To prevent any damage to this product, avoid vibration and shock when transporting and handling it. In particular, be careful of shocks caused by dropping this product.**
- **To avoid damage to this product, do not input voltage or current to the probe.**

1.4 Precautions during transportation

Pay attention to the following when transporting this product. Note that we do not guarantee against any damage occurring during transportation.

⚠ CAUTION

When transporting this product, carefully handle it so that it will not be damaged due to vibration or shock.

1.5 Handling of probes

Pay attention to the following when handling probes.

⚠ DANGER

To prevent electric shock, do not short-circuit the line to which voltage is applied by the tip of a probe.

⚠ CAUTION

- **To prevent damage to the coating of probes, do not step on or pinch the probes.**
- **Do not bend or pull the cable where it connects to the plug head to prevent damage due to disconnection.**

- **To prevent cable disconnection, when pulling out the connector, hold the plug (rather than the cable itself).**
- **The tips of the measurement pins are sharp and dangerous. Handle them carefully to avoid injury.**
- **If the cable coating melts, the metal part will be exposed, which is dangerous. Do not touch the heat-generating parts and the like.**

1.6 Batteries

Be sure to observe the following precautions when installing this product. The “battery” in this manual refers to the battery that drives this product.

⚠ WARNING

Do not short-circuit, attempt to charge, or disassemble the batteries, or put them in a fire. This may result in an explosion, which is dangerous.

When batteries need to be replaced, be sure to contact the dealer from which you purchased this product.

⚠ CAUTION

- **Do not mix new batteries, old batteries, and batteries of different types.**
- **Pay attention to the polarity (+ and -) and do not insert batteries in reverse directions. This may result in deterioration of performance or leakage of liquid.**
- **Do not use batteries for which the recommended expiration period has elapsed.**
- **Do not leave expired batteries in this product.**

- **To prevent corrosion or other damage and performance deterioration due to battery leakage, check the operation of this product at least once every three months (refer to “3.3 Operation check”, p. 26), and then use the service pack (refer to “4.1 Calibration”, p. 39). For information on using the service pack, contact your dealer.**
- **If you suspect any damage, check “5.1 FAQs” (p. 41), and then contact the dealer from which you purchased this product.**

Note

- Perform the operation check at least once every three months (refer to “3.3 Operation check”, p. 26). It is possible to check the integrity of this product, including the remaining battery level.
- When  lights up, the batteries are running low, so contact the dealer from which you purchased this product.
- To reduce battery consumption, be sure to turn off the power after each use.
- Dispose of batteries according to local regulations.

1.6.1 Display of remaining battery level and replacement time

You can check the remaining battery level on the screen of this product. As the battery power decreases, the scale will disappear from the left as shown in the table below. If the battery level drops below “Low battery level”, contact the dealer from which you purchased this product as soon as possible to have the batteries replaced.

Display	Description
	Sufficient battery level.
	Slightly low battery level.
	Low battery level. The battery power is low. Contact the dealer from which you purchased this product as soon as possible.
 (Flashing)	No battery level. Contact the dealer from which you purchased this product immediately.

1.6.2 Connecting the probe

Observe the following precautions before connecting the probe.

DANGER

To avoid electric shock and short-circuit accidents, turn off the power to the object to be measured before connecting the probe.

1.7 Precautions before measurement

Observe the following precautions before performing measurements.

DANGER

- **To prevent electric shock or damage to this product, do not input voltage to the probe. Also, to prevent electrical accidents, turn off the power supply to the object to be measured before performing the measurement.**
- **Sparks may be generated at the moment when the probe is connected to the object to be measured or at the moment when it is removed. Do not use this product in a place where explosive gas (hydrogen, etc.) is generated.**
- **Make sure that the engine is fully stopped before performing the measurement in the crankcase. Do not use this product until the temperature inside the crankcase has decreased sufficiently and the oil mist has disappeared.**

CAUTION

Do not measure a part to which voltage is applied. Even after the motor is turned off, a large electromotive force is generated at the terminals while the motor is inertially rotating. If the transformer or motor is measured immediately after a pressure test, the induced voltage and residual charge will damage this product.

1.8 Product label

The product label provides the model number, manufacturing number, etc. of this product. Do not remove or modify the product label, as this information will be required when you contact us.

2 Product Information

2.1 Overview and features of this product

Conventionally, the hammering test has been known as one of the methods used to detect tightening failures of connecting-rod bolts. However, it is difficult to numerically quantify and share the results, and there can be large variations in the skill of the people who perform the test. Therefore, it is not easy to apply this test to the detection of tightening failures.
This product features easy measurement and the digital display of measurement results for accurate detection of tightening failures. These features are based on the characteristics of the contact surface that exists between conductive materials at the tightening part of the connecting-rod bolt, where the higher the load applied to the contact surface (the more firmly the bolt is tightened), the lower the resistance value. Assuming that the condition in which the connecting-rod bolt is forgotten to be tightened is equivalent to the condition when the bolt is tightened by hand, there is a noticeable difference in resistance values between tightening the bolt by hand and tightening it using the correct procedure with the appropriate tool.
With these features, this product contributes to early detection of human errors in the tightening of connecting-rod bolts, and also to the prevention of accidents that can damage an engine due to insufficient tightening of connecting-rod bolts. Such accidents are mainly caused by human error when, for example, an engineer forgets to tighten the bolts.

2.2 Unpacking

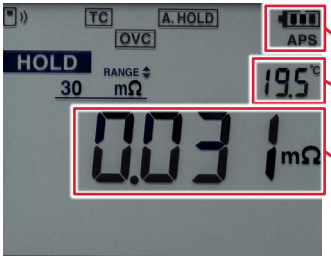
This product is shipped in a cardboard packing box. After this product is taken out, dispose of the packing box according to local regulations. Also, after unpacking, check “2.3 Names and functions of each part” (p. 18) to see if any contents are missing.

2.3 Names and functions of each part

The names and functions of each part of this product are as shown below.

Screen

The screen displays the measurement result of the resistance value. It also displays the remaining battery level and ambient temperature.

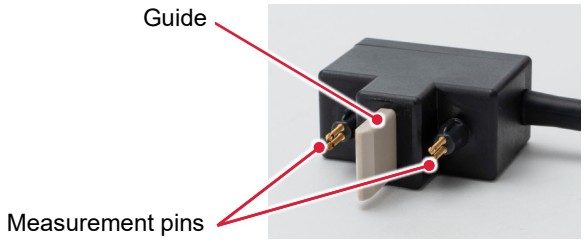


Power supply button

Press the power supply button to turn the power on or off.

Probe

Press the probe against the target connecting-rod to measure the resistance value. A guide to determine the measurement position and a measurement pin to press against the connecting-rod for measurement are provided.



⚠ CAUTION

Since the probe is a precision instrument, handle it carefully.

Operation check plate

This is used to check if this product can perform measurement properly. It is stored under the probe.

Measurement value ranges for operation check

Shows the normal measurement value ranges for operation checks. If a value outside the range is detected as a result of the operation check, there is a possibility that the probe or resistance meter is malfunctioning.

3 Measurement

3.1 Measurement workflow

The resistance value is measured using the following workflow.

⚠ WARNING

Before measuring the resistance value, make sure that the connecting-rod bolt is ready for measurement by securing a work space around the inspection window or adjusting the crankcase position according to the inspection procedure in the inspection and maintenance manual for the engine to be measured.
If a measurement is performed without the connecting-rod bolt being ready for measurement, not only will the measurement not be performed properly, but the operator may also be seriously injured.

Placing this product at the work site at least one hour before measurement

Checking before the measurement (p. 21)
- Checks on this product and peripherals
- Checks when power is turned on

Operation check (p. 26)

Measuring resistance value (p. 28)
- How to measure at the mating surface of the connecting-rod cap
- How to measure at the top of the bolt of the connecting-rod cap

Determining measurement value (p. 34)
- How to determine by comparison with the same connecting-rod bolt
- How to determine by comparison with other cylinders
- How to determine by comparison with a guide resistance value

Completing the measurement (p. 37)

3.2 Checking before the measurement

Perform the following checks before measuring the resistance value.

IMPORTANT

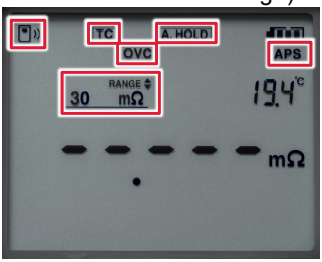
- **To minimize the temperature difference between the connecting-rod and this product, place this product at the work site at least one hour before measurement. If the temperature difference between the connecting-rod and this product is large, the resistance value may be affected by temperature dependence.**
- **Before measurement, visually check for any malfunction that may have occurred during storage or transportation. If any damage is found, contact the dealer from which you purchased this product.**

3.2.1 List of inspection items

Checks on this product and peripherals

Inspection items	Remedy
Are there any damaged or cracked areas in this product?	If there is any damage, stop using this product and have it repaired.
Are the internal circuits of this product exposed?	If any internal circuits are exposed, stop using this product and have it repaired.
Are there any metal pieces or other debris adhering to the terminals?	If anything is adhered to the terminals, wipe it off with a cotton swab or the like.
Is the probe coating torn or any metal exposed?	If there is any damage, the measurement value may be unstable or an error may occur. It is recommended to replace the probe with a new one. For information on probe replacement, refer to “5.3 Probe replacement” (p. 44).

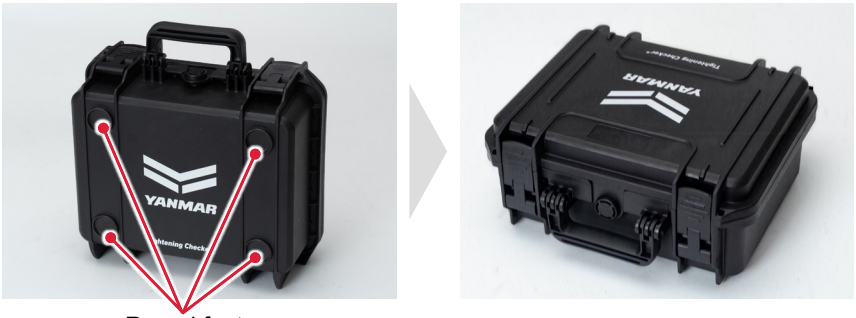
Checks when power is turned on

Inspection items	Remedy
Is the remaining battery level sufficient?	The current status is indicated by in the upper right corner of the display. If is displayed, the battery is running low. Contact the dealer from which you purchased this product as soon as possible.
Are any display items missing?	Check the display all segments are fully lit when the power is turned on. If any item is missing, contact the dealer from which you purchased this product.
When the power is turned on, are all display segments lit and then is the display changed to the initial screen?	If the display does not appear in this order, there may be damage inside this product. Contact the dealer from which you purchased this product.
Is the initial screen displayed correctly? (Are the items marked with red frames the same as the following?) 	If not, the internal settings of this product may be incorrect or there may be internal damage. Contact the dealer from which you purchased this product.

3.2.2 Checking procedure for inspection items

Checks on this product and peripherals

1 Place this product on a flat surface with the round feet facing down.



Round feet

2 **Pull out the two latch locks toward you.**

3 **Pull out the two latches toward you.**

4 **Open the case cover.**

5 Attach the probe connections to the probe terminals on the front panel.

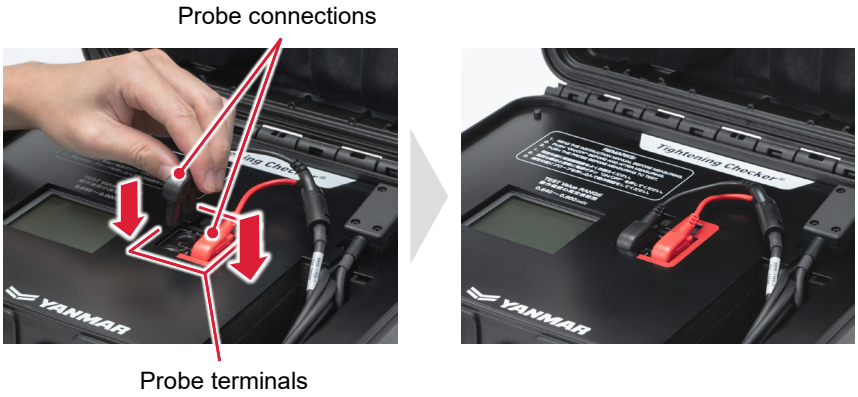
Attach the black cable to the left side (black side) and the red cable to the right side (red side). Also, attach the cables so that they extend upward as shown in the figure below.

⚠ DANGER

To avoid electric shock and short-circuit accidents, turn off the power to the object to be measured before connecting the probe.

IMPORTANT

- **Attach the probe connections while confirming the position and direction of the color coding. If the attachment position or direction is incorrect, accurate measurement cannot be performed.**
- **Insert each probe connection firmly all the way to the back of the terminal.**
- **After using this product, store it with the probe still connected.**



6 Check the condition of this product and the probes.

Perform the following inspections.

- Are there any damaged or cracked areas in this product?
- Are there any internal circuits exposed?
- Are there any metal pieces or other debris adhering to the terminals?
- Is the probe coating torn or any metal exposed?

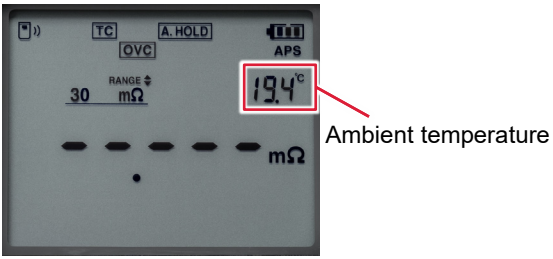
Reference For more information, refer to “Checks on this product and peripherals” (p. 21) in “3.2.1 List of inspection items”.

Checks when power is turned on

1 Press the power supply button of this product.

The power is turned on and the initial screen is displayed.

Note The ambient temperature displayed in the upper right corner of the screen is automatically applied to the internal calculation to complement the temperature dependence of the resistance value.



2 Check the condition of this product after the power is turned on.

Perform the following inspections.

- Is the remaining battery level sufficient?
- Are any display items missing?
- When the power is turned on, are all display segments lit and then is the display changed to the initial screen?
- Is the initial screen displayed correctly?

Reference For more information, refer to “Checks when power is turned on” (p. 22) in “3.2.1 List of inspection items”.

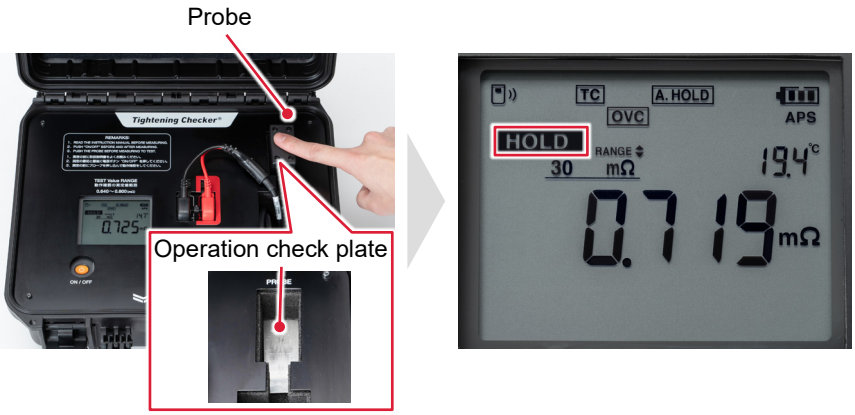
3.3 Operation check

After completing the checks before measurement, perform an operational check of this product.

IMPORTANT

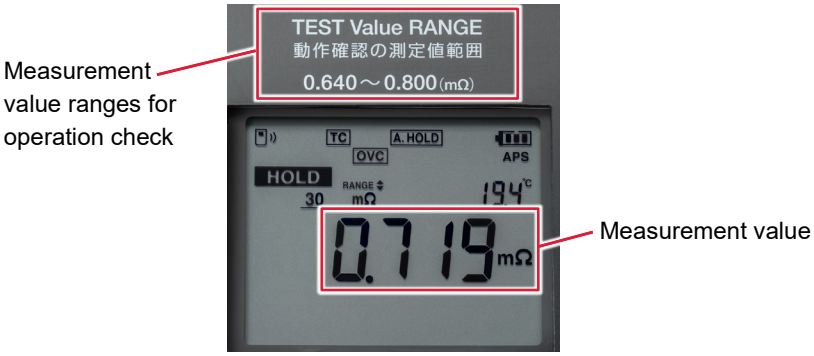
This should be performed at the beginning of a series of measurements in order to confirm that this product is working properly.
Even if this product is kept in storage, be sure to perform the operation check at least once every three months.

1 Leave the probe stored in the front panel and press it firmly into the operation check plate.
Press and hold the probe for about 10 seconds until “HOLD” is displayed on the screen.



2 Remove your hand from the probe and confirm that the measurement value displayed on the screen is within the range of 0.640 to 0.800.

The figure below shows an example when the measurement value is normal. The normal measurement value range is also shown on the front panel of this product as “TEST Value RANGE 動作確認の測定値範囲 mΩ”.



Note

- If the measurement value is outside the range, replace the probe with a spare one and check the operation again. It is recommended to always have a new spare probe available. For how to replace the probe, refer to “5.3 Probe replacement” (p. 44).
- If the measurement value is still outside the range after replacing with a spare probe, the resistance meter may be malfunctioning. Discontinue using the probe and contact the dealer from which you purchased this product.

3.4 Measuring resistance value

Once the operation check is completed, measure the resistance value.

IMPORTANT

- **To measure the resistance value, it is necessary to prepare an environment in which the measurement position is electrically conductive. If the measurement value is not updated even when the probe is applied, the measurement position may not be electrically conductive. In this case, do not forcefully apply the probe to the measurement position and remove any oil and dirt around the measurement position.**
- **If the engine has been in operation for a long time, oil may be adhered on the coating of the connecting-rod bolt. Clean the area with fine paper or a wire brush, and remove the remaining oil with a cleaning solution.**

3.4.1 Number of measurements

Measurement values may vary depending on how the probe is applied to the measurement position, so be sure to measure three times at the same measurement position.

IMPORTANT

- **When measuring the resistance value, be sure to measure three times at the same measurement position.**
- **After the measurement, the second smallest value (median value) among the three values should be adopted as the measurement value. The smallest value among the three values may be the resistance value of the connecting-rod bolt itself due to the use of an incorrect measurement position. Be sure to adopt the second smallest value as the measurement value.**

3.4.2 Measurement procedure

There are two types of measurement methods, “How to measure at the mating surface of the connecting-rod cap” and “How to measure at the top of the bolt of the connecting-rod cap”, depending on the characteristics of the engine. Check which one is appropriate for the engine to be measured before performing the measurement. For engines of the same model, always perform the measurement at the same positions.

How to measure at the mating surface of the connecting-rod cap

Supported engines manufactured by our company	EY33、EY26、EY22、EY21、N21、EY18、12GY175、EY17、6N165、NY16

Note The above information is current as of January 2025. Be aware that the engines we support may be added or deleted without notice.

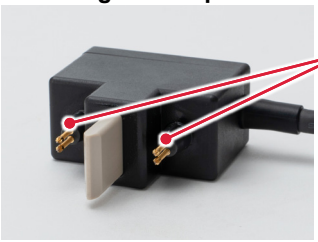
1 **Remove the probe from the front panel.**

2 **Press the guide of the probe against the connecting-rod to perform positioning.**

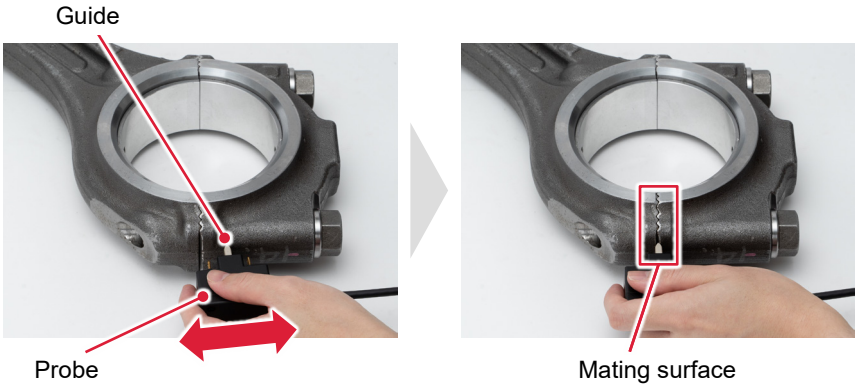
Slide the probe until the guide is exactly in contact with the chamfered part of the mating surface of the connecting-rod.

⚠ CAUTION

When positioning the probe by sliding it, make sure that the measurement pin does not come into contact with the connecting-rod. Sliding the probe with the measurement pin touched may result in damage to the probe.

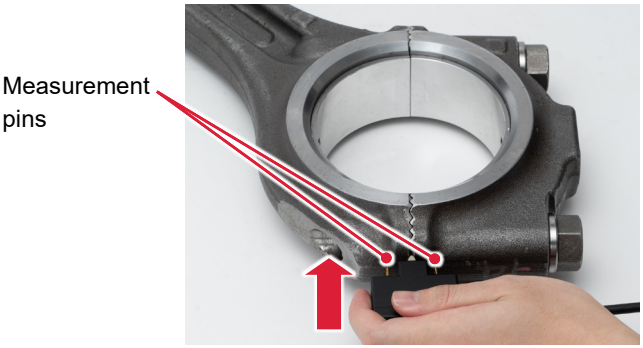


Since the probe is a precision instrument, handle it carefully.



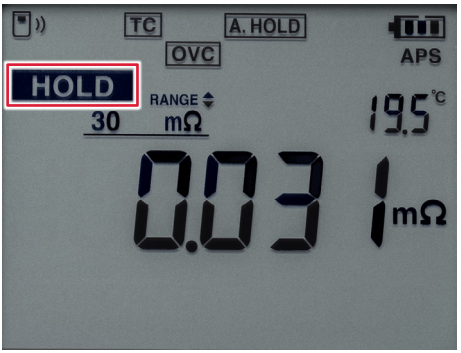
3 Gently push the probe in until the measurement pin comes into contact with the connecting-rod.

Press and hold the probe for about 10 seconds until “HOLD” is displayed on the screen.



4 Confirm that “HOLD” is displayed on the screen and remove the probe from the connecting-rod.

Record the resistance value displayed on the screen.



Note The material characteristic value of the connecting-rod is used to convert the measured value to a resistance value equivalent to the value at 30°C ambient temperature. It is then displayed on the screen.

5 To continue the measurement, push the probe in the connecting-rod again.

Keep pressing the probe until “HOLD” disappears from the screen and then appears again.

IMPORTANT

When measuring the resistance value, be sure to measure three times at the same measurement position.

How to measure at the top of the bolt of the connecting-rod cap

Supported engines manufactured by our company	12AY、6AY、6GY135、HY、HA、CH

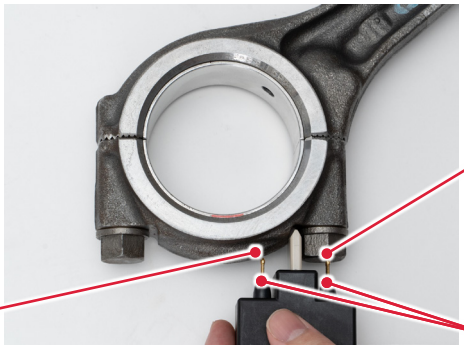
Note The above information is current as of January 2025. Be aware that the engines we support may be added or deleted without notice.

1 **Remove the probe from the front panel.**

2 **Find a place where the measurement pins of the probe are exactly in contact with the connecting-rod cap and the top of the bolt, and perform positioning there.**

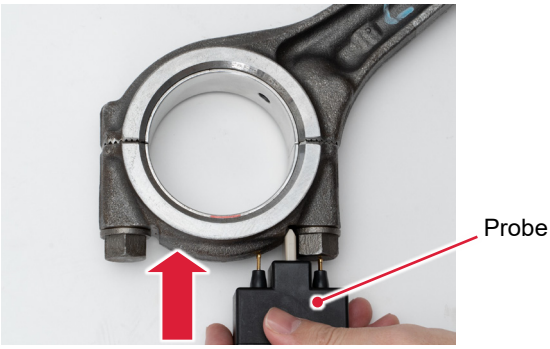
⚠ CAUTION

Since the probe is a precision instrument, handle it carefully.



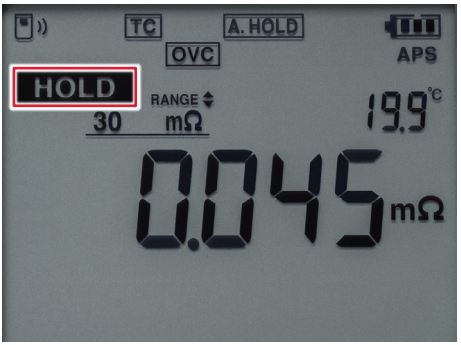
3 **Gently push the probe in.**

Press and hold the probe for about 10 seconds until “HOLD” is displayed on the screen.



4 **Confirm that “HOLD” is displayed on the screen and remove the probe from the connecting-rod.**

Record the resistance value displayed on the screen.



Note The material characteristic value of the connecting-rod is used to convert the measured value to a resistance value equivalent to the value at 30°C ambient temperature. It is then displayed on the screen.

5 **To continue the measurement, push the probe in the connecting-rod again.**

Keep pressing the probe until “HOLD” disappears from the screen and then appears again.

IMPORTANT

When measuring the resistance value, be sure to measure three times at the same measurement position.

3.5 Determining measurement value

Based on the measurement value, determine whether there is a tightening failure of the connecting-rod bolt. Three examples of the determination method are provided below.
Note that all of these methods are auxiliary determination methods to support engine maintenance work performed by the customer. They are not guaranteed to reliably detect or prevent accidents such as connecting-rod bolt tightening failures or other inadequacies in servicing and maintenance.
It is up to the customer to decide how to determine the measurement value.

3.5.1 How to determine by comparison with the same connecting-rod bolt

When comparing the resistance values of the same connecting-rod bolt before it is loosened and after it is tightened, if there is a deviation of approximately 10% or more, the connecting-rod bolt might have failed to tighten or be forgotten to be tightened. Retighten the connecting-rod bolt and complete the process.

Unit: μΩ(1 μΩ=0.001 mΩ)

	Before loosening the connecting-rod bolt	After tightening the connecting-rod bolt
Resistance value	49	63

The above shows an example of a measurement result. In this case, the deviation between before loosening and after tightening the bolt is much higher than 10%, indicating that the connecting-rod bolt tightening might have failed to tighten or be forgotten to be tightened. Retighten the relevant connecting-rod bolt.

3.5.2 How to determine by comparison with other cylinders

When determining the value by comparison with other cylinders, check the variations of the resistance value between cylinders with respect to the average value.
If the deviation is approximately 10% or more, there is a possibility that the worker has not properly tightened or forgotten to tighten the connecting-rod bolts. Retighten the connecting-rod bolt and complete the process.

Unit: μΩ(1 μΩ=0.001 mΩ)

Cylinder	1		2		3		4		5		6	
Measurement position	A	B	A	B	A	B	A	B	A	B	A	B
Resistance value	47	46	46	48	49	47	46	50	82	46	47	46
Average value	50											
Deviation	3	4	4	2	1	3	4	0	**32**	4	3	4

Measurement position A indicates the operation side, and B indicates the non-operation side.

The above shows an example of a measurement result. In this case, the deviation of the measurement position on the operation side of the No.5cyl. is much higher than 10%, indicating that the connecting-rod bolt might have failed to tighten or be forgotten to be tightened. Retighten the relevant connecting-rod bolt.

3.5.3 How to determine by comparison with a guide resistance value

If the measured resistance value is larger than the upper limit value for each relevant engine (the upper limit value considering the statistical variations under any given conditions), the connecting-rod bolt tightening might have failed to tighten or be forgotten to be tightened. Retighten the connecting-rod bolt and complete the process.

Note For a list of upper limit values that take into account the possible variations for each engine, refer to “8.1 Supported engines manufactured by our company and guide resistance values (examples)” (p. 50). The guide resistance values can also be set independently based on the performance records of the customer’s engine.

(Example) Model name: CH

Unit: μΩ(1 μΩ=0.001 mΩ)

Cylinder	1		2		3		4		5		6	
Measurement position	A	B	A	B	A	B	A	B	A	B	A	B
Resistance value	45	49	44	46	47	49	46	50	**72**	46	48	44

Measurement position A indicates the operation side, and B indicates the non-operation side.

The above shows an example of measurement results on the “CH”. The adjusted, modified upper limit value for the “CH” is “53”. However, the measurement position on the operation side of the No.5cyl. exceeds that upper limit value, indicating that the connecting-rod bolt tightening might have failed to tighten or be forgotten to be tightened. Retighten the relevant connecting-rod bolt.

3.6 Completing the measurement

To complete the measurement, follow the steps below to prepare the product for storage.

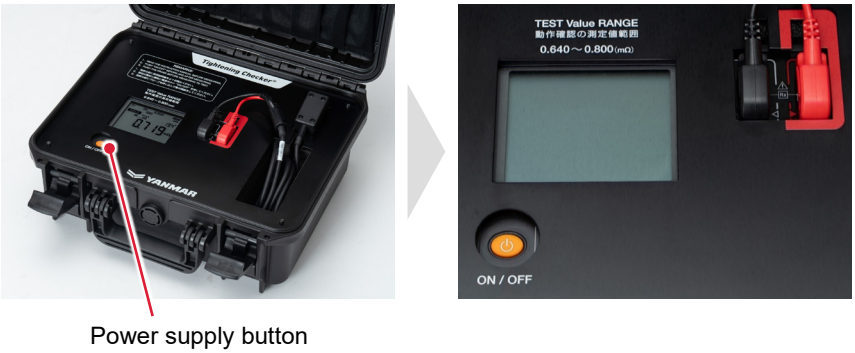
1 Store the probe in the front panel.

IMPORTANT

Leave the probe connected to the probe terminals of the front panel.

2 Press and hold the power supply button on this product.

The power supply turns off and the screen display disappears.



3 Close the cover of the case.

4 Lock the cover with the two latches to ensure it remains in an appropriate state for storage.

This completes the measurement.

4 Maintenance and Service

4.1 Calibration

Periodic calibration is necessary to ensure that this product provides correct measurement results within the specified accuracy.
Calibration should be performed once every three months by conducting an operational check (refer to “3.3 Operation check”, p. 26).
For calibration, use the “Calibration service pack” for this product. For more information, contact Yanmar Dealer or dealer.

IMPORTANT

Do not continue to use this product without performing periodic calibration. You may not obtain correct measurement results.

Note Calibration service pack overview:
- Battery replacement
- Calibration
- Checking of LCD display, relevant devices, and wiring

4.2 Cleaning

To remove dirt from this product, wipe it lightly with a soft cloth moistened with a small amount of water or neutral detergent.
Wipe the screens gently with a soft, dry cloth.

IMPORTANT

Never use detergent containing benzene, alcohol, acetone, ether, ketone, thinner, or gasoline. These chemicals can deform or discolor this product.

4.3 Replacement parts and service life

The service life of each part varies depending on the operating environment and frequency of use. The following periods of operation are not guaranteed. When you wish to replace a part, contact the dealer from which you purchased this product.

Part	Service life
Electrolytic capacitor	Approximately 10 years
Lithium battery for backup of the clock	Approximately 10 years This product has a built-in lithium battery for backup of the clock. If the date or time is significantly deviated when the power is turned on, it indicates that it is time to replace the battery. Contact the dealer from which you purchased this product.

5 Troubleshooting

5.1 FAQs

When you suspect damage to this product, check the following items. If none of these apply, contact the dealer from which you purchased this product.

Problem	Possible cause	Countermeasure
The power does not turn on. (Nothing is displayed on the screen.)	Remaining battery charge is insufficient.	Contact the dealer from which you purchased this product.
The power supply turns off immediately.	Batteries other than alkaline batteries are being used.	Use alkaline batteries.
The power supply turns off immediately. (The scale of the remaining battery level mark on the screen has decreased.)	Remaining battery charge is insufficient.	Contact the dealer from which you purchased this product.
The power supply turns off immediately. (APS is lit.)	Since the automatic power saving function (APS) is operating, the power is automatically turned off if there is no operation for a certain period of time.	Turn on the power again.

5.2 Error display and countermeasures

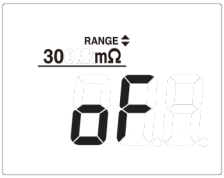
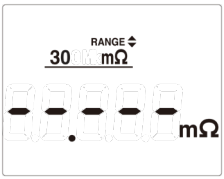
When the condition of this product or the measurement state is not normal, an error message will be displayed on the screen.
If you suspect damage to this product, check “5.1 FAQs” (p. 41) and then contact the dealer from which you purchased this product.
For any repairs required, contact the dealer from which you purchased this product.
When an error is displayed on the screen, repair is required. Contact the dealer from which you purchased this product.

General product errors

Display	Meaning	Countermeasure
FAiL	Execution error	The countermeasure varies depending on what is being executed. (Example) When an execution error is displayed during zero adjustment, it indicates that the result is outside the range of zero adjustment.
Err08	Communication error	Contact the dealer from which you purchased this product.
Err90	Program ROM check sum error	Version upgrade may have failed. Contact the dealer from which you purchased this product.
Err91	CPU RAM error	The device has been damaged. Contact the dealer from which you purchased this product.
Err92	SRAM reading/writing test error	The device has been damaged. Contact the dealer from which you purchased this product.
Err93	FRAM reading/writing test error	The device has been damaged. Contact the dealer from which you purchased this product.
Err95	Adjustment data error	The device has been damaged. Contact the dealer from which you purchased this product.
Err96	Setting backup error	Contact the dealer from which you purchased this product.
Err99	Clock display error	Contact the dealer from which you purchased this product.
FUSE	Blown fuse	Contact the dealer from which you purchased this product.
PrtCt	The protection function is working.	If overvoltage is input by mistake, immediately disconnect the probe from the object to be measured. Measurement is not possible while the protection function is working. To cancel the protection function, turn the power off and then on again.
t.Err	When TC is turned on, the temperature sensor is not connected or the temperature is displayed as oF.	Contact the dealer from which you purchased this product.

Measurement errors

If a measurement was not performed correctly, a measurement error indication will be displayed on the screen.

Error name	Display in screen	Error description and countermeasure
Overrange		This is displayed when the resistance value and ambient temperature exceed the measurement range or display range. Perform measurement again or turn the power off and then on again.
Current fault or measurement not performed		This is displayed when the resistance value and ambient temperature exceed the measurement range or display range. When this is displayed, remove any oil and dirt around the measurement position. Especially for engines that have been used for a long period of time, remove the oil film adhered to the connecting-rod using fine paper, etc.
The protection function is working.		When overvoltage is input to the probe, the protection function of the internal circuit is activated and the red backlight turns on. If overvoltage is input by mistake, immediately disconnect the probe from the object to be measured. Measurement is not possible while the protection function is working. To cancel the protection function, turn the power off and then on again.
Fuse disconnection		This product is equipped with a fuse to protect it from overvoltage input. If you input overvoltage by mistake and blow the fuse, contact the dealer from which you purchased this product.
Temperature computation error		Temperature computation is not possible because the temperature sensor is abnormal or the temperature is displayed as oF. If this indication is displayed, contact the dealer from which you purchased this product.

5.3 Probe replacement

Follow the steps below to replace the probe with a new one.

IMPORTANT

- **After performing “3.3 Operation check” (p. 26), if the measurement value is not in the normal range, replace the probe with a new one.**
- **Attach the probe connections while confirming the position and direction of the color coding. If the attachment position or direction is incorrect, accurate measurement cannot be performed.**
- **Insert each probe connection firmly all the way to the back of the terminal.**
- **After using this product, store it with the probe still connected.**

1 **Press and hold the power supply button on this product.**
The power supply turns off and the screen display disappears.

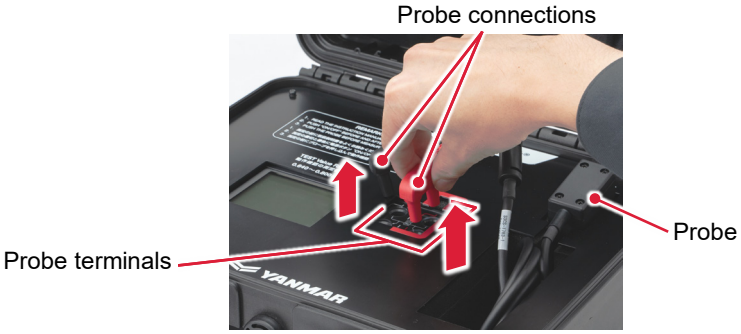
2 **Remove the probe from the front panel.**
Pull the probe connections of the cable outside the probe terminals on the front panel and remove the probe from the storage unit.

⚠ CAUTION

The tips of the measurement pins are sharp and dangerous. Be very careful when handling the probe, as you may be injured.

IMPORTANT

To remove the probe, do not pull the cable, but firmly hold the probe connections.



3 Prepare a new probe and attach the probe connections to the probe terminals on the front panel.

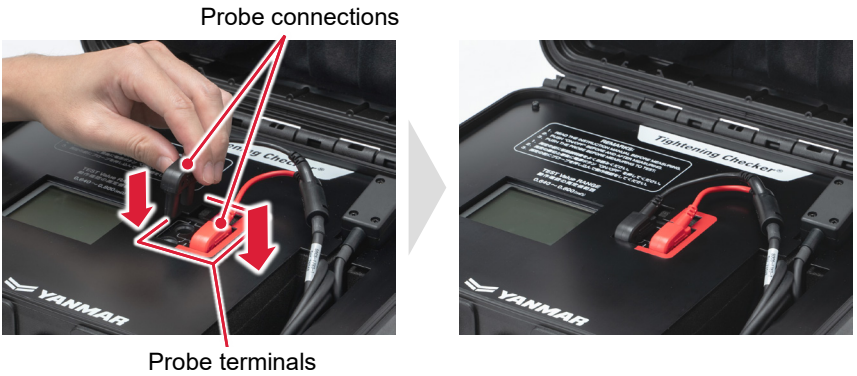
Attach the black cable to the left side (black side) and the red cable to the right side (red side). Also, attach the cables so that they extend upward as shown in the figure below.

⚠ DANGER

To avoid electric shock and short-circuit accidents, turn off the power to the object to be measured before connecting the probe.

IMPORTANT

- **Attach the probe connections while confirming the position and direction of the color coding. If the attachment position or direction is incorrect, accurate measurement cannot be performed.**
- **Insert each probe connection firmly all the way to the back of the terminal.**
- **After using this product, store it with the probe still connected.**



This completes the probe replacement.

5.4 Battery/fuse replacement

If a battery or fuse needs to be replaced, contact the dealer from which you purchased this product.

6 Repair and Disposal

6.1 Repair

If this product does not return to normal condition even after performing the countermeasure described in “5 Troubleshooting” (p. 41), it must be repaired. Contact the dealer from which you purchased this product.

6.2 Disposal

To dispose of this product, contact the dealer from which you purchased this product.

7 Specifications

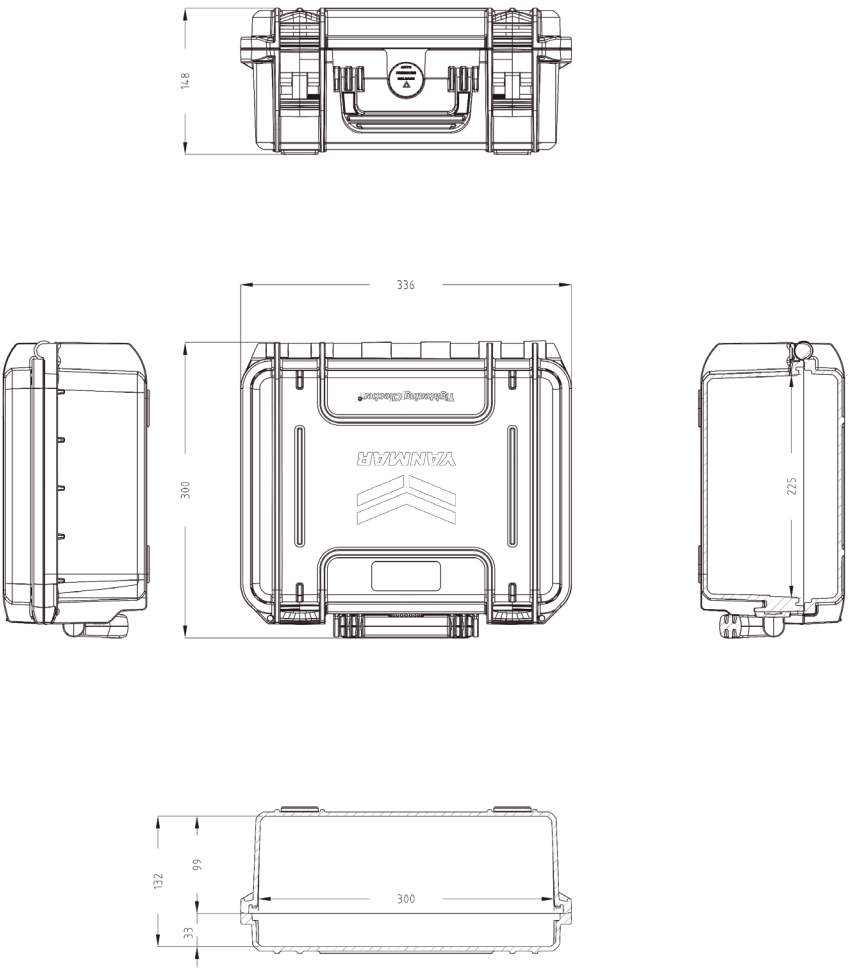
7.1 Specifications of this product

Location of use	Indoor, pollution level 2, altitude of less than 2,000 m
Operating temperature and humidity range	0°C to 40°C, 80% RH or less (no condensation)
Storage temperature and humidity range	-10°C to 50°C, 80% RH or less (no condensation)
Applicable standards	RoHS2 directive: EN IEC 63000: 2018
Power supply	AA alkaline dry battery (LR6) x 8
Rated supply voltage	1.5 V DC x 8 (AA alkaline dry battery (LR6) x 8)
Maximum rated power	5 VA
Continuous usage time	New AA alkaline batteries (LR6) (23°C, reference value) Approximately 10 hours (measuring for 1 second in each interval of 10 seconds in the 3 mΩ range, backlight OFF)
Bluetooth® wireless adapter	Bluetooth Ver.5.0LE
External dimensions	W336 mm × H300 mm × D148 mm
Weight	Approximately 3.1 kg
Product warranty period	1 year
Fuse	F2AH/250 V (built into this product)

7.2 Specifications of the case

Feature	• Air pressure regulating valve that supports opening and closing of the case during changes in air pressure • Paddle locks to which padlocks can be attached • Double-throw latches that enable easy opening and closing • Stacking structure that allows cases to be stacked on top of each other
Material	Polypropylene resin
Waterproof protection and dustproof protection level	IP67
Environmental standards	RoHS2 compliant
Standard of UK Ministry of Defense	DEFSTAN81-41 compliant
NATO standard	STANAG4280 compliant
ATA standard	ATA-300-CAT1 compliant

7.3 External dimensions



Unit: mm

8 Appendix

8.1 Supported engines manufactured by our company and guide resistance values (examples)

The table below shows the models of our company's engines that are compatible with this product. It also shows the guide resistance values for each engine after factory assembly. Note that these resistance values are not designed values and include variations between engines and individual cylinders. The values should only be used for reference. These values can also be set independently based on the performance records of the customer's engine.

Guide resistance value when fully tightening the connecting-rod bolt for each model

Unit: μΩ(1 μΩ=0.001 mΩ)

Model name	Measurement position	Full tightening Finished state using appropriate tools according to the Operation Manual of the engine		
		Average value	Upper limit values that take into account the possible variations for data*	Remarks
EY33	Mating surface of the cap	Upper 38 Lower 32	**Upper 42** **Lower 36**	Three-part connecting-rod
EY26		Upper 30 Lower 30	**Upper 33** **Lower 35**	Three-part connecting-rod
EY22		30	**35**	
EY21		30	**35**	
N21		30	**35**	
EY18		31	**37**	
12GY175		32	**36**	12 V model
EY17		30	**34**	
6N165		30	**33**	
NY16		28	**34**	

Model name	Measurement position	Full tightening Finished state using appropriate tools according to the Operation Manual of the engine		
		Average value	Upper limit values that take into account the possible variations for data*	Remarks
12AY	Cap and top of the bolt	44	**47**	12 V model
6AY		49	**60**	
6GY135		48	**52**	
HY		48	**56**	
HA		47	**53**	
CH		48	**53**	

* If the measurement value is larger than this, there is a possibility of forgetting to tighten (average value + 3σ).

9 Yanmar Dealers and Sales Offices

Yanmar Dealers

YANMAR ENGINEERING CO., LTD.

Technical Support Division	1-1-1 Nagasu Higashi-dori, Amagasaki, Hyogo, 660-8585, Japan MAIL：tech_ye@yanmar.com TEL：+81-6-7636-9991 FAX：+81-6-6481-6101
Sales offices	
Head Office	1-1-1 Nagasu Higashi-dori, Amagasaki, Hyogo, 660-8585, Japan TEL：+81-6-6489-8045 FAX：+81-6-6489-8075
Tokyo Engineering Division	1-6-4 Monzennaka-cho, Koto-ku, Tokyo, 135-0048, Japan TEL：+81-3-6733-4210
Yaizu Engineering Division	434-1 Araya, Yaizu, Shizuoka, 425-0023, Japan TEL：+81-54-629-1111
Osaka Engineering Division	1-1-1 Nagasu Higashi-dori, Amagasaki, Hyogo, 660-8585, Japan TEL：+81-6-6489-8051
Shikoku Engineering Division	508-2 Nii Kokubunji-cho, Takamatsu, Kagawa, 769-0101, Japan TEL：+81-87-874-9116
Chugoku Engineering Division	3-1-31 Suminohama, Saeki-ku, Hiroshima-shi, Hiroshima, 731-5145, Japan TEL：+81-82-923-4152
Kyushu Engineering Division	7-1 Kitaminato-machi, Wakamatsu-ku, Kitakyushu, Fukuoka, 808-0027, Japan TEL：+81-93-771-3751
Nagasaki Service Group	Shochiku building 2F, 6-19 Goto-machi, Nagasaki-shi, Nagasaki, 850-0036, Japan TEL：+81-95-822-2494
Oita Service Center	501-2 Azaura, Shitanoe, Usuki, Oita, 875-0002, Japan TEL：+81-972-67-2447
Kagoshima Service Group	1-4-13 Nanatsujima, Kagoshima-shi, Kagoshima, 891-0132, Japan TEL：+81-99-261-1793
Nichinan Service Group	588-121 Ishigo, Nichinan, Miyazaki, 887-0000, Japan TEL：+81-987-23-1031
Overseas Engineering Division	1-1-1 Nagasu Higashi-dori, Amagasaki, Hyogo, 660-8585, Japan TEL：+81-6-6489-8048

2024.02.01

Be sure to read this Operation Manual to ensure safe and correct use of this product. Improper use of this product may result in accidents.
After reading this manual, always keep it near the product for easy reference.

YANMAR POWER SOLUTIONS CO., LTD.

yanmar.com

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