Version: V2.0
Language: EN

WPM-P

Shaft power meter

User manual

Ningbo SHANBEI Technology Co.,Ltd

User notice

Disclaimer

Warning: Before using this product, please refer to the important safety information in the user manual and review all warnings, limitations and disclaimers.

This product is no substitute for proper training and careful seamanship. Proper installation and proper use of the equipment is the responsibility of the owner to avoid accidents, personal injury or property damage. The user of this product is solely responsible for compliance with maritime safety practices.

The owner is solely responsible for installing and using the equipment in a manner that will not cause accidents, personal injury or property damage. The user of this product is solely responsible for compliance with maritime safety navigation practices.

This document represents the product at the time of release. Ningbo SHANBEI Technology Co., Ltd. reserves the right to change product specifications at any time without prior notice. If you need any further assistance, please contact your nearest dealer.

Governing language

This Statement, any instruction manuals, user guides and other Product-related information (documentation) may be or have been translated into another language (translation). If there is any conflict between any translated version of the document, the Chinese version of the document will be the official version of the document.

Copyright

Cautions

1 Do not place the equipment at will without fixing it, so as to avoid serious damage when it is dropped due to turbulence or other factors during the voyage.
2 Do not use any power adapter that is not equipped with this product. Otherwise, the device may not work due to the different circuit design, or the performance may be affected or even damaged.
3 Do not disassemble the equipment. If the maintenance engineer is not authorized by the company to disassemble the equipment, the free warranty will be lost.
4 During use or cleaning, avoid any liquid or other objects falling into the equipment to avoid circuit damage or short circuit.
5 Do not place the device and its accessories in an environment prone to humidity or direct sunlight. Keep the device in a dry environment.
6 In case of hardware failure (such as damage to the machine shell or foreign matter falling into the machine, etc.), please stop using the machine immediately and contact the dealer in time.
7 The company shall not assume any legal or other liability for any maritime accident, monetary loss or loss of interests that occurs on vessels using this equipment.

Contents

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1 Introduction

1.1 Overview

WPM-P shaft power meter is an instrument used for long-term continuous measurement of speed, torque, power and thrust (optional). Designed according to maritime specifications, it can be used for power monitoring of ship main engine shafting, propeller and generator shaft, providing reliable and real-time data support for various power management systems and energy efficiency management systems. The product adopts non-contact measurement, wireless induction power supply, strong adaptability, the longest data storage time can be up to 5 years, used in Marine diesel engines and gear boxes, mining machinery, offshore fans and other large power and transmission devices.
The product has the following characteristics:
1. Fully modular design;
2. RS485 or CAN CAN be used to connect to third-party devices.
3. Support multiple protocols: NMEA0183, NMEA2000, Modbus-RTU;
4. High precision measurement: 1.5% (paste strain gauge);
5. High reliability;
6. Easy installation.

Base customization item		
Whether to include display	1	Include
	2	Exclude
Stator type	1	Shaft diameter 130~159mm
	2	Shaft diameter 160~209mm
	3	Shaft diameter 210~252mm
	4	Shaft diameter 253-345mm
	5	Shaft diameter 346~464mm
	6	Shaft diameter 465~530mm
	7	Shaft diameter 531~780mm
	8	Shaft diameter < 130mm
	9	Shaft diameter > 780mm

Table 1.1

1.2 Product appearance

Shaft power meter product appearance diagram	Displays the unit product appearance diagram
	

Figure 1.1

1 Introduction

1.3 Product composition

Number	Name	Quantity
1	Transmitter	1
2	Rotor belt	1
3	Stator	1
4	Stator column	1
5	Side control box	1
6	Remote display	1
7	Strain simulator	1
8	Mounting fittings	1
9	Certificate of conformity	1
10	Warranty card	1
11	Specification	1

Table 1.2

1.4 Product size drawing

Shaft power meter dimensions

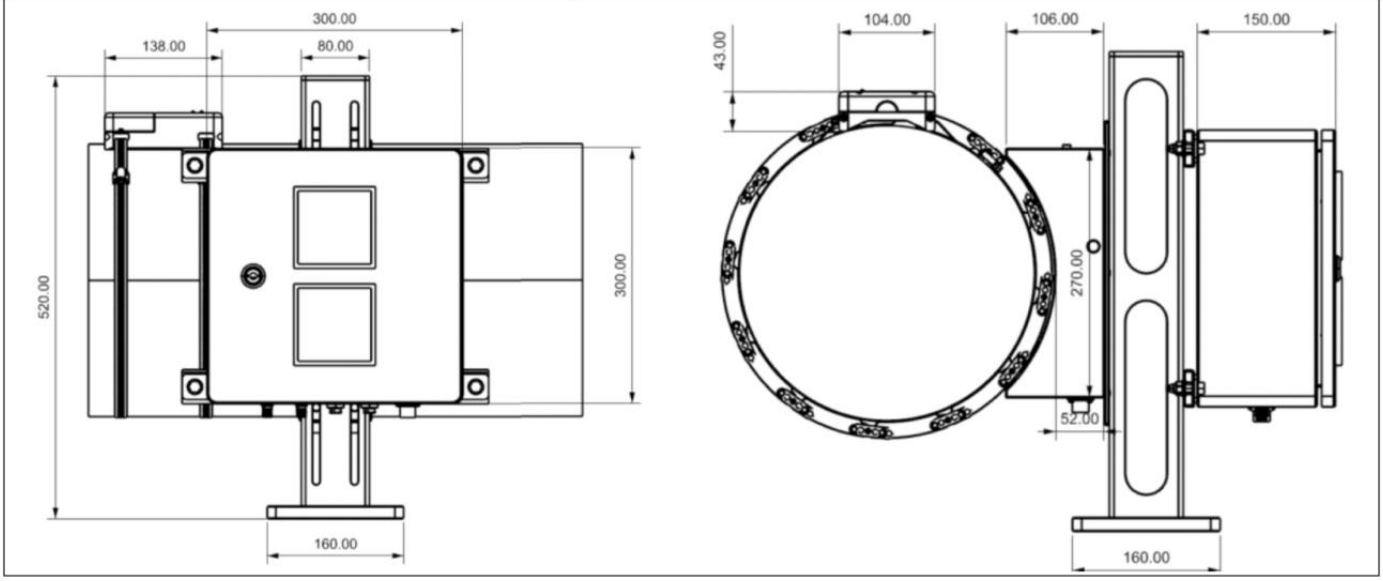

Figure 1.2

1 Introduction

Displays unit outline dimensions

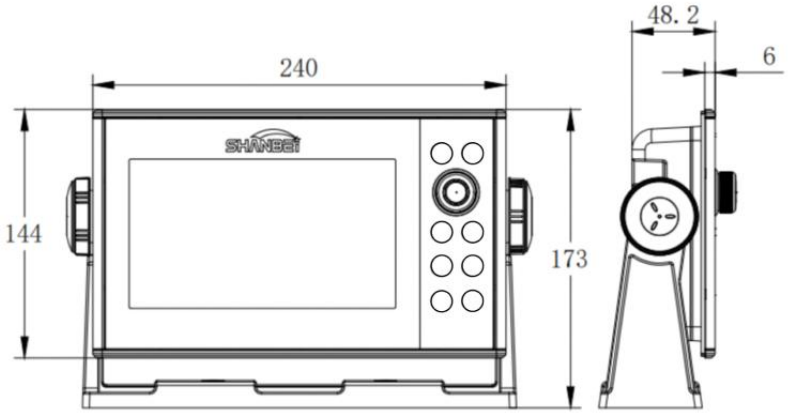

Table 1.3

1.5 Product wiring diagram

Make sure that the power supply is disconnected before wiring!

1. Prepare crimping terminals and cables.
2. Type D grounding is used.
3. Connect the power terminal. Connect the + and - of the DC power supply to the V+ and V- terminals of the product, and the PE of the power supply to the common end of the device ground.

Wiring diagram

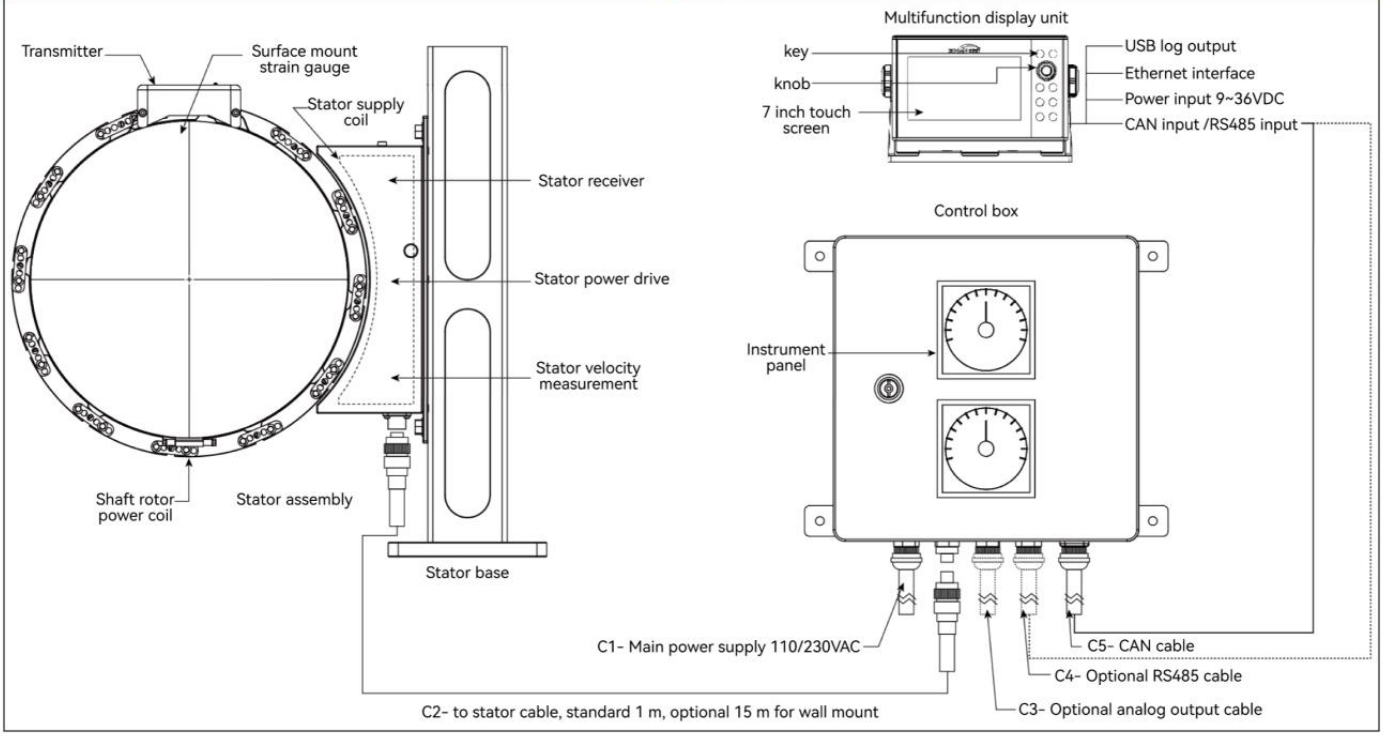

Figure 1.4

1 Introduction

Interface type	Wiring specification
Power supply AC	18~14AWG (reference), 3.5mm spring type terminal
RS485	Shielded twisted pair, 3.5mm spring terminal
CAN	Shielded twisted pair, 3.5mm spring terminal
Analog output	24~16AWG (reference), 3.5mm spring type terminal
Ethernet	RJ45

Table 1.3

CAN terminal definition is shown in Table 1.4:

Type	Number	Signal	Instructions
CAN	1	H0	CAN channel 0 data +
	2	L0	CAN channel 0 data -
	3	PE	CAN channel 0 ground end
	4	H1	CAN channel 1 data +
	5	L1	CAN channel 1 data -

Table 1.4

Table 1.5 shows the definition of RS485 terminals:

Type	Number	Signal	Instructions
RS485	1	A0	RS485 channel 0 data +
	2	B0	RS485 channel 0 Data -
	3	PE	RS485 channel 0 ground end
	4	A1	RS485 channel 1 Data +
	5	B1	RS485 channel 1 Data -
	6	PE	RS485 channel 1 Ground end

Table 1.5

Analog output terminals are defined as shown in Table 1.6:

Signal	Instructions
AO0	Analog output channel 0, thrust
G_A	Analog output area
AO1	Analog output channel 1, power
G_A	Analog output area
AO2	Analog output channel 2, torque
G_A	Analog output area
AO3	Analog output channel 3, speed

Table 1.6

1 Introduction

Wiring diagram

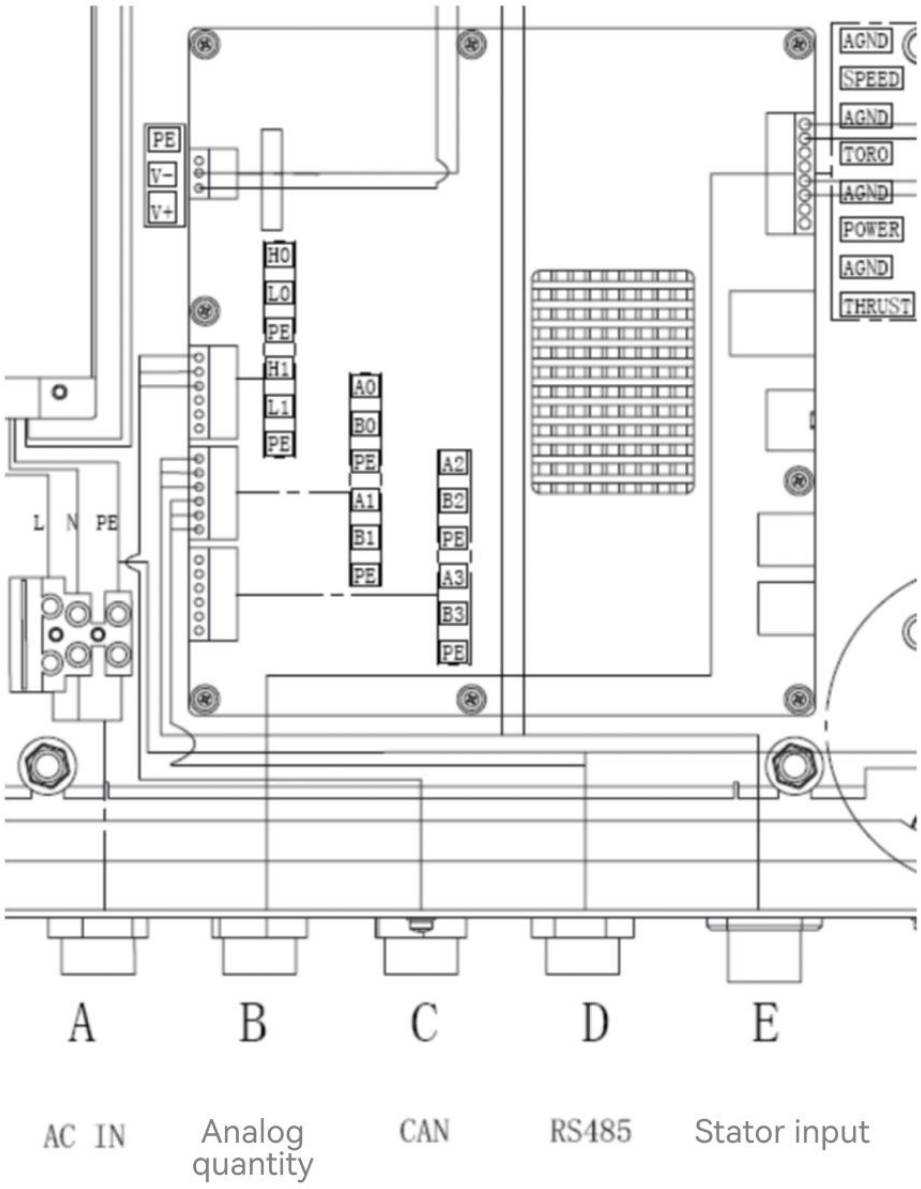

Figure 1.5

2 Technical parameter

2.1 Product basic parameter

Power source	AC220
Power dissipation	<15W
Power supply protection	Anti-static, anti-surge
Interactive interface	Rotational speed instrument、Power instrument
Communication interface	RS485，CAN Bus
Communication protocol	NMEA0183，NMEA2000，Modbus-RTU
Operating temperature	5~55℃
Storage temperature	-25~70℃
Class of protection	IP44
System measurement accuracy	1.5%+Ke（Ke:The total error of axial modulus constant and axial diameter measurement）
System repeatability accuracy	0.1%
ut signal	Simulation and Digital

Table 2.1

3 Installation instructions

Product installation is shown in Figure 3.1: A control box, B stator base, C stator assembly and D multi-function display unit.

Product installation diagram

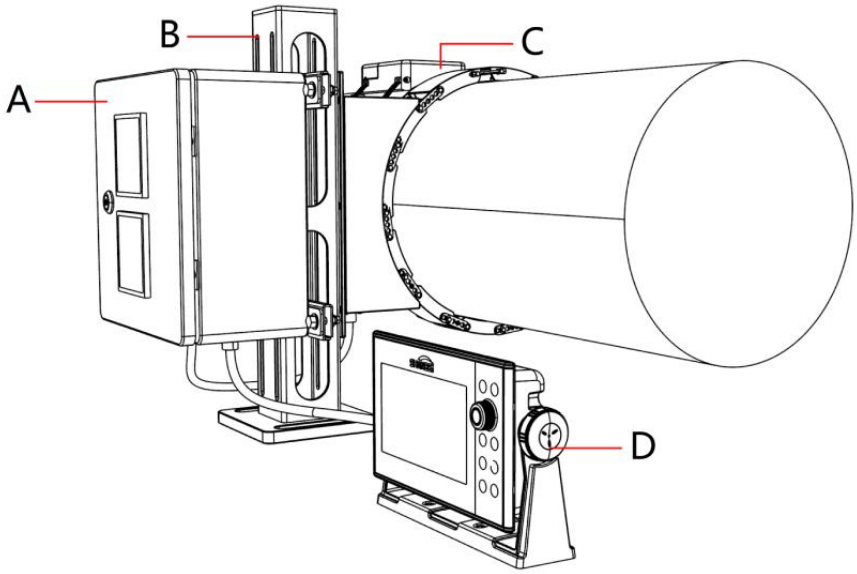

Figure 3.1

3.1 Introduction to the strain gauge installation process

There are four steps:
1. Strain gauge: test once per axis
2. Cleaning and preparation: Ensure the suitability of strain gauge installation
3. Bonding: temporary (up to 6 months) or permanent (up to 10 years)
4. Protection: Depends on the test environment

3.1.1 Strain gauge

Figure 3.2 Strain gauge with joint.

Strain gauge diagram

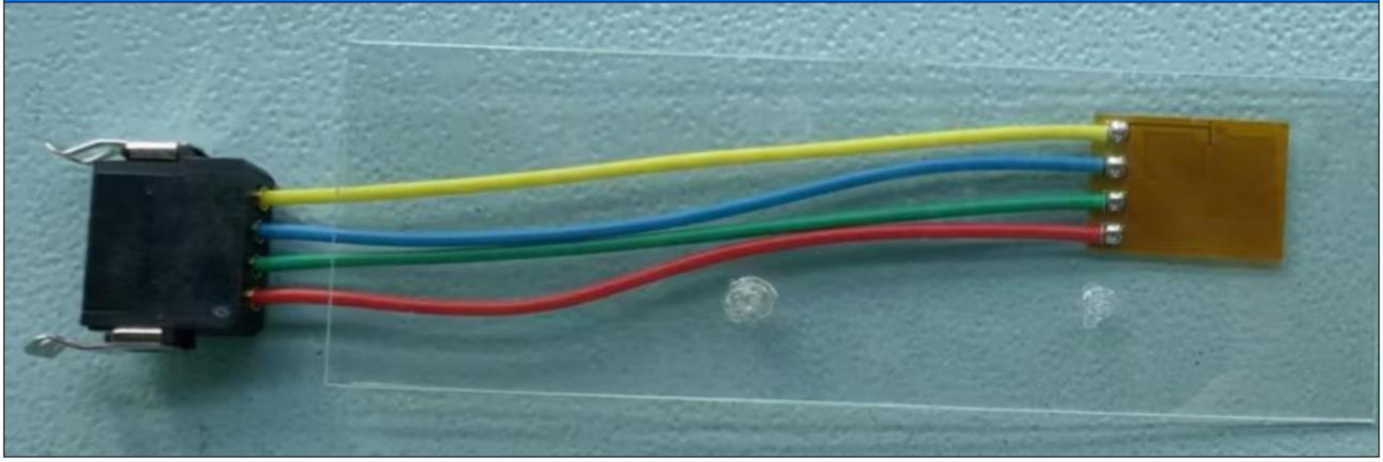

Figure 3.2

3 Installation instructions

3.1.2 Clean

The strain gauge with joint is shown in Table 3.1.

Name	Quantity
Neutralizer	1
Conditioning agent	1
400 and 120 grit sandpaper	2 packs
Permanent marker	1
Cotton swab	100 pieces
Gauze sponge	100 pump
Wipe the lint-free paper	1 box

Table 3.1

3.1.3 Splice

Name	Quantity
Resin mixing tank	6
Curing agent	10
Calibrate the pipette	6
Stirring rod	6
Silicone pad	1
Mylar tape roll	1

Table 3.2

3.1.4 Protection

Name	Quantity
Self-adhesive tape	1
Butyl flexible rubber sealant	1
Rubber sheet	1
Aluminum foil tape	1
Nitrile rubber coating	1

Table 3.3

3 Installation instructions

3.1.5 Consumables

Strain gauges with joints are shown in Table 3.4.

Name	Quantity
Ballpoint pen	1
Industrial degreaser	1
Cable tie	6
Cleaning cloth	1
Tin-copper wire	1
Masking tape or marker	1
Binding kit	1

Table 3.4

3.1.6 Tools needed

Name	Quantity
Angle rail	1
Allen wrench set	1
Large flat head screwdriver	1
Side milling cutter	1
Tin snips	1
tweezers	1
Small tempered glass plate for strain gauge preparation	1

Table 3.5

3 Installation instructions

3.2 Equipment preparation

3.2.1 System familiarity

1. Familiarize yourself with and understand the system on the desktop before installing the system on site in the cabin. Lay out all the components of the system on a table or workbench so that the bending side of the stator faces up, as shown in Figure 3.3.
Warning! Before continuing, make sure the main power connection is isolated. Connect the power cable from the stator to the machine side control box and connect it to the multi-function display using the CAN or RS485 interface, directly through the APP on the interface. (Or PC, laptop directly use the browser to open the monitoring interface)

System component diagram

Figure 3.3

2. Connect the strain gauge simulator to the transmitter unit by inserting the cable into the center-aligned transmitter connector in 3 channels, as shown in Figure 3.4.

Schematic diagram of transmitter connector

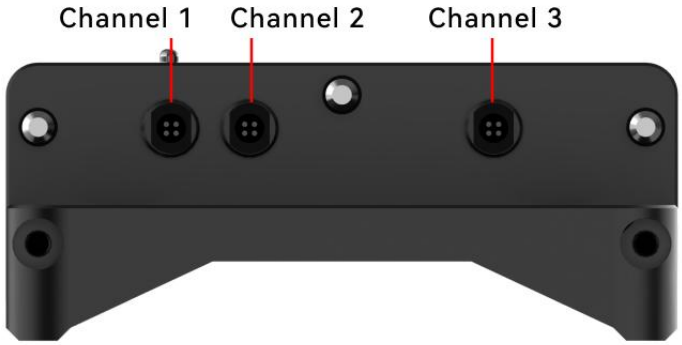

Figure 3.4

3 Installation instructions

3. Lay a 10mm thick foam strip on the curved surface of the stator, face up. This will act as a gasket, giving you a separation gap close to the final field installation. Place the rotor band on top of the foam above the stator, as shown in Figure 3.5.

Foam strip diagram

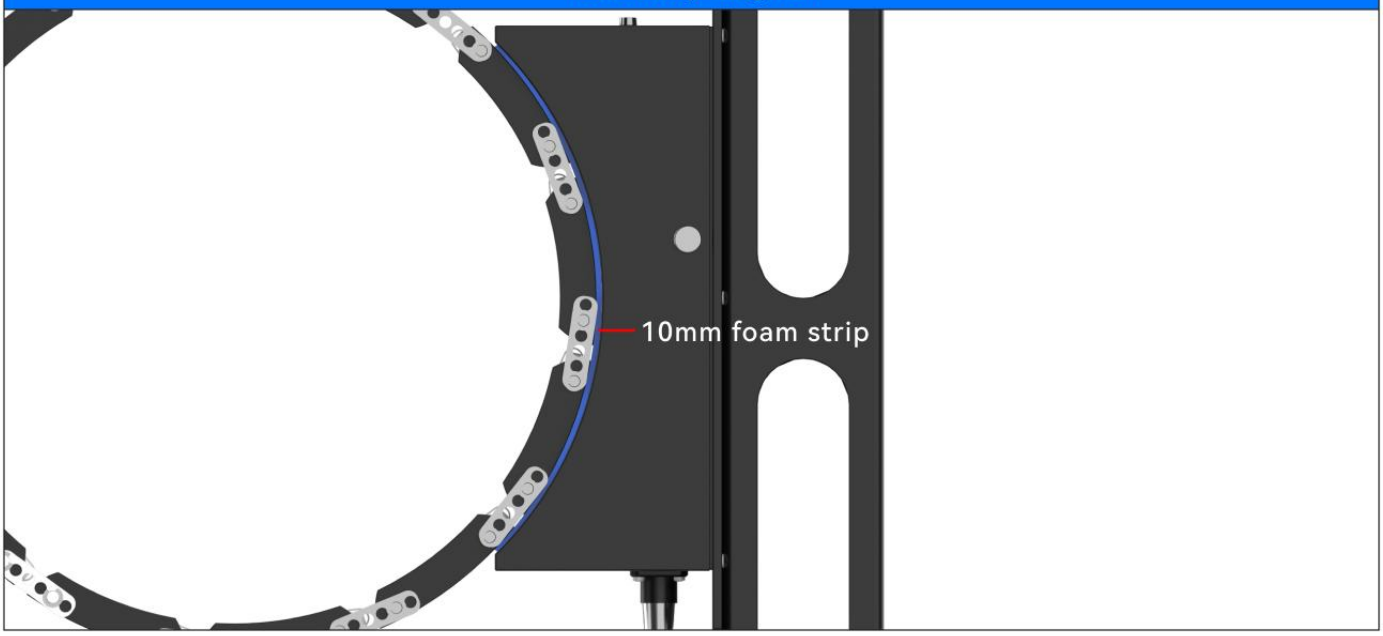

Figure 3.5

4. The side control box can now be connected to the main power supply (110/230V).
If the system is powered on, the stator will sense power in any rotor assembly link and light the LED indicator on the transmitter assembly, as shown in Figure 3.6. You can turn the rotor band along the stator surface to observe the electrical induction that powers the rotor band.
One of the rotor belt assemblies is marked with a white cross and contains the magnet of the sensor to detect the shaft speed. When you move this link to the lower end of the stator's surface, you will see the stator's green LED flash twice.

LED indicator diagram

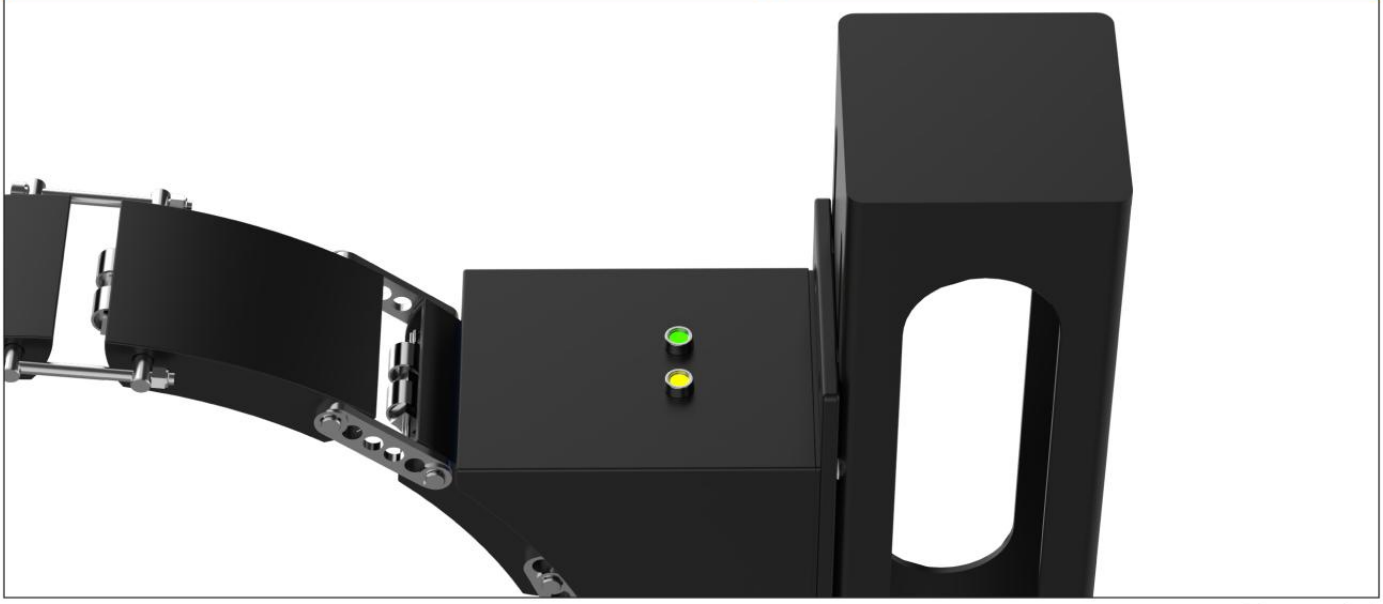

Figure 3.6

3 Installation instructions

5. After connecting the strain gauge simulator, the software display should read the nominal value set by the switch of the strain gauge simulator, as shown in Figure 3.7. Switch values to familiarize yourself with the device. The values will be approximate. Now move the strain gauge simulator plug to the external connector of the transmitter and repeat the test.
After completing this test, you have tested the transmitter and test receiver and have some familiarity with the suite.

Display diagram

Figure 3.7

3.2.2 Strain gauge preparation

1. To install the strain gauge, you need to prepare the strain gauge on a small tempered glass plate with mylar tape. It is best to complete this stage in a well-lit clean room before entering the site. Use a conditioner first, then a neutralizer to clean the surface of the glass plate. This will ensure that the board is chemically clean.
2. Using clean tweezers, place the strain gauge on the board, solder/cable side up. Familiarize yourself with the orientation of the strain gauge element using a magnifying glass.
3. Cut a length of about 150mm Mylar tape. Carefully place the tape on top of the strain gauge and stick the gauge roughly in the center of the mylar tape, as shown in Figure 3.8. Attach the tape to the glass plate and center the strain gauge.

Strain gauge paste 1

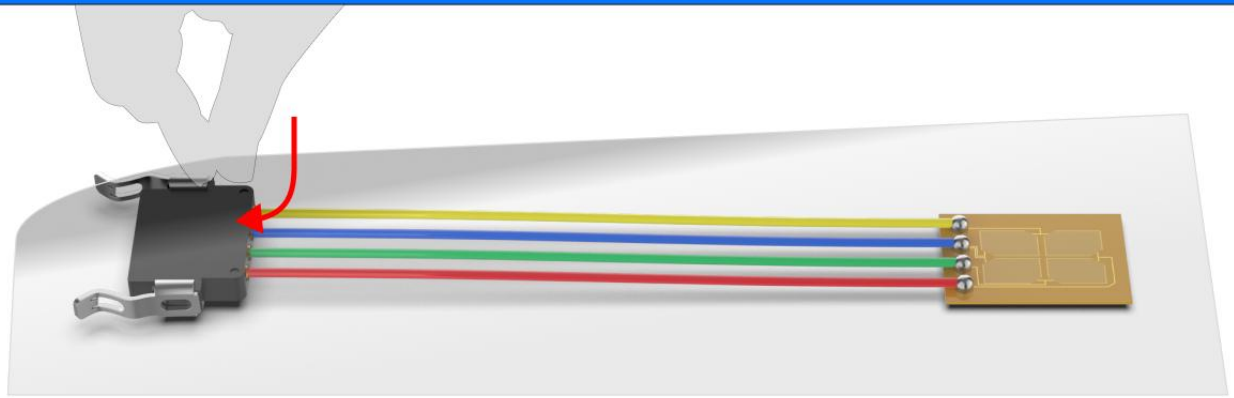

Figure 3.8

3 Installation instructions

4. After applying the first layer of tape, mark a line on the strain gauge using the non-erasable mark, as shown in Figure 3.9, parallel to the long side of the strain gauge. Then add a second layer of mylar tape. When the strain gauge is applied to the shaft, the second layer will prevent the tape from curling. Gently lift the two layers of tape while the strain gauge is glued to it to ensure that you are always able to handle the tape and not the strain gauge itself.
If no ready clean surface is available: cut a mylar tape about 150mm long. Place the tape on a flat, clean surface with the adhesive backing facing up. Use a pair of clean tweezers to remove the gauge from its packaging with as little pressure as possible. Carefully place the strain gauge in the center of the mylar tape. During all processes, care should be taken to avoid contaminating the strain gauge or mylar tape.

Strain gauge paste 2

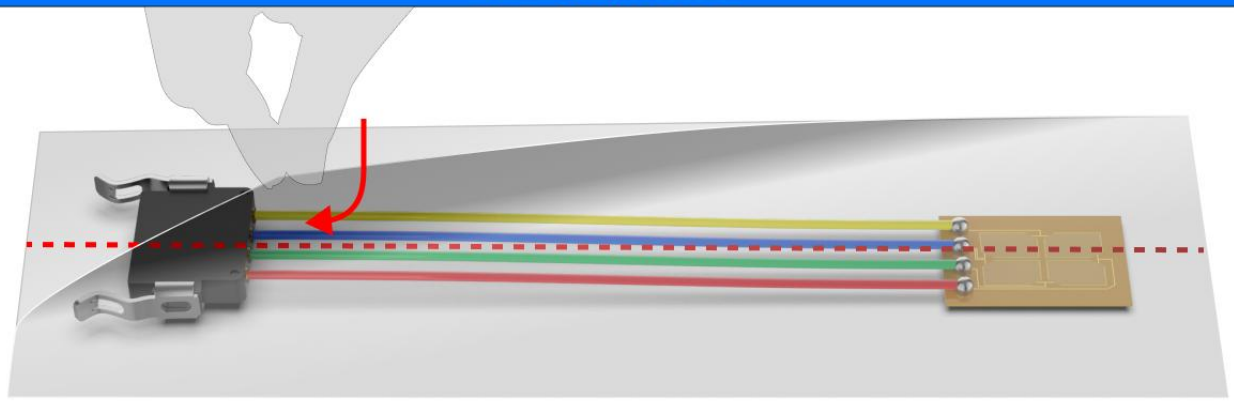

Figure 3.9

5. The strain gauges provided are full bridge package strain gauges with connectors. These simplify the installation process and do not require on-site welding. The mesh of the strain gauge contains fine elements for measuring strain. These elements can be seen under a magnifying glass and should be aligned with the axis of the shaft at 45 degrees to measure the torsional strain. Before going to a site with limited light, you should familiarize yourself with the strain gauge in a well-lit environment.
6. Strain gauge preparation is now complete.

Strain gauge diagram

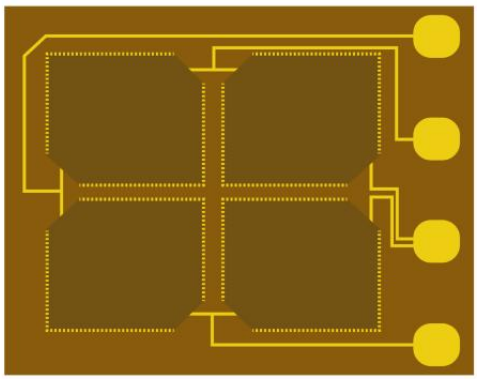

Figure 3.10

3 Installation instructions

3.3 Shaft preparation

3.3.1 Installation location selection

Selecting the right measurement area on the drive shaft is critical to the success of installation and data recovery. Where feasible, the area to be measured shall transmit the maximum level of torque/ strain to be measured through the shaft.

1. The stator mounting column shall be fixed to the ship floor structure using 2 x M16 bolts. The position relationship between the stator mounting column and the drive shaft needs to be within the size range provided by the benchmark electronics to ensure that the final full system components are properly aligned after assembly.

Adjustments in these dimensions can be made through slotted bolt holes in the stator mounting posts.

If required, the mounting plate to be manufactured by the Marine engineer shall be in place before the installation of the Marine torque gauge is commenced. The mounting plate shall be installed in accordance with the alignment requirements for Marine torque meter installation and pre-drilled for 2 x M16 mounting bolts.

It is recommended to first plan the position of the rotor belt and transmitter device on the shaft in order to contact the Marine engineer of the mounting plate required for the stator mounting column. Careful planning will ensure a successful installation.

The stator columns are designed to mount the system onto a horizontal axis. Mounting the stator assembly on the other shaft requires an adapter plate.

Figure 3.11 illustrates the required position dimensions between the stator mounting column and the shaft.

Position dimensions between the stator mounting column and the shaft

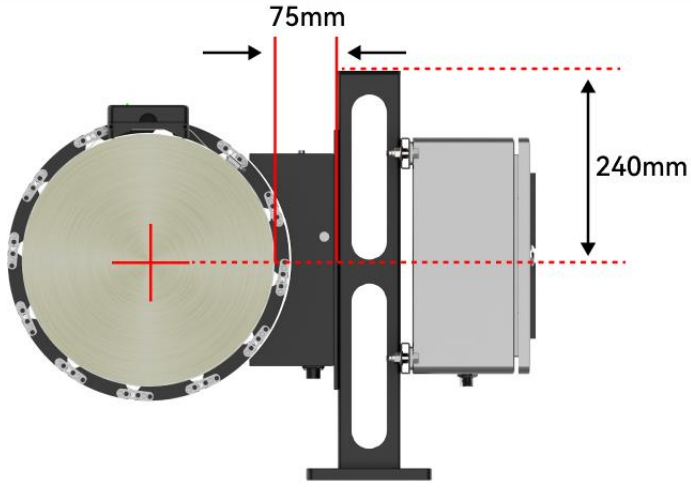

Figure 3.11

2. The measuring area should be large enough to install the instrument. View the transmitter unit to approximate the size of the desired clean measurement area.

3. Measure the diameter of the shaft. Ideally, the measurement area should be 3 times the diameter of any obstacles, shaft profile changes, or joints, and where possible not less than one shaft diameter, as shown in Figure 3.12.

3 Installation instructions

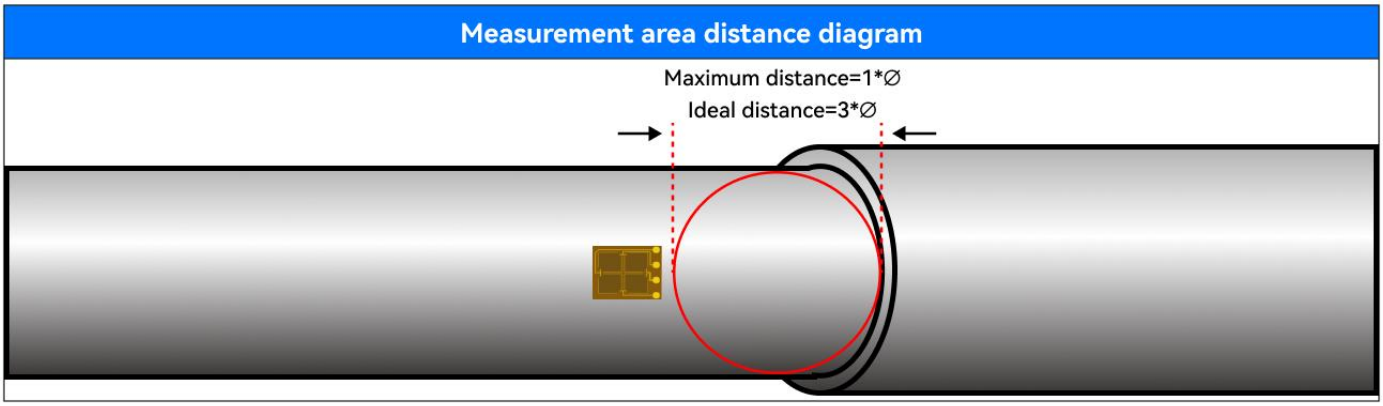

Figure 3.12

4. Once the instrument is installed and the shaft is rotated, there must be no interference area. The pitch/travel variation of the shaft during normal operation should be considered and the strain gauge installed should be free of any obstructions.
5. There should be sufficient hands and working channels for the installation of equipment.
6. Avoid serious pitting or deep scratches on any part of the shaft.
7. Provide complete transmitter assembly and torque rotor assembly up to the selected area to check the clearance and check for any rotational interference.

3.3.2 Surface preparation

Basic cleaning preparation:

1. Clean the selected area with a rag and industrial cleaner/degreaser. Remove any protective coating from the shaft of the area to be measured. Remove as much dirt and grease as possible.
2. Clean it again, as shown in Figure 3.13. Once the area is clean, follow these steps to start drawing lines.

Figure 3.13

Mark:

3. The installation of Marine torque gauges requires the installation of strain gauges along the guide line parallel to the axis. Place the Angle iron flush with the shaft and use a ballpoint pen to mark the polishing line parallel to the shaft, as shown in Figure 3.14. This will serve as a positioning reference for the center line marked on the mylar tape above the strain gauge in Figure 3.9.

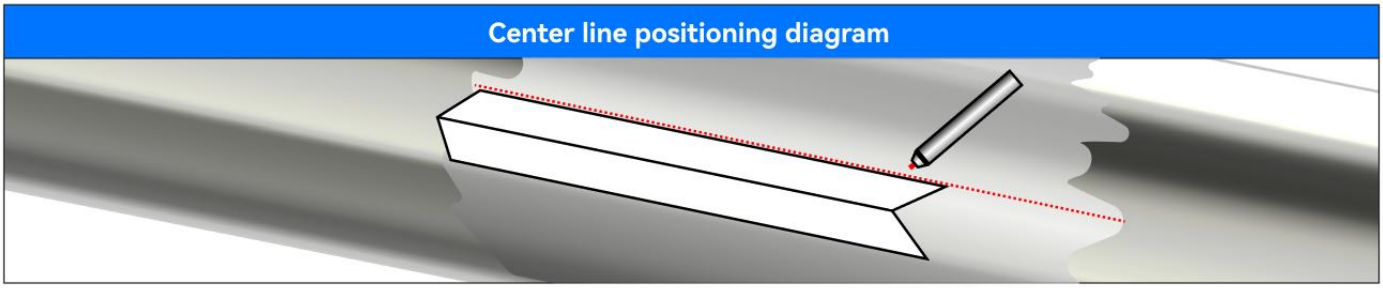

Figure 3.14

4. When aligning the torque gauge assembly with the shaft, it is helpful to mark a guide line on the shaft circumference.
5. Plastic tape is provided to help mark precise circular guide lines. Unfold the shaft around the plastic belt provided. If the torque gauge assembly, the guide line needs to be aligned with an edge. If a mounting platform is prepared on the container floor, check to ensure that the guide line will allow the torsion gauge assembly to align with the position of the mounting column. Take care to ensure that the plastic tape is laid flat without any distortion or collision. Secure the ends of the plastic tape to the shaft with tape. Use a pen to mark a guide line around the shaft circumference along the edge of the tape, as shown in Figure 3.15.

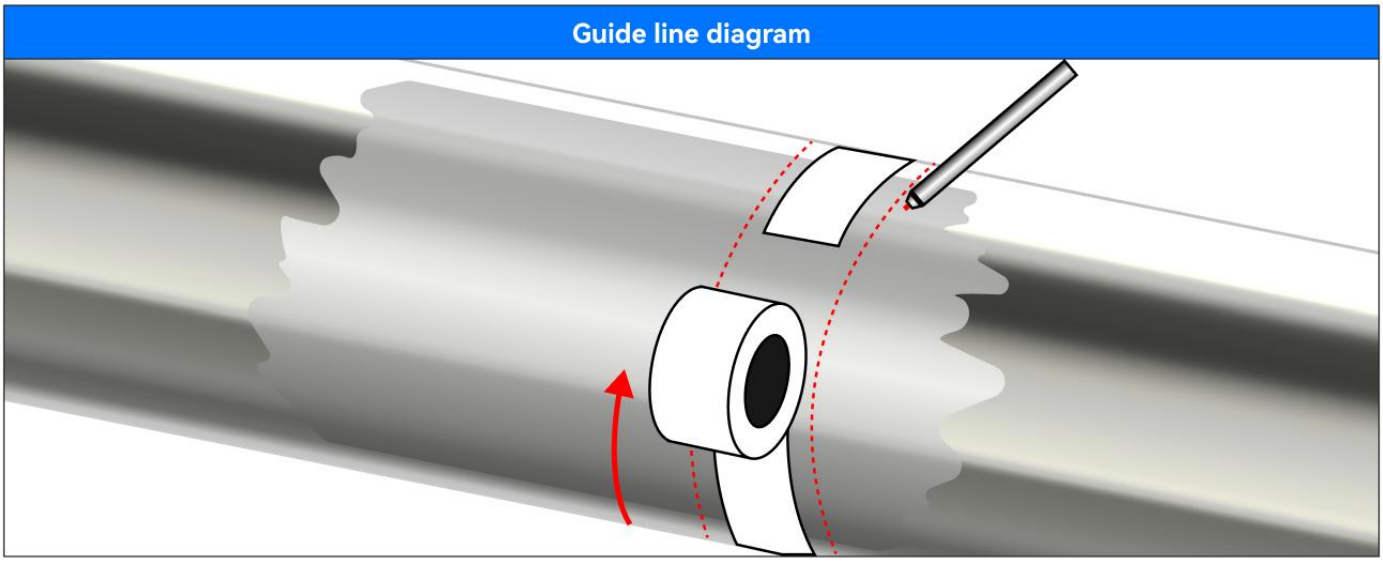

Figure 3.15

Surface grinding:
The drive shaft surface should be ground to remove any loosely bonded adhesives such as oxide, rust, anti-rust coating, paint, galvanized coating or oxide.
6. Guided by the transmitter unit, use masking tape to roughly indicate the area to be cleaned, as shown in Figure 3.16. This area should be close to the perimeter line marked for the rotor assembly so that the transmitter can be easily connected to the rotor assembly after installation.

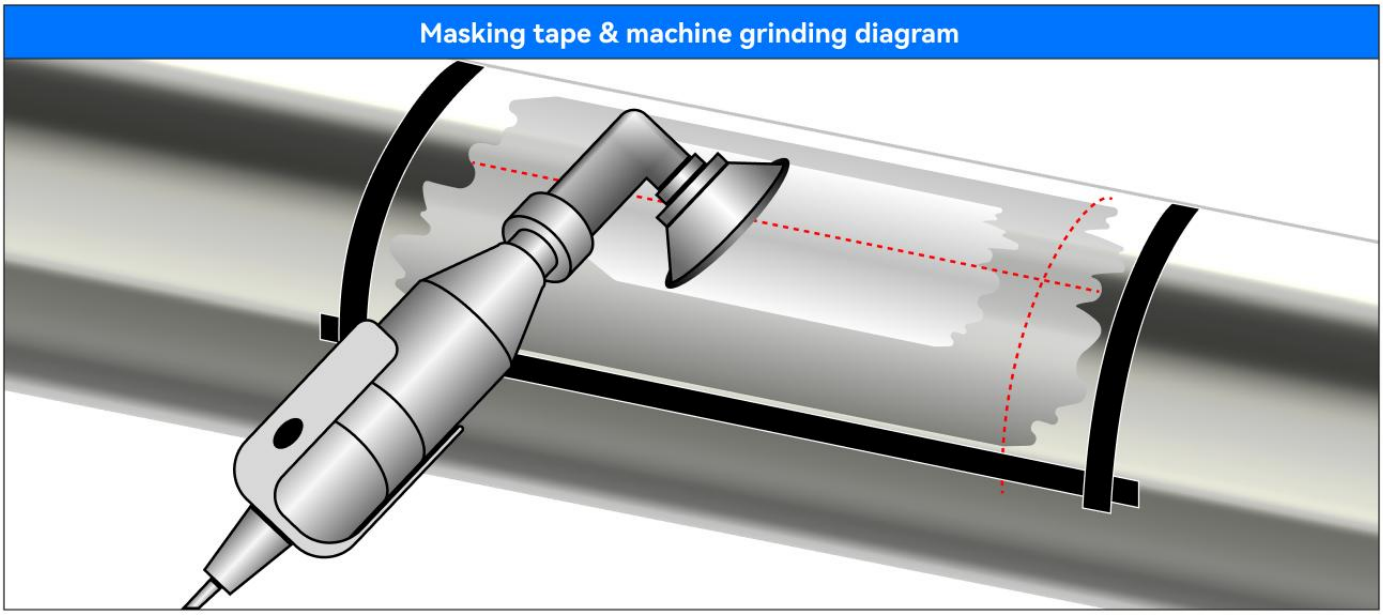

Figure 3.16

3 Installation instructions

First use a grinder, Angle grinder, grinder, or file to rough the surface and remove any large particles such as paint, rust, or any other adhesion. Grind with 80-120 grit abrasives to create a surface texture suitable for bonding.

7. The second stage of grinding using the appropriate granularity of carbon paper. It is recommended to start at 120 grit and grind in a random pattern up to 400 grit for a flat, clean and well-bonded surface, as shown in Figure 3.17.

The optimal surface finish of the strain gauge joint depends to some extent on the nature and purpose of the installation. For general stress analysis applications, a relatively smooth surface is appropriate.

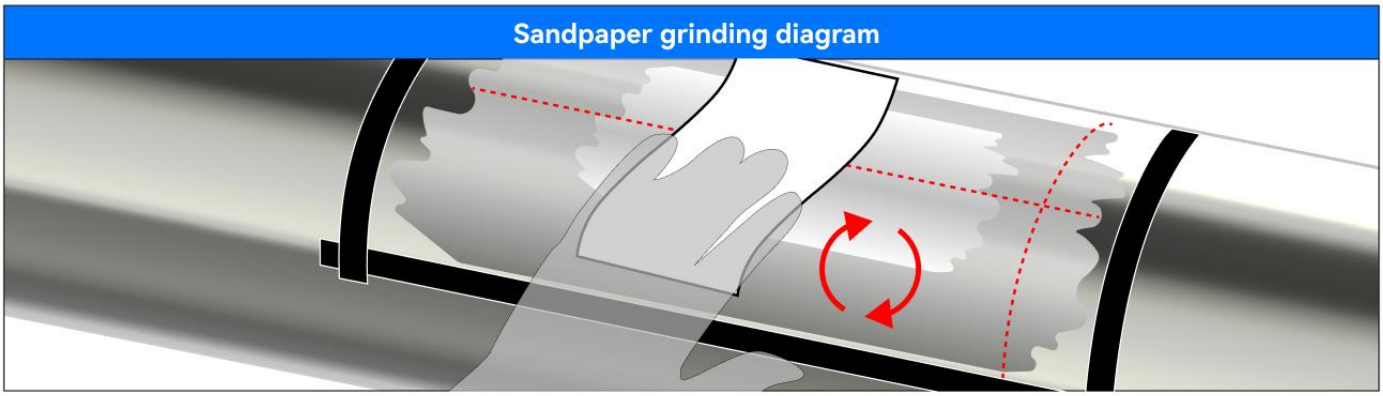

Figure 3.17

Wet Grinding:

Wet grinding is carried out using a regulator solution. A regulator is a mild acidic solution that usually speeds up the cleaning process and acts as a mild etcher on some materials.

8. Use 400 sandpaper for final grinding while keeping the surface wet with a conditioner solution. Use random patterns to get a flat, clean surface with good key points.

After cleaning, the polishing line should still be visible. If working in poor light, reference lines are marked on both sides of the strain gauge marker to draw the eye to the polished line.

Strain gauge position layout line:

The strain gauge position layout line should use a tool that sands the surface, not scoring or marking. Scribing or scoring lines may create burrs or stress concentrations that are detrimental to strain gauge performance. It is recommended to use a ballpoint pen for alignment marking. Layout lines are usually applied after grinding operations and before final cleaning. As described in step 11 of the surface treatment process, all residues from the location marking operation should be removed by scrubbing with a regulator.

9. Mark the strain gauge position line on the center line marked in Figure 3.18.

10. You can now remove all masking tape from the drive shaft.

Surface treatment:

11. Apply the conditioner repeatedly and scrub the surface with a cotton swab until the clean tip is no longer discolored by scrubbing. During this process, the surface should always be kept wet until the cleaning is complete. The cleaning solution must not dry on the surface.

12. When cleaning, use lint-free paper to gently wipe the clean area and dry the surface. Flushing should start with the well inside the clean area and move outward to avoid dragging contaminants in from the area boundaries. Each piece of paper can only be used once.

Neutralize:

The final step in surface preparation is to restore the surface conditions to an optimal alkalinity of 7.0 to 7.5 pH, which is applicable to all strain gauge adhesive systems.

13. Apply the neutralizer generously to the clean surface and scrub the surface with a cotton-tipped applicator. A neutralizer should be used to keep the clean surface completely wet throughout the operation.

3 Installation instructions

14. After neutralization, gently wipe the clean area with clean lint-free paper to dry the surface. For fresh lint-free paper, a single stroke should be made in the opposite direction, starting from the clean area and moving outward to avoid re-contamination of the uncleaned boundary, as shown in Figure 3.18. After each outward wipe, replace the paper towel until the area is completely clean.
Finally, the surface is properly prepared for strain gauge bonding. Install strain gauges as soon as possible after operation to prevent contamination.
15. The preparations are now complete.

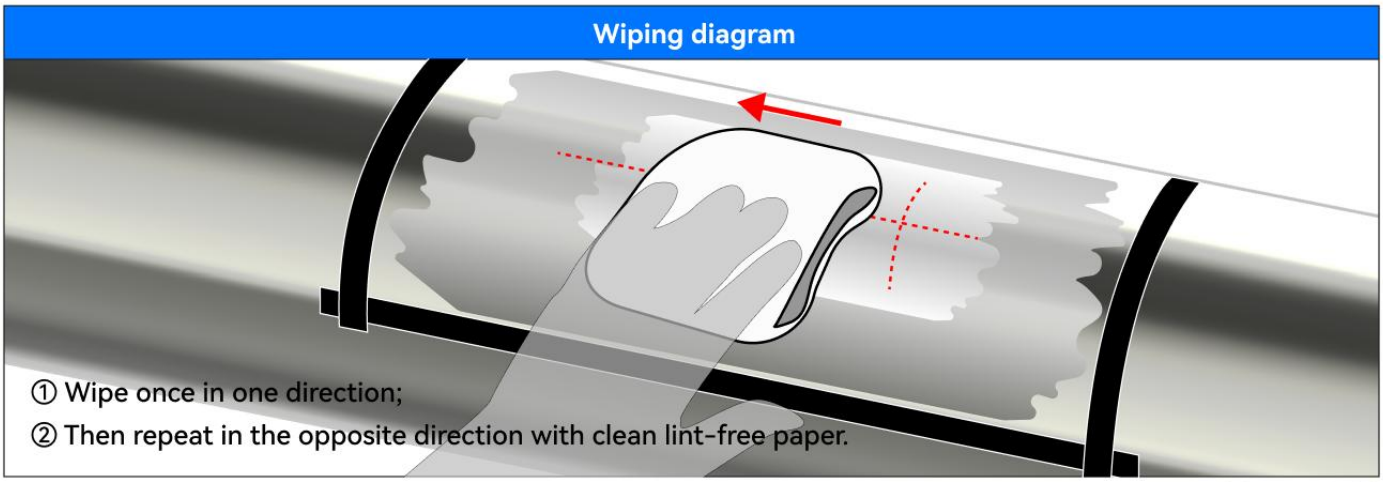

Figure 3.18

3.4 Install

3.4.1 Strain gauge application

1. The strain gauge is mounted on the axis of the shaft, as shown in Figure 3.19, so that it is protected when the transmitter is covered. The polishing lines you created in stage 4.3 will help achieve the correct alignment of the strain gauge.
The transmitter assembly has two built-in connectors for connecting the strain gauge.
The system uses one strain gauge to monitor data, but also supports connecting a second backup strain gauge. It is useful to install and connect two strain gauges at this stage to avoid the need to disassemble the system if the main strain gauge may fail in the future.

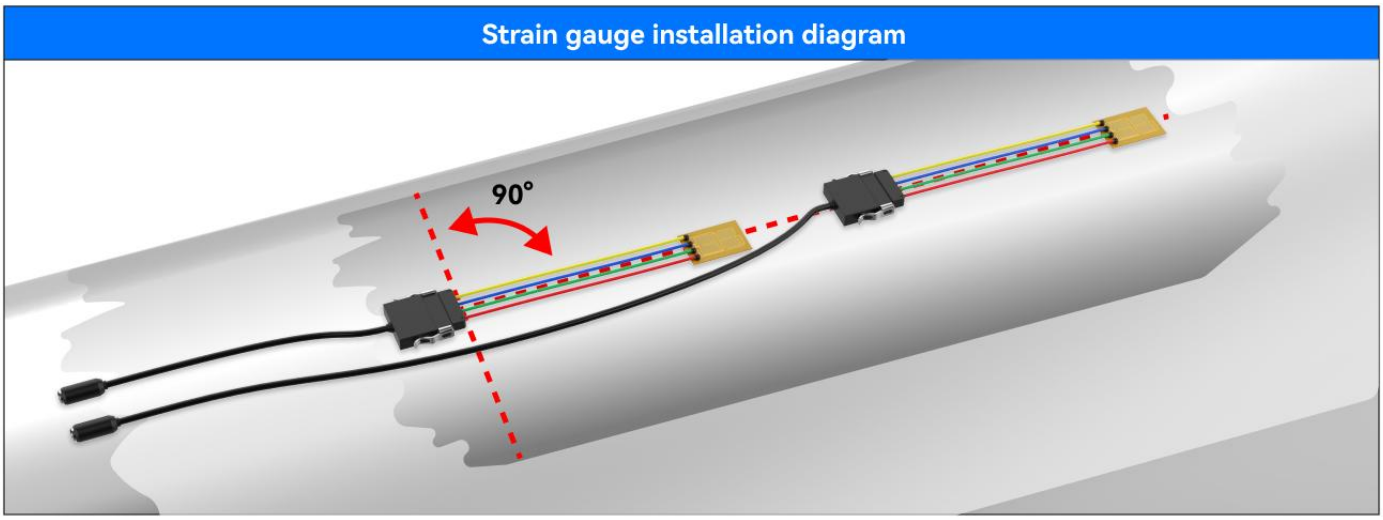

Figure 3.19

3 Installation instructions

For long-term installations, an adhesive process is recommended, where the strain gauge needs to operate for 10 years or more. The procedure uses a two-part epoxy resin adhesive that cures for 6 hours at 20 ° C and 1 hour at 60 ° C. When curing, the strain gauge is held in place by a pressure pad.

Environmental protection

The strain gauge installation method requires a coating to ensure that moisture or other contaminants do not reach the gauge or exposed wiring. The level of coating applied will vary depending on operating conditions and test duration.

2. After using the strain gauge, the strain gauge should be visually inspected to check whether the bond is firm and whether there are obvious bubbles or inclusions below the strain gauge.

Once the strain gauge is bonded, it will be offset due to the deformation of the strain gauge around the radius of the surface and the action of hand pressure applied during the bonding process.

Offset levels will vary from installation to installation. The deviation of the strain gauge can be measured using a PC. The output of the strain gauge, and the resulting offset, will be expressed in mV/V.

Typically, this reading ranges from +/-0.000mV/V to +/-0.500mV/V, and strain gauges are designed to accommodate offsets up to 1.0mV/V. If the offset is greater than this value, the installation may fail. This may be caused by uneven pressure or distortion during installation. If the gauge offset is greater than 1.0mV/V, the gauge needs to be replaced. Clean the area and repeat the strain gauge installation. Alternatively, the offset can be measured using a strain gauge indicator of some description.

3. Once the system is fully installed, it is best to work with the captain to turn the main engine forward and backward while mooring. A small amount of loading of the shaft in this way is enough for you to see the reading change on the software display, as shown in Figure 3.20.

By applying less force while the ship is mooring, you can gain additional confidence in the strain gauge installation before conducting a full-sea test, which may not allow any corrections to be made to the installation if the ship engine is running continuously.

When the shaft loads torque, the value should increase/decrease slightly and then return to the starting value. Note the value of the no-load strain gauge at this stage, as this will be required for future tests and diagnostics.

4. Strain gauge installation is now complete.

Software display

Figure 3.20

3.4.2 Strain gauge protection

In order to maintain a good strain reading, the protection of the strain gauge is essential.

Too much moisture or other fluids entering can cause the strain gauge to drift, resulting in poor or unrealistic readings. When using package strain gauges, the following procedures provide the appropriate level of protection.

1. Cut two 5mm x 15mm coatings and place them under the connecting lines of each strain gauge.

2. Cut two strips of tape to cover the strain gauge and connector (approx. 30mm) and glue each strain gauge to the clean area where the two strain gauges are bonded to the shaft, but not to the coating just applied, as shown in Figure 3.21.

3 Installation instructions

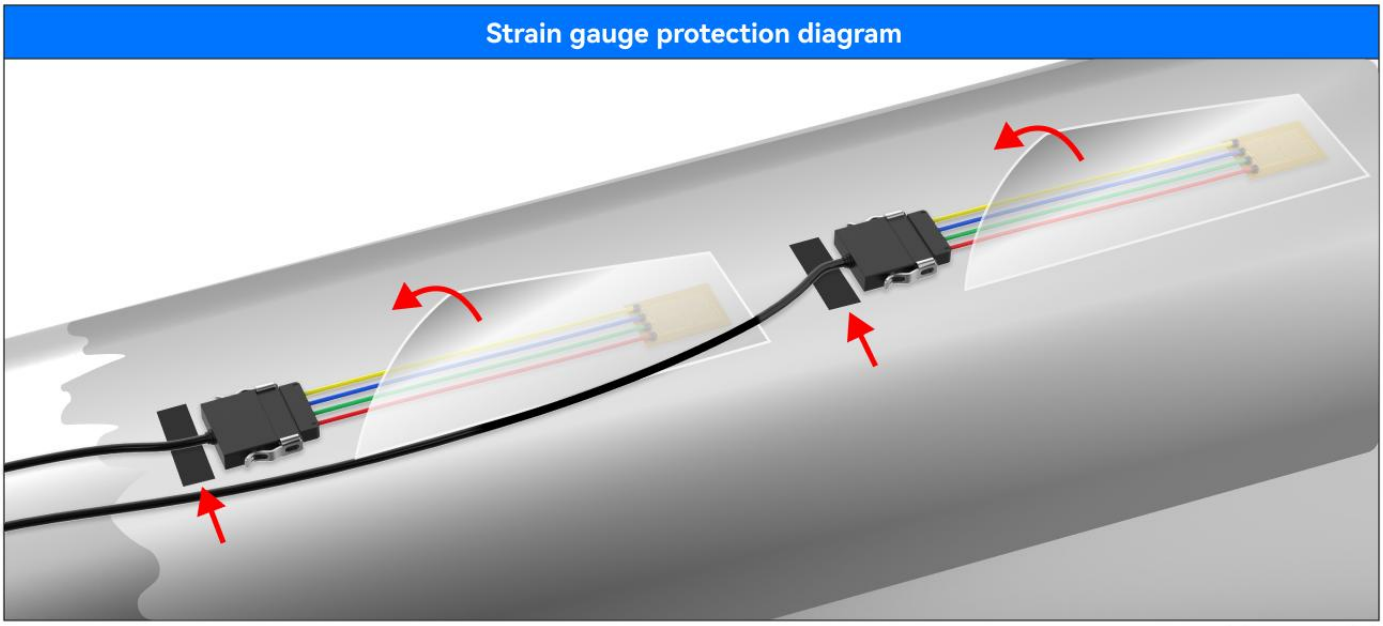

Figure 3.21

Pressure is applied to the edge of the tape to provide a good seal around the strain gauge.
3. Cut another strip of coating large enough to cover the two strain gauges and the two tape areas, and glue the strain gauges to the clean area where the two strain gauges are connected to the shaft, as shown in Figure 3.22. Pressure is applied to the edge of the coating to provide a good seal around the measurement area.

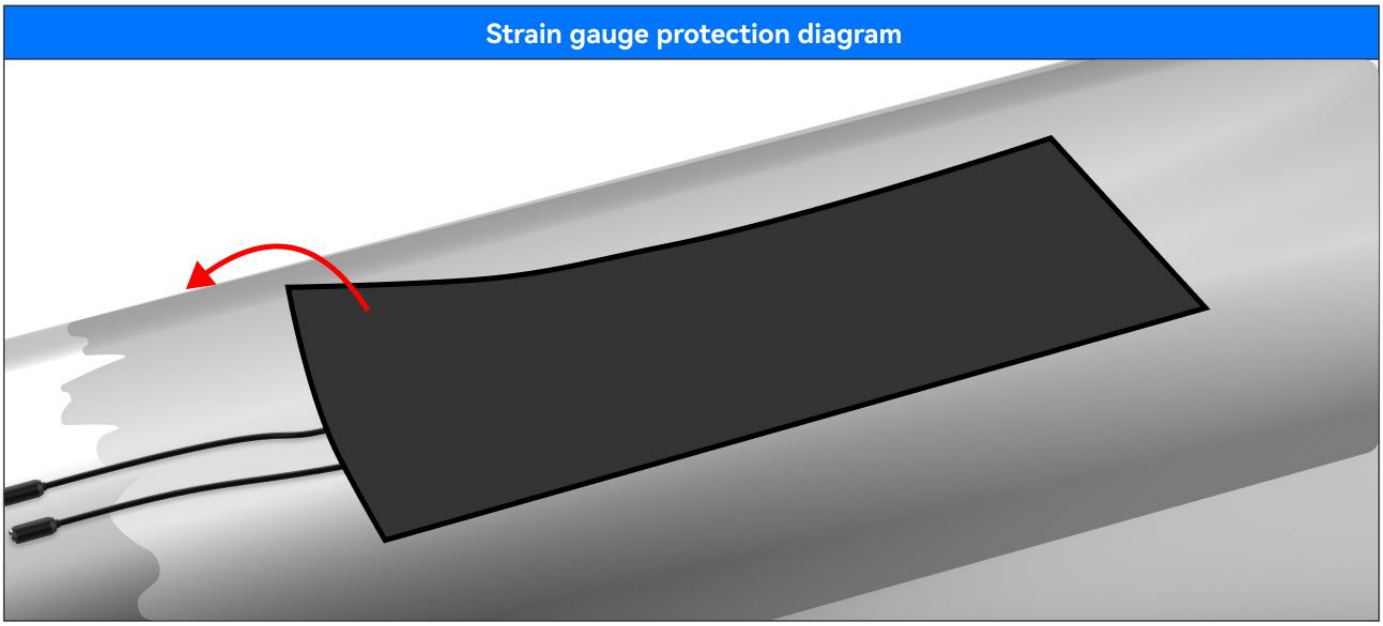

Figure 3.22

4. Cut two foil pieces from the coating kit that should be large enough to overlap each other by approximately 10mm and cover the F-coated area by at least 10mm in order to bond with the clean shaft area. Place the first piece of foil on half of the F-coated area at the other end of the connector cable. Press down and smooth the edges to create a good seal for the clean shaft area.
Now, overlay the second piece of foil over the other end of the area covered by the F-coat, overlapping the first piece of foil and the coat. Press the foil onto the shaft and smooth it so that it tightly surrounds the cable and forms a good seal, as shown in Figure 3.23.

3 Installation instructions

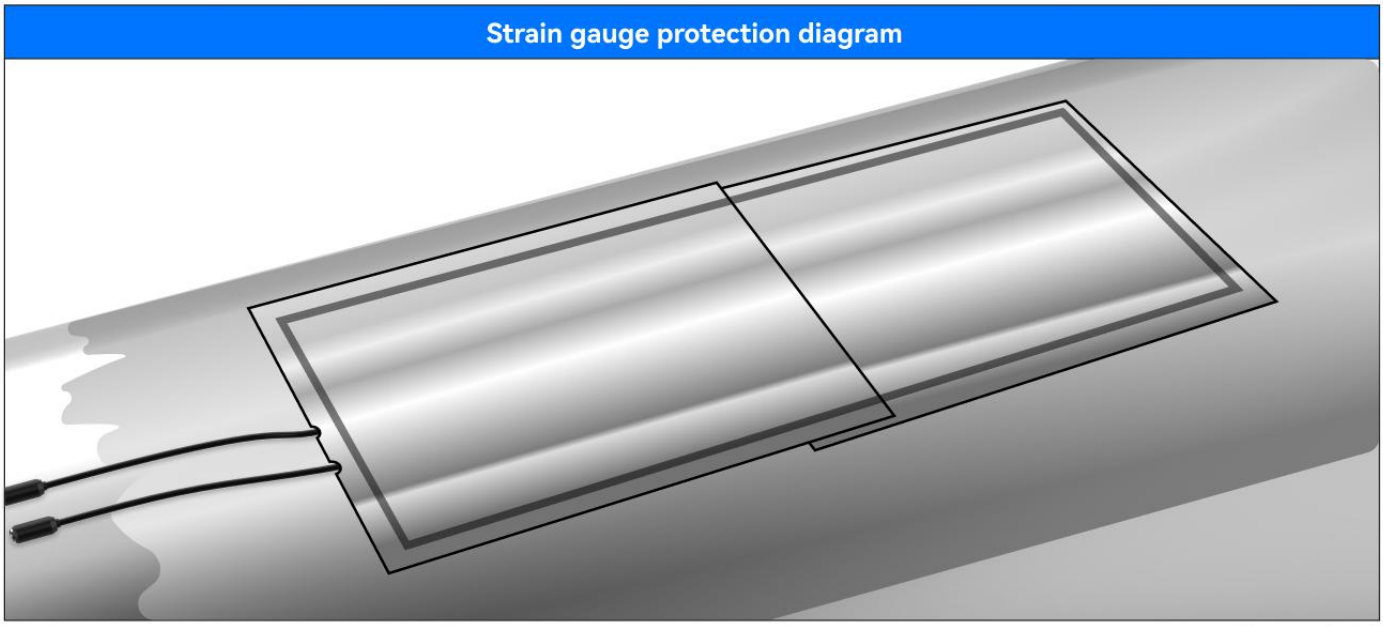

Figure 3.23

5. Use a brush brush to apply a butyl flexible rubber sealant to the contact between the foil edge and the shaft surface to provide a good seal, as shown in Figure 3.24. In addition, spray along the joint of the two foils (where they overlap each other). Pay special attention to the area around the cable leaving the foil.

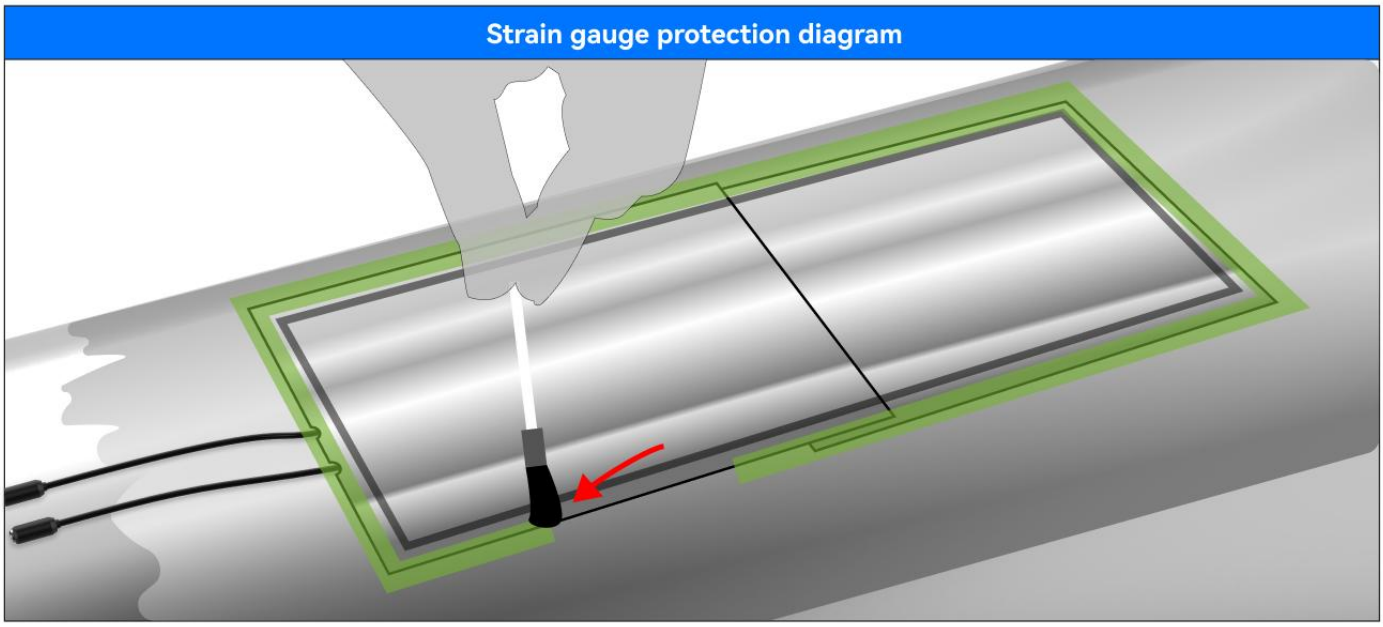

Figure 3.24

6. Cut a protective layer of about 50 x 100mm. It should be large enough to cover the foil area and stick to the clean shaft area. Carefully press the cement firmly onto the strain gauge cable but leave it exposed, as shown in Figure 3.25.

3 Installation instructions

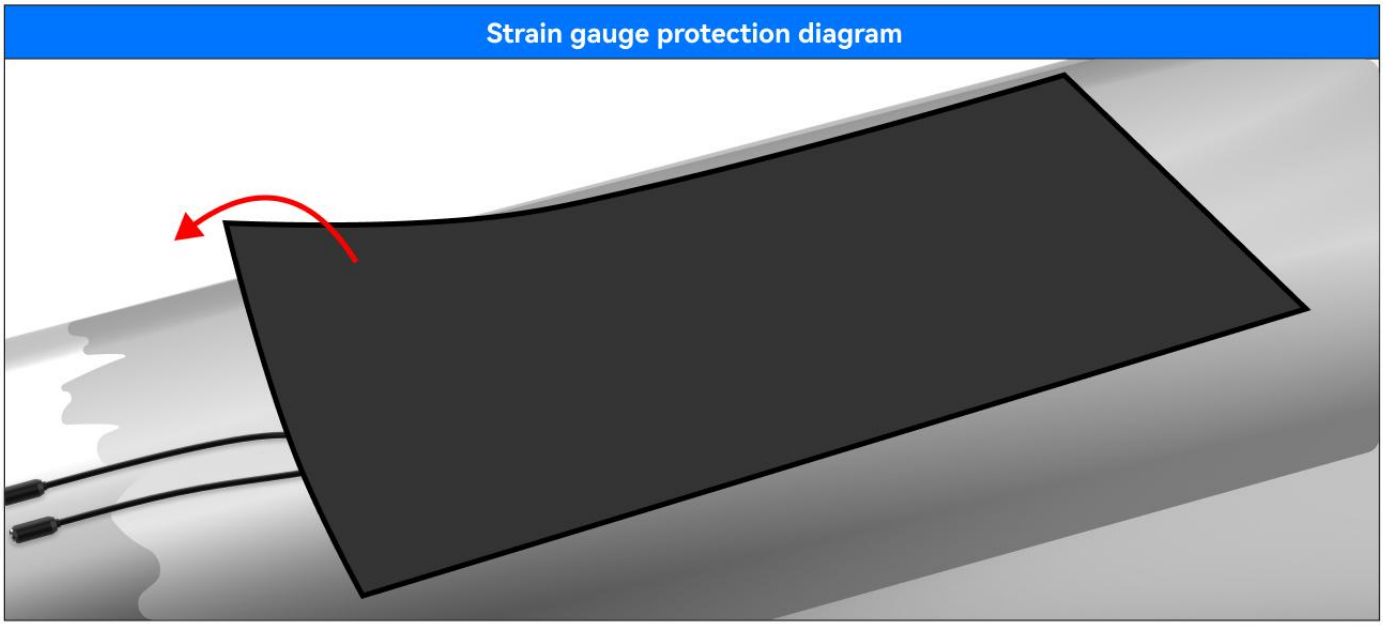

Figure 3.25

7. Cut Treaty II 50 x 50mm nitrile rubber coating.
Press the second NBR coated half piece onto the clean shaft area and overlap the patch in step 6 to expose the strain gauge cable, as shown in Figure 3.26. Press down gently to form a good seal on all edges.
The shaft area needs to be chemically cleaned in order for the mastic to adhere - heating the mastic to 25-30˚C also helps to fit and adhere.
8. The protection of strain gauge has been completed.

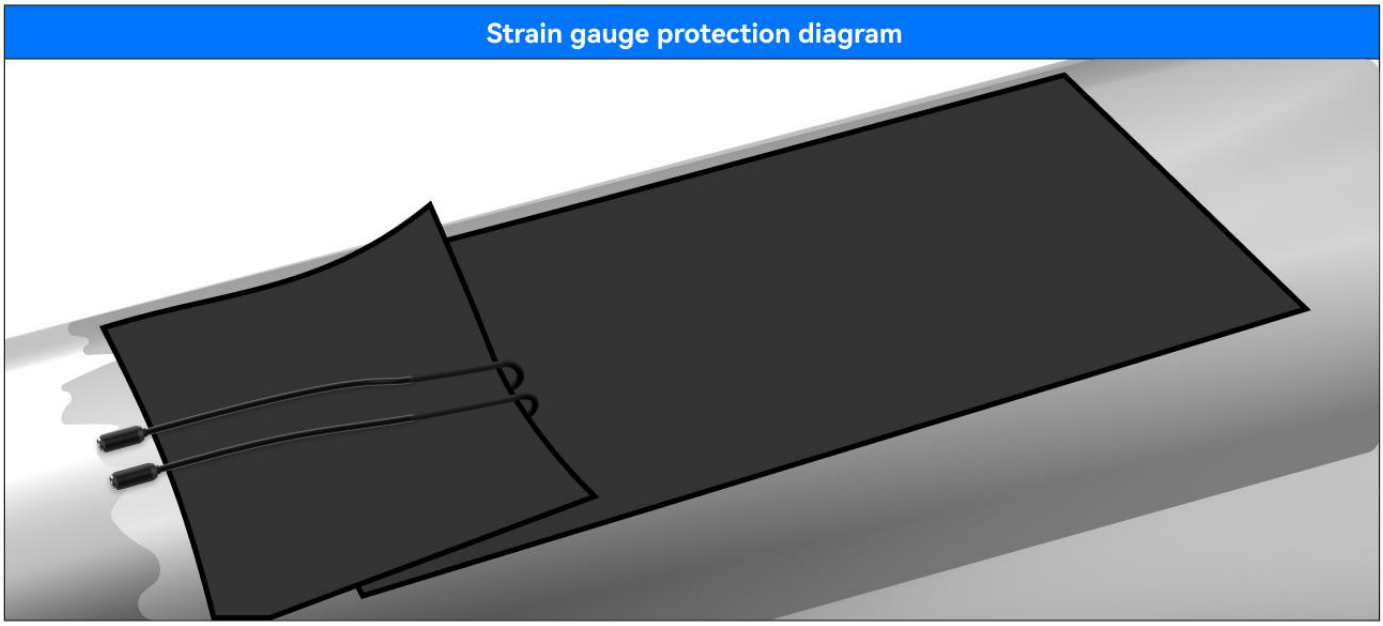

Figure 3.26

3 Installation instructions

3.4.3 Transmitter protection ready

1. Remove the transmitter housing cover from the transmitter assembly.
2. Measure drive shaft diameter and record.
3. Use tin snips to cut throat band to desired length. This length is about three times the diameter of the drive shaft.
4. To secure the hose band cable, first cut a length of 100mm tinned copper wire. Wrap the copper wire around the throat band, through the screw slots, and twist together. Trim off any excess.
5. Connect the ends of the throat band together.
6. For shafts with smaller diameters, you may find it helpful to preform the throat band into a "U" shape by bending the band over the two cap bolts in the sender housing, as shown in Figure 3.27, which will give the throat band the correct shape to insert into the sender housing.

Transmitter installation preparation diagram

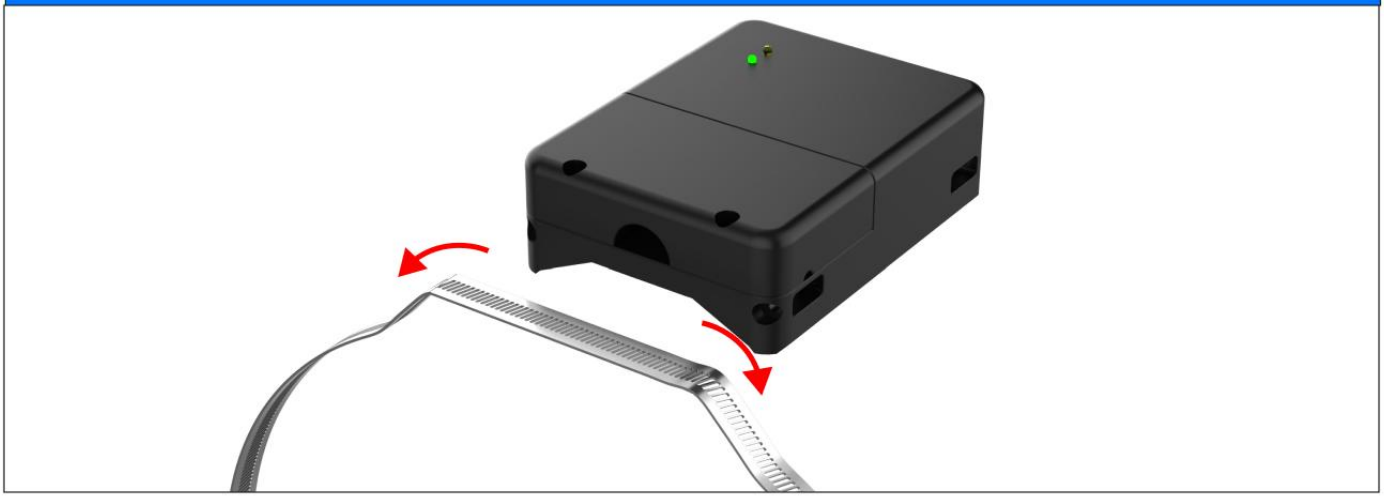

Figure 3.27

7. Feed the throat band through a slot in the transmitter housing.
8. Attach the cover bolt to the transmitter housing to secure the formed throat band in place. Tighten with a hexagonal screwdriver.
9. If a counterweight is needed to balance the shaft, repeat steps 4 and 5 to use throat straps and grooves in the counterweight.
10. Install bolts to balance the weight and secure the formed throat band in place. Tighten with a hexagonal screwdriver.

3.4.4 Transmitter installation

1. Connect the connector of the strain gauge to the connector of the transmitter. Wrap the excess cable around the connector as shown in Figure 3.28.
Place the transmitter housing above the protected measuring area, ensuring that the strain gauge line is not jammed in any way and is covered and protected by the transmitter assembly.
Ensure that the end of the transmitter with two strain gauge connectors deviates from the desired position of the rotor assembly. The connector of the rotor assembly is located at the other end of the transmitter and should face the rotor a assembly.

3 Installation instructions

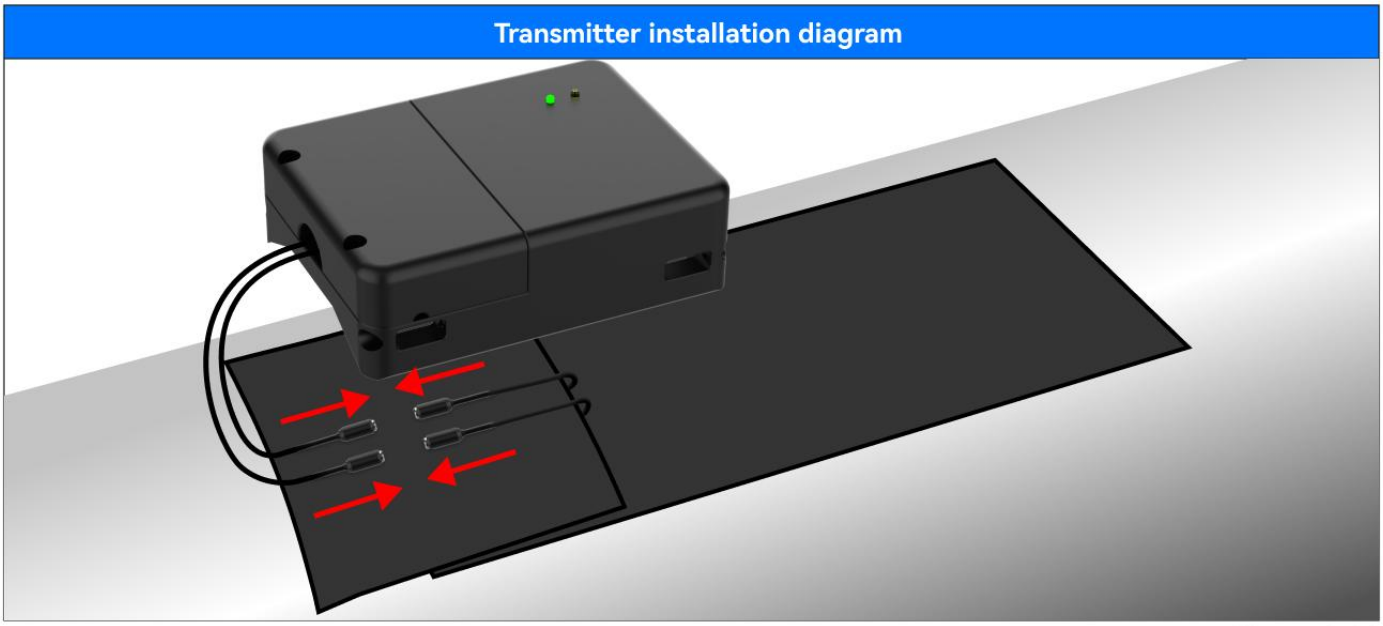

Figure 3.28

2. If you need to install shaft type counterweights, refer to the optional guide in 3.4.3 Step 9.
3. Tighten the screws in the throat band until the transmitter is firmly fixed to the shaft, as shown in Figure 3.29.

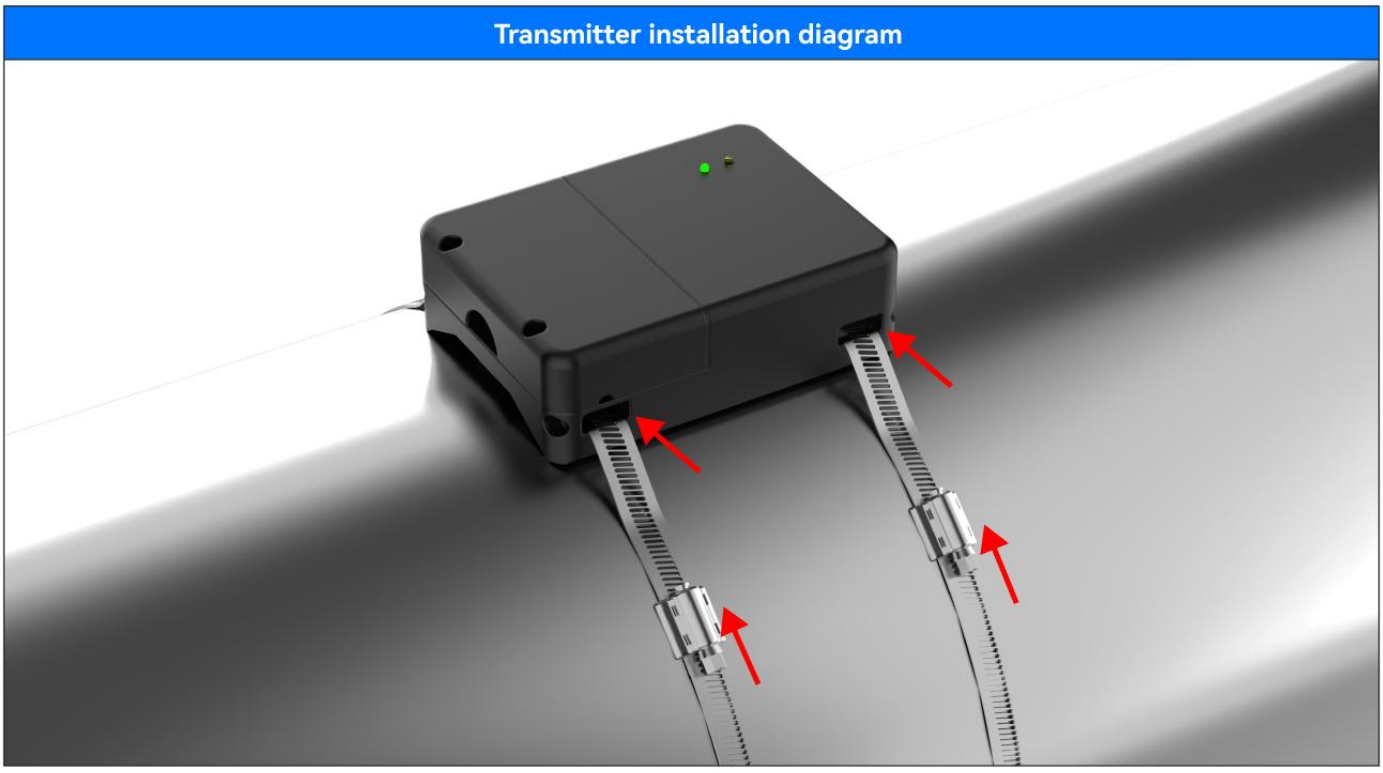

Figure 3.29

5. If the transmitter housing cover is removed to aid in installation, secure the cover to the transmitter using two M5 x 40 head screws.
For high speed shafts, exposed cement blocks require restraint, such as nylon straps, or mechanical bindings, such as throat straps, as shown in Figure 3.30.

3 Installation instructions

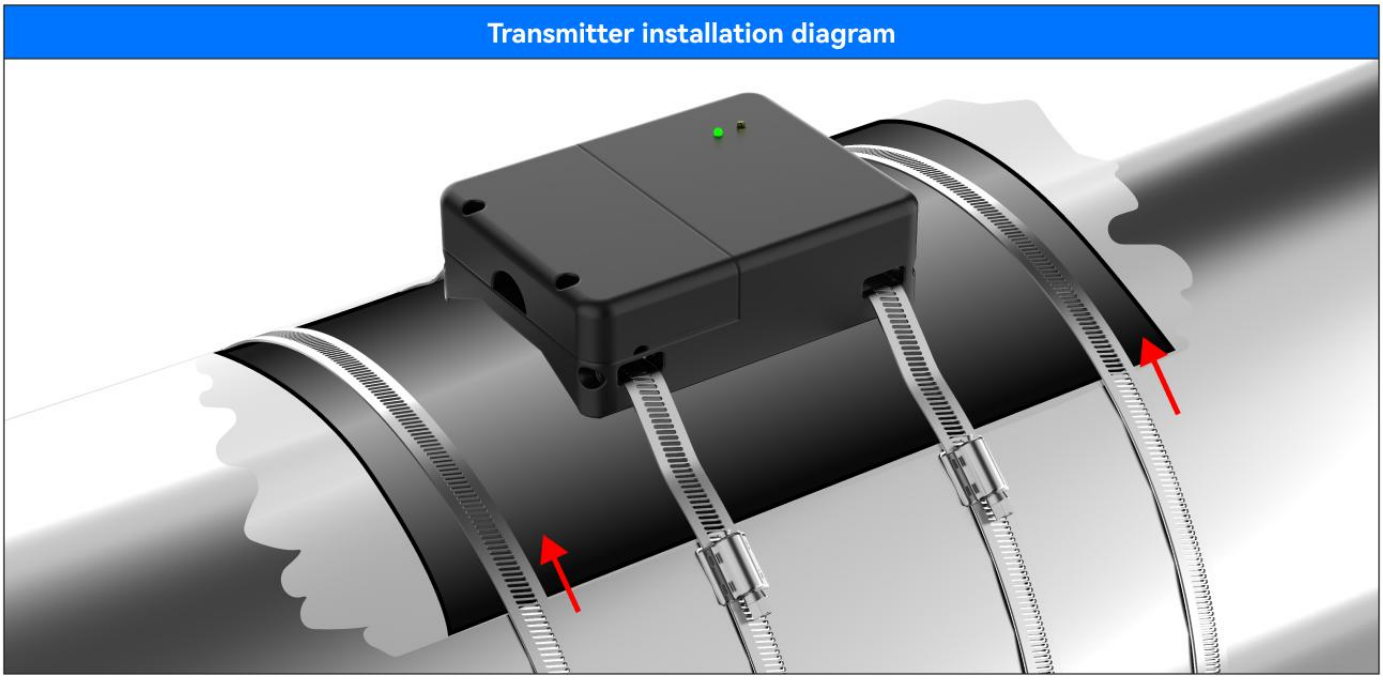

Figure 3.30

3.4.5 Counterweight mounting

Depending on shaft diameter and speed, you may need to install shaft type counterweights.
1. Place the counterweight under the shaft directly opposite the transmitter device, and use a long cable tie to temporarily fix the counterweight and transmitter in place, as shown in Figure 3.31.

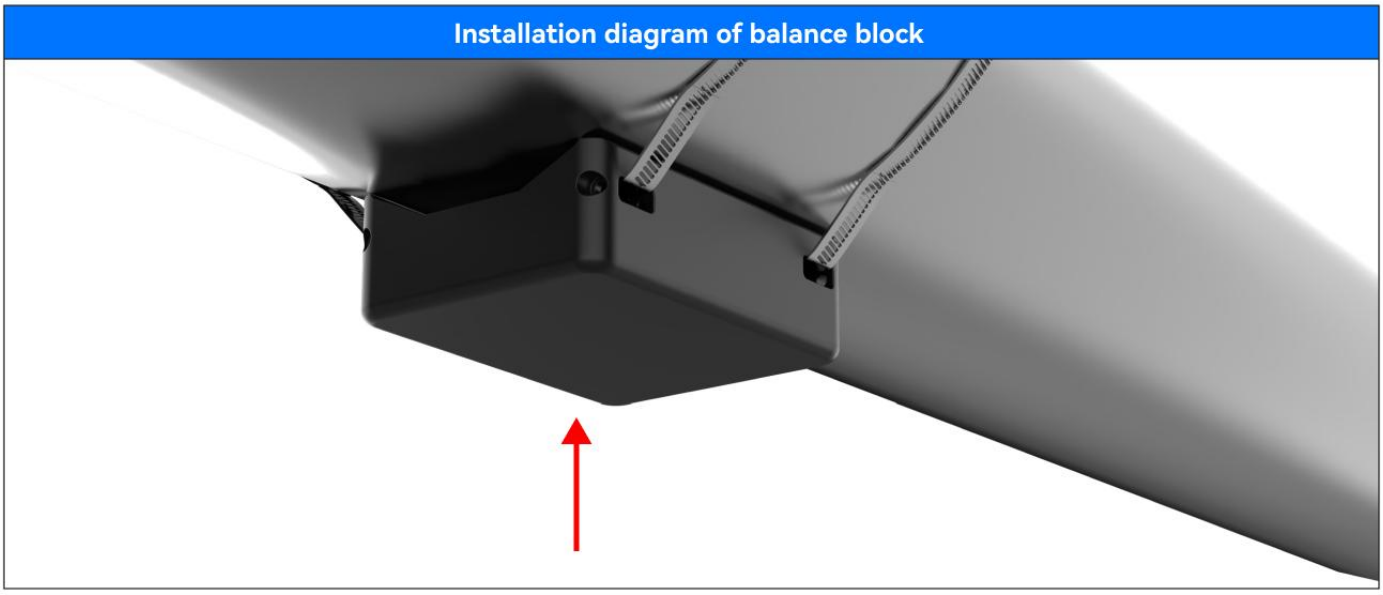

Figure 3.31

2. Tighten the screws in the throat band until the transmitter and counterweight are fixed together and firmly fixed to the shaft. Take care to ensure that the transmitter and the balance block are equally spaced and at a 180 degree Angle to each other, as shown in Figure 3.32.
3. The transmitter is installed.

3 Installation instructions

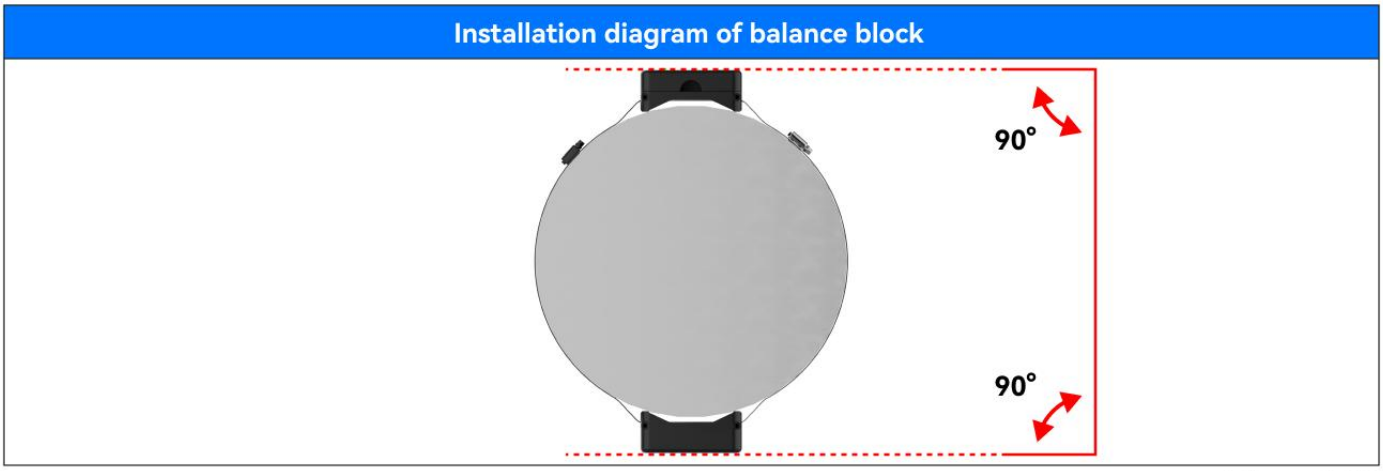

Figure 3.32

3.4.6 Rotor belt mounting

Shaft power meters are available in a variety of configurations to cover shaft diameter ranges. Your rotor assembly is pre-configured according to the shaft dimensions specified in the order.
An adjustment range is established in each rotor assembly through the regulator bolts. Further adjustment ranges can be achieved by changing the bolt hole arrangement of the rotor connecting plate. Preconfigured rotor assemblies do not need to do this.

1. Install the rotor assembly on the shaft from below. The center link of the longer model rotor assembly contains one of a pair of connecting rods with adjusting bolts. Place the center link at the bottom of the shaft.

Your goal is to have the ends of the rotor assembly joined together at the top of the shaft. The power cable for the rotor assembly should end next to the transmitter unit for easy insertion through its electrical connector.

Move the end of the rotor assembly up to the top in a loose test joint. Align the edges of the rotor assembly with the guide lines marked in Figure 3.14. Adjust the rotor assembly by hand until it is positioned correctly.

Now, starting with the rotor link at the bottom of the shaft, press the rotor assembly firmly onto the shaft by hand, gradually pressing up to both sides of the shaft, link by link, as shown in Figure 3.33. Take care to ensure that there is no slack in the rotor assembly, especially at the bottom of the shaft.

Mounting the rotor assembly from below in this manner helps prevent the connecting rod from sagging at the bottom of the shaft and mounting too loosely.

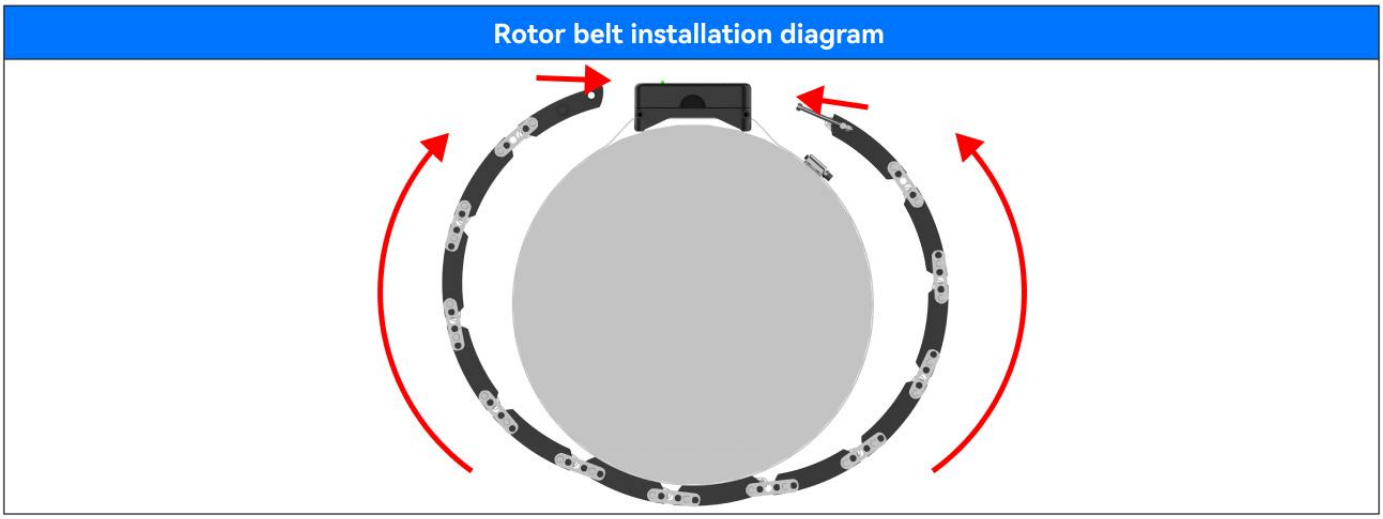

Figure 3.33

3 Installation instructions

2. Connect both ends of the rotor assembly to the top of the shaft using adjustable bolts. Check to ensure that the cable of the rotor assembly is close to the transmitter assembly and that the rotor assembly is positioned along the circumference guide rail, as shown in Figure 3.34.
Gradually tighten the top and bottom M4 regulator bolts and nuts until they are tight and the rotor assembly is secure.

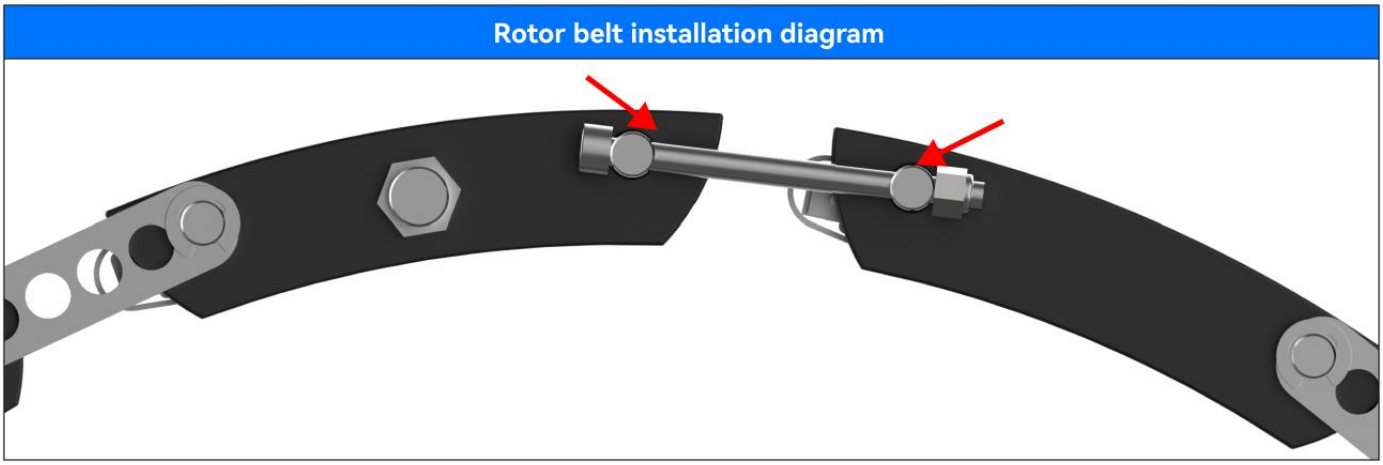

Figure 3.34

3. Insert the connector from the rotor assembly into the transmitter assembly, as shown in Figure 3.35.

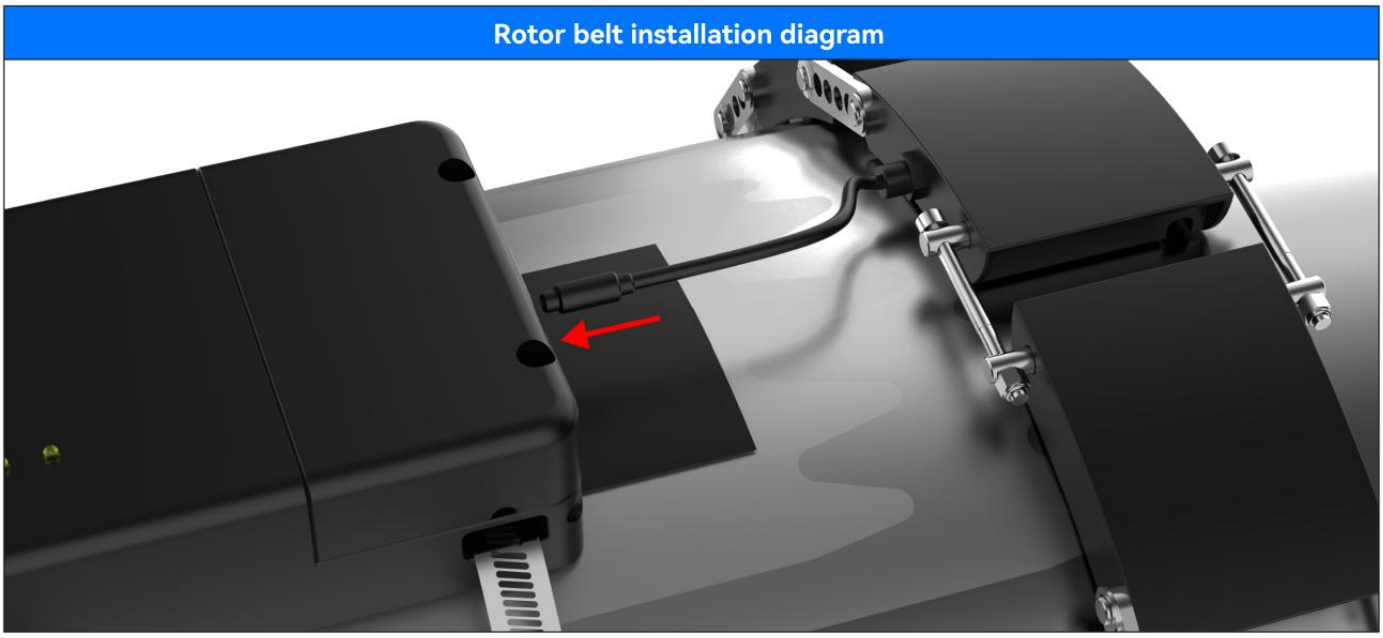

Figure 3.35

4. Starting from the top of the rotor assembly, wrap cloth reinforcement tape (included) around the entire rotor assembly and rub it on each rotor link. Repeat this for the shaft two to three times. Overlap it at the beginning of the tape and trim the ends. Tape adds additional protection to the rotor assembly, as shown in Figure 3.36.
5. Secure the transmitter/rotor connection with another piece of cloth reinforcement tape, wrapping the entire rotor assembly in a similar manner to secure it to the shaft.
6. Torque meter assembly installation is now complete.

3 Installation instructions

Rotor belt installation diagram

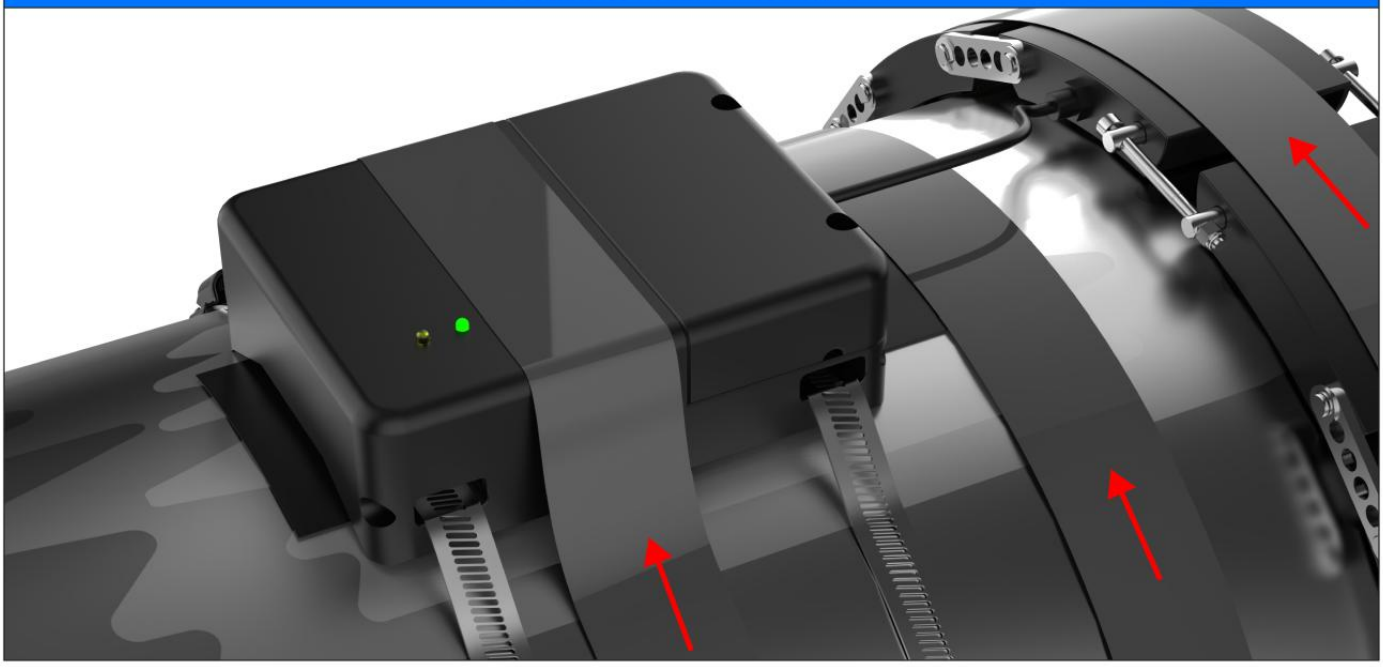

Figure 3.36

3.4.7 Fixed column installation

1. The struts of the mounting column are organically machined into grooves on the front and rear surfaces, and the stator coil assembly (front) and the side control box (rear) are fixed to these grooves. These will be pre-mounted on the mounting posts. The stator surface should face the axis.
2. Align the slots in the base of the mounting column with the holes in the mounting plate, which is attached to the ship deck and prefabricated by your Marine or shipyard engineer. Secure the mounting column base plate with 2 x M16 bolts, washers, and nuts. At this stage, it can only be tightened by hand, as shown in Figure 3.37.

Fixed column installation diagram

Figure 3.37

3 Installation instructions

3. Adjust the distance from the surface of the mounting column to the outer surface of the shaft surface to 75mm, as shown in Figure 3.38. About 50mm can be moved in the machining groove where the column base is installed.
If the mounting column installation plan is correct, the stator center line should be aligned with the rotor assembly center line and the mounting column center line when viewed from above.

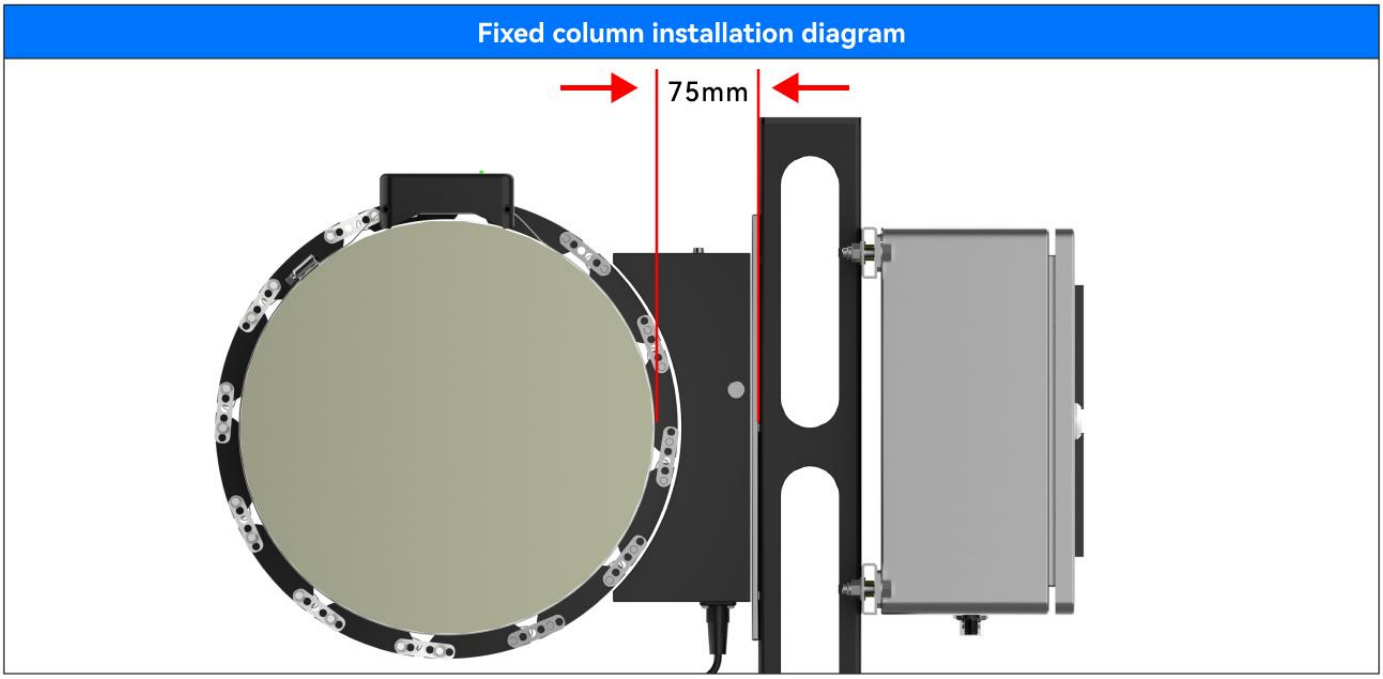

Figure 3.38

4. Loosen the stator mounting nuts and bolts if necessary, and adjust the stator mounting vertically on the mounting column slot until the air gap between the stator and rotor assembly is consistent with 10mm along its curved surface, as shown in Figure 3.39.

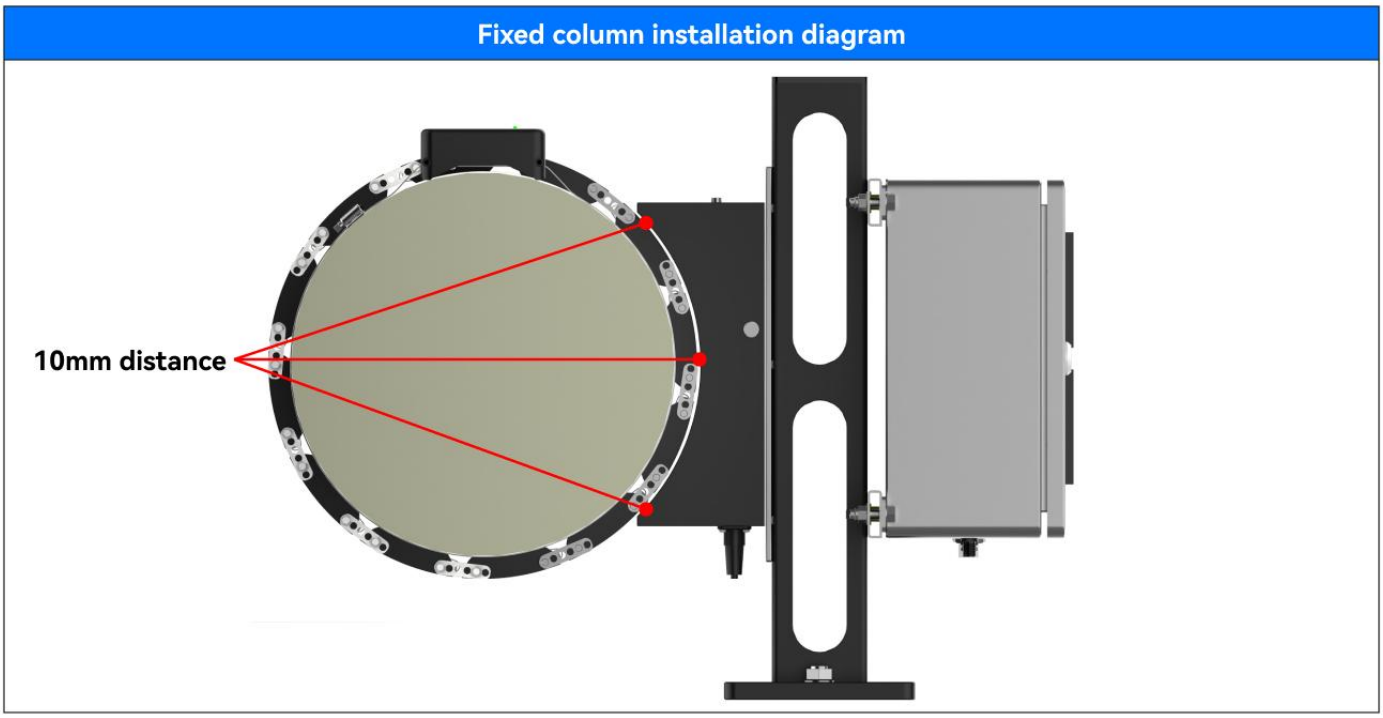

Figure 3.39

3 Installation instructions

5. Completely tighten the stator mounting nuts and bolts to the mounting column and the M16 bolts on the base of the mounting column. The mounting column has large holes on both sides for easy access by tools, as shown in Figure 3.40.

Fixed column installation diagram

Figure 3.40

3.4.8 Display unit installation

1. Install the display unit on the table as shown in Figure 3.41, and tighten the H screw to ensure secure.

Display unit installation diagram

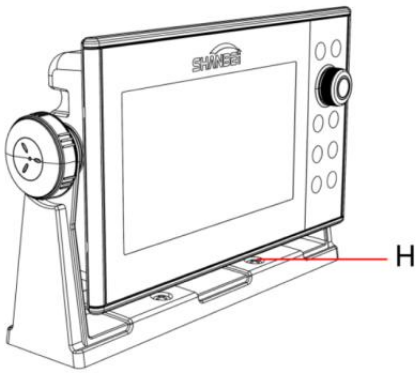

Figure 3.41

3.4.9 Data and power connection

Warning. Before continuing, make sure the main power connection is isolated.

1. Refer to the wiring diagram 2.4 provided in this document.
2. Open the door panel of the control box beside the machine.
3. Connect data output cables of related ports.
4. Finally connect the power supply 110/230V.
5. Close the door panel of the control box.
6. The shaft power meter is installed and connected to the monitoring port.

3 Installation instructions

3.5 Parameter configuration

3.5.1 Torque calculator

Click Calculator on the menu bar below the system home page to enter the page of torque, power, and thrust (optional) parameters configuration. Click on the torque calculator and input spindle outer diameter, inner diameter, maximum torque, spindle material, Young's modulus, Poisson's ratio and strain coefficient in turn. Click the Calculate and Save button on the current page again, and the system completes the parameter configuration

Torque zero calibration. Zero point calibration is generally calibrated once after the installation and commissioning of the shaft power meter system, without the need for secondary calibration. Enter the torque calculator, after the shaft power meter system is installed and adjusted, enter the torque calculator page when the measured equipment is at static, and click the zero scale button to complete the system torque zero calibration.

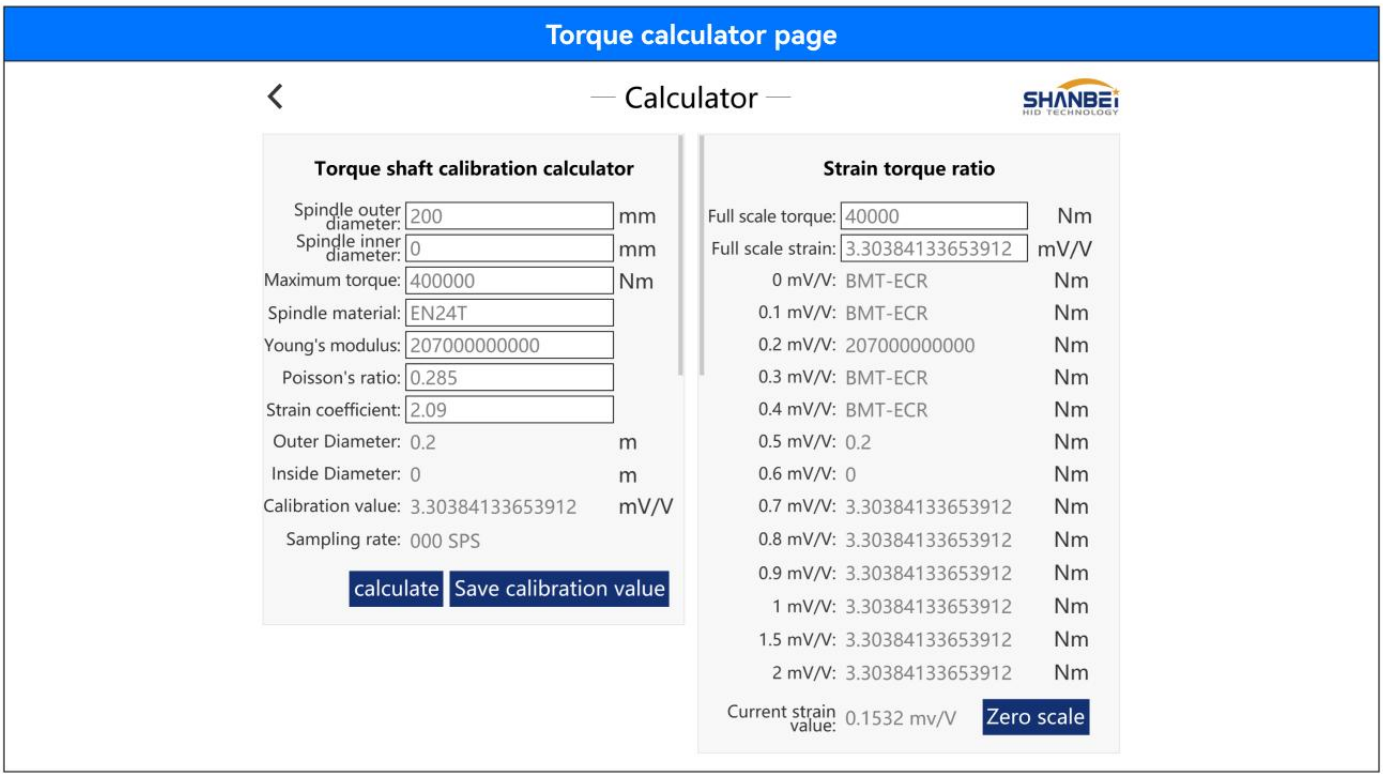

Figure 3.42

3.5.2 Thrust calculator

Click Calculator on the menu bar below the system home page to enter the page of torque, power, and thrust (optional) parameters configuration. Click the thrust calculator, and input spindle outer diameter, inner diameter, maximum thrust, spindle material, Young's modulus, Poisson's ratio and strain coefficient in turn. Click the Calculate and Save button on the current page again, and the system completes the parameter configuration

Thrust zero calibration. Zero point calibration is generally calibrated once after the installation and commissioning of the shaft power meter system, without the need for secondary calibration. Enter the thrust calculator. After the shaft power meter system is installed and adjusted, enter the thrust calculator page when the measured equipment is at static. Click the zero scale button to complete the system thrust zero calibration.

3 Installation instructions

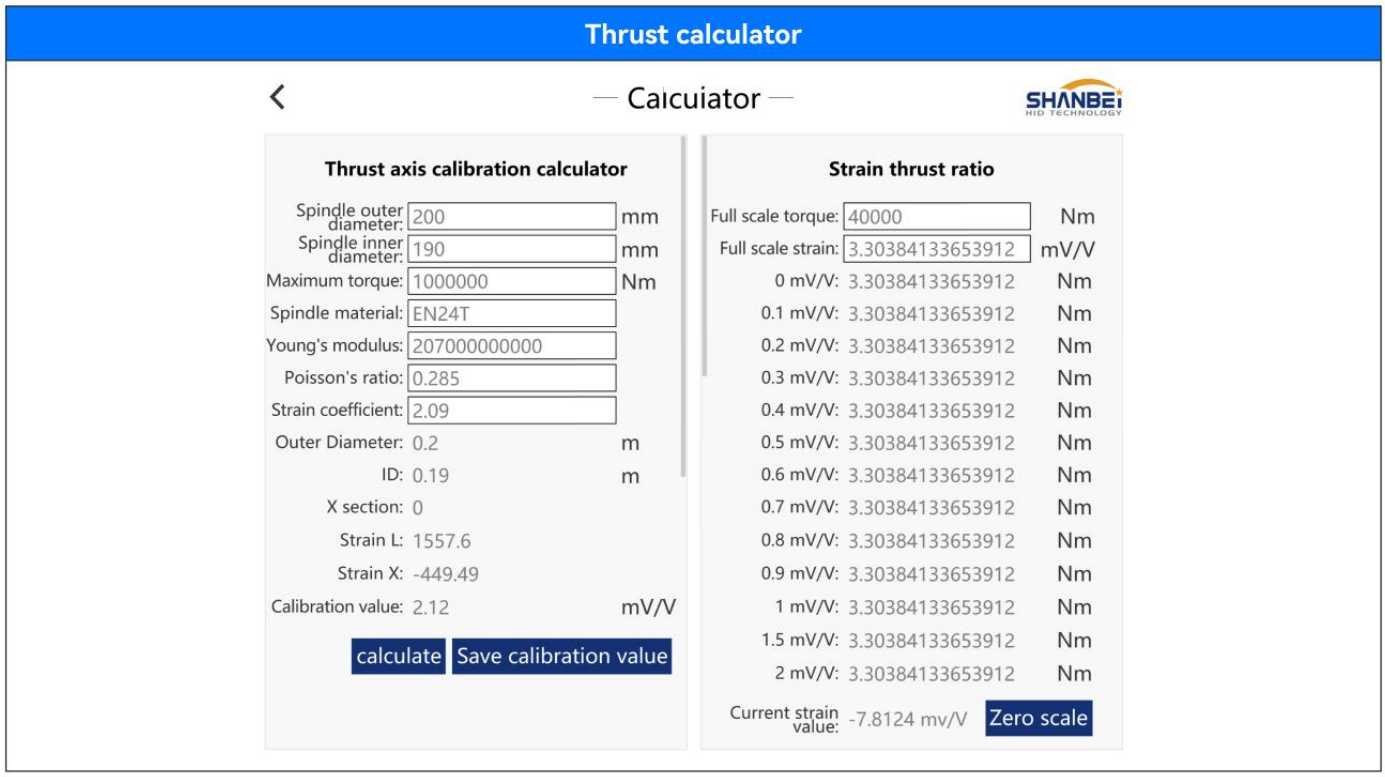

Figure 3.43

3.5.3 Power calculator

Click Calculator on the menu bar below the system home page to enter the page of torque, power, and thrust (optional) parameters configuration. Click the power calculator menu to enter the page of mutual calculation of power and torque and power unit conversion, enter parameter values in the box, and click the calculation button to complete the corresponding parameter calculation.

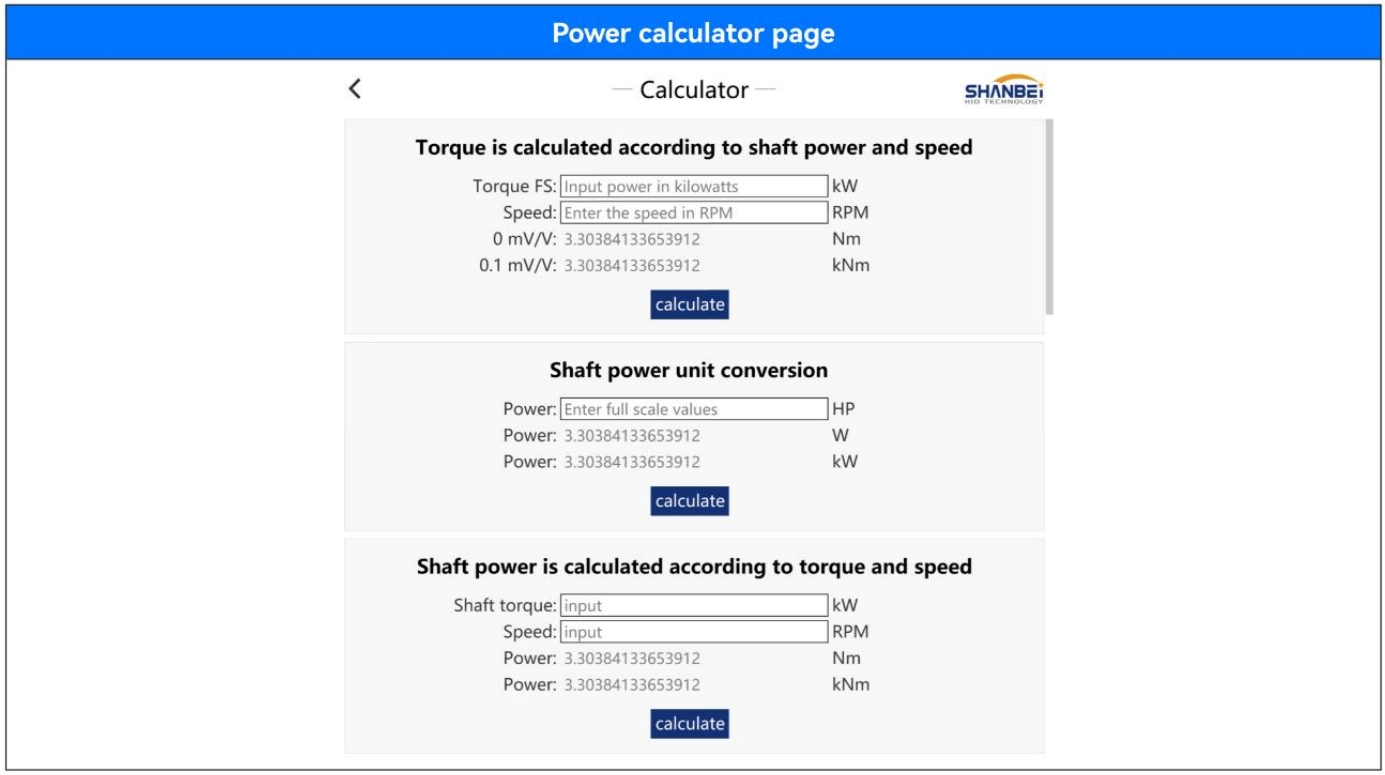

Figure 3.44

3 Installation instructions

3.6 Settings

3.6.1 Ethernet parameter Settings

Click the setting menu at the bottom of the system home page to enter the setting page of Ethernet, serial port, CAN, analog and other parameters. Tap the Ethernet button to enter the network port parameter Settings. Enter the IP address, subnet mask, gateway, and DNS in sequence. Tap Save.

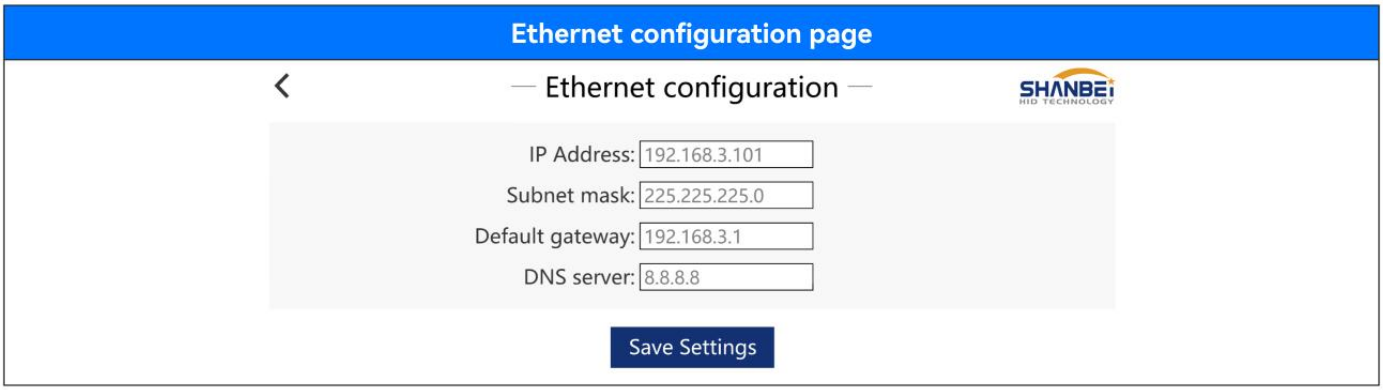

Figure 3.45

3.6.2 CAN parameter setting

Click the setting menu at the bottom of the system home page to enter the setting page of Ethernet, serial port, CAN, analog and other parameters. Click the CAN button to enter the CAN interface parameter Settings. Select the CAN number and baud rate in sequence and click to save the Settings. The system restart parameters take effect.

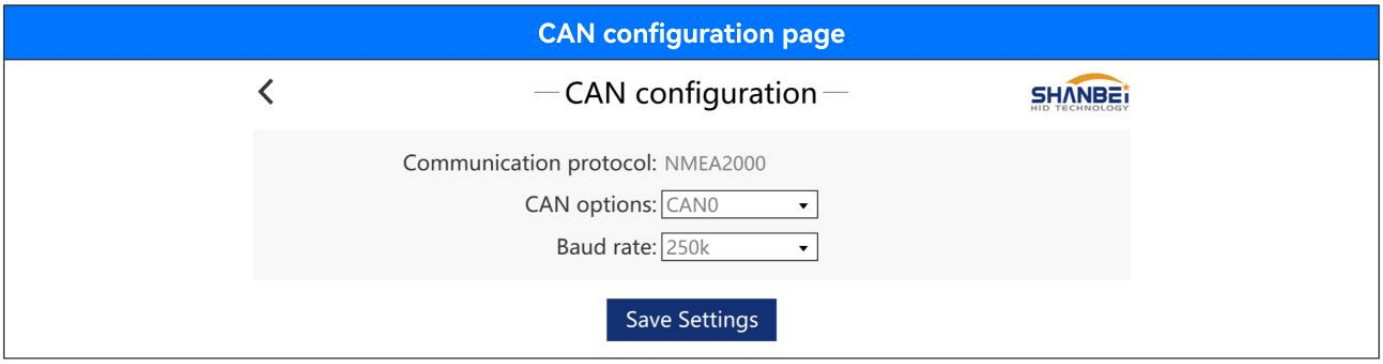

Figure 3.46

3.6.3 Serial port parameter Settings

Click the setting menu at the bottom of the system home page to enter the setting page of Ethernet, serial port, CAN, analog and other parameters. Click the serial port button to enter the serial port parameter Settings, select the communication protocol, serial port number, baud rate, stop bit, data bit, and check bit in sequence, and click to save the Settings. The device address is valid only under Modbus-RTU, and the system restart parameters take effect.

3 Installation instructions

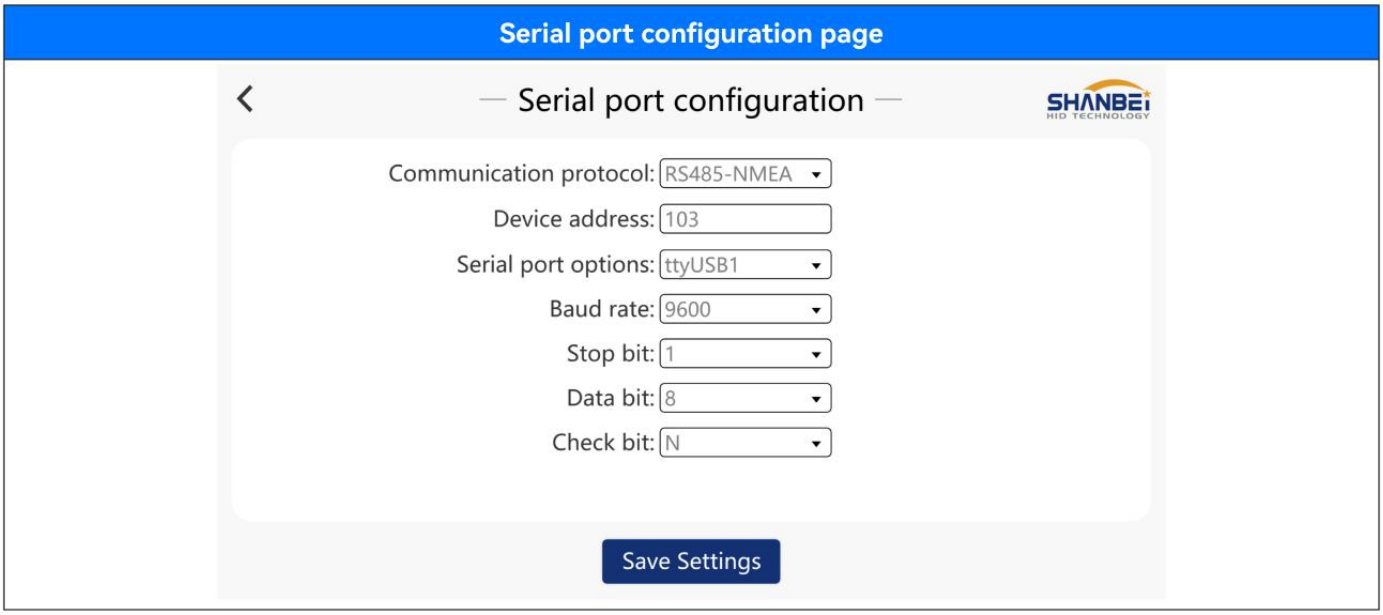

Figure 3.47

3.6.4 Shaft power parameter adjustment

Click the setting menu at the bottom of the system home page to enter the setting page of Ethernet, serial port, CAN, analog and other parameters. Click the parameter setting button to enter the parameter configuration page. Input torque, speed, power, thrust full scale value and corresponding analog output mode and unit in turn, click Save Settings, and the system will restart to take effect. Other partial parameters. The average time of real-time data on the main interface can be selected, which is 0.1 seconds, 1 second, 30 seconds, 60 seconds. The energy consumption unit is Wh and KWh. Period and time are adjustable. If you check thrust, the thrust dashboard will be displayed on the main interface. If you check torque or thrust strain value to reverse, the acquisition value will be negative. If you check torque or thrust instrument bipolar display, the main boundary interface dashboard will display positive and negative numbers.

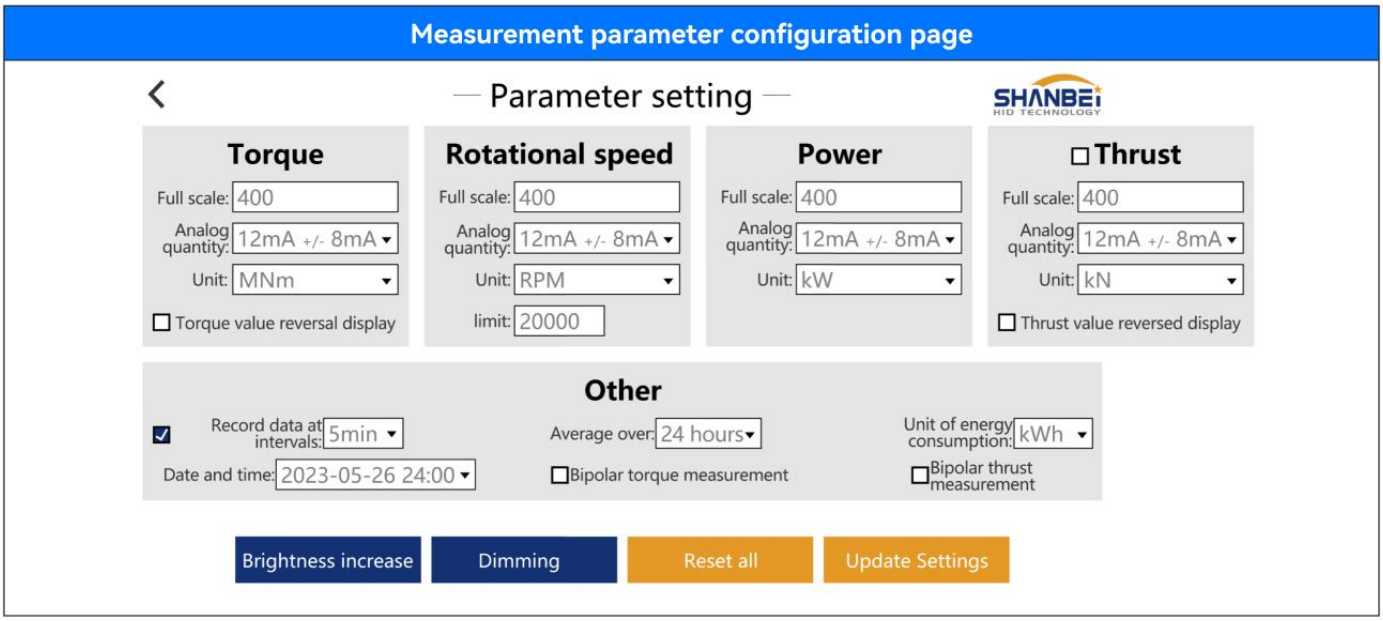

Figure 3.48

4 Instructions and precautions for use

4.1 Display unit instructions

Display unit key function diagram

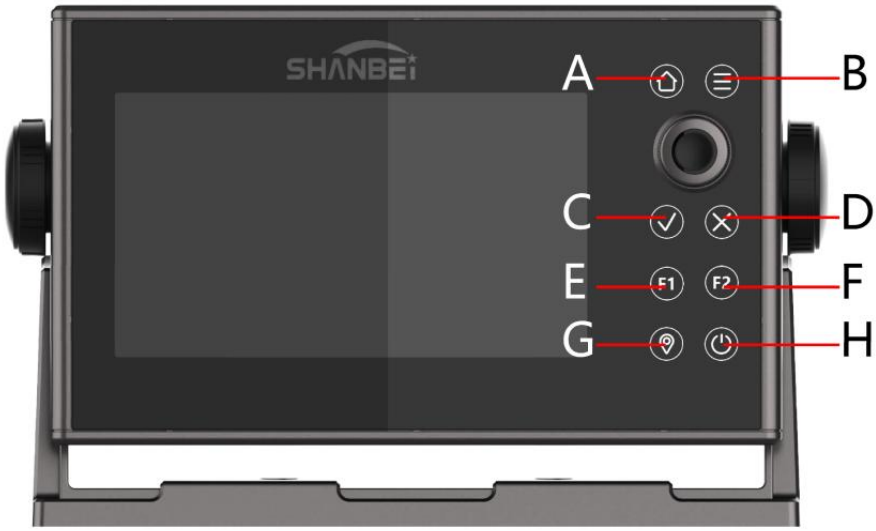

Figure 4.1

1. A-Home page: Return to the main page of the software
2. B-menu: capture screen, lock screen, night mode, brightness adjustment, standby and shutdown functions;
3. C-Confirm: Confirm the selection;
4. D-Cancel: Cancel the selection.
5. E-Custom F1: can choose the function to define;
6. F-Custom F2: You can choose the function to define;
7. G-positioning: positioning position;
8. H-power supply: switching power supply;
9. Knob: Rotate the selection of page components and press to confirm the selection.

4.2 Software overview

1. Home page for the device to start the first page, the main content is time, current connection status, three dial, data abnormal alarm; 1Sec indicates the current data acquisition rate, NMEA2000 indicates the current connection status, blinks when the connection is disconnected, and displays gray after the connection is disconnected. The left dial shows the current speed, the middle is the current power, and the right side shows the current torque; The lower right corner is the data alarm area, the user can set the power over limit, speed over limit, torque fluctuation value in the setting, where the power can set the first alarm value and the second alarm value, when the data exceeds the set value, the red light will be displayed, where the power exceeds the first alarm value yellow light, and the second alarm value red light.

4 Instructions and precautions for use

Main page

Figure 4.2

2. The cumulative page displays the current speed, power, torque, energy consumption in the past 24 hours, energy consumption of the current voyage, the number of turns selected by the spindle and the advancing distance, the energy consumption of the cumulative voyage and the number of turns of rotation.

Cumulative page

Figure 4.3

4 Instructions and precautions for use

3. Trend: The trend page shows the short-term trend and long-term trend button, click to enter the trend chart page.
Short-term trend: When entering the short-term trend, the speed data chart of the 5-minute period is displayed by default. Click the speed, power, and torque buttons to switch the data content of the chart. Click the 5-minute, 1-hour, and 24-hour buttons to switch the time period of the chart and modify the display content of buttons 1-5.

Short trend page

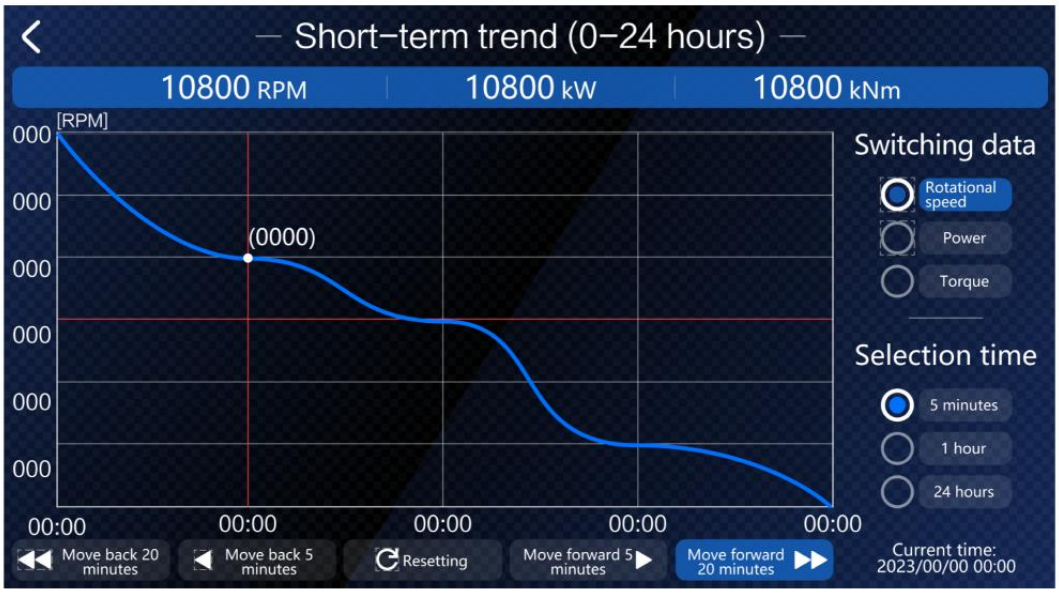

Figure 4.4

Long-term trend: To enter the short-term trend, the speed data chart of the 5-minute period is displayed by default. Click the speed, power, and torque buttons to switch the data content of the chart. Click the button of 1 week, 1 month, and 1 year to switch the time period of the chart and modify the display content of the buttons of 1-5.

Long-term trends page

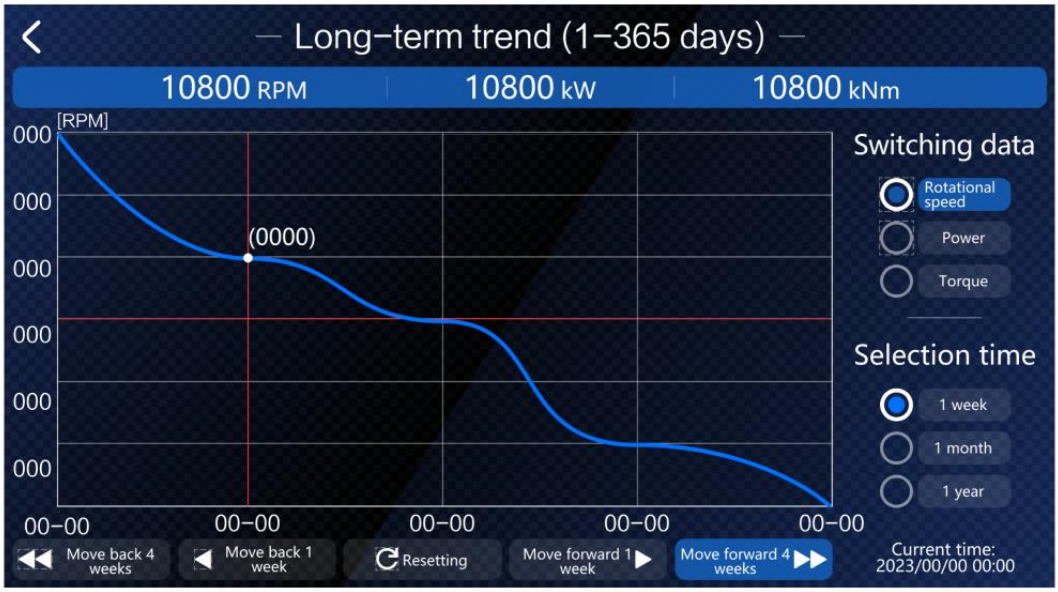

Figure 4.5

4 Instructions and precautions for use

4. The first part of the report list page is the current voyage report, and the rest is the historical voyage report.

Report page

Figure 4.6

5. The Settings page contains adjustment options for system, personalization, network and shaft power meter parameters.

Setup page

Figure 4.7

5 Fault analysis and elimination

This product has been put into operation since the use, basically no fault, with our statistics, the after-sales problem is basically due to wiring errors, resulting in normal use, in addition, there is no technical fault. Customers in the use of the process, if you find technical problems, please promptly communicate with our technical personnel.

6 Safety protection and accident handling

6.1 Safety protection devices and precautions

1. When installing or connecting cables, disconnect all external power supplies before performing operations; otherwise, electric shock and product damage may occur.
2. Do not bundle the communication and signal cables with the main circuit or power cables, or connect them close to each other. In principle, please leave more than 100mm.
3. Select a load driver whose capacity is about twice the load current.
4. When the inductive load is used, please use the twisted-pair shielded wire on the load. When the shielded wire is used on the signal receiving side, please ground the shielded wire.
5. Do not wire empty terminals; otherwise, the product may be damaged.
6. Keep the device clean and tidy. Do not let metal chips or small metal fall into the wiring hole, which may cause product failure

6.2 Troubleshooting procedures and methods

1. In the process of use, there is an unsolvable fault problem, contact our after-sales service engineer.
2. During the warranty period, if the fault occurs due to the product itself, we will provide a complete replacement product and send it to the buyer for free replacement. And provide technical support; If the fault is not caused by the product itself, we can provide two options of complete replacement products and on-site services, which are selected by the buyer. All costs are borne by the recipient.
3. If the warranty period is exceeded and the fault occurs, we can provide two service options that can completely replace the product or replace some parts of the product, which are selected by the buyer. The required cost shall be borne by the purchaser.

7 Maintenance and repair

7.1 Daily maintenance and maintenance

In the daily non-use state, attention should be paid to the maintenance of this product. Through maintenance, maintenance can improve the service life of the product, the specific maintenance and maintenance methods are as follows:
1. Wipe the surface of the product regularly with a dry rag to ensure that the outside of the product is clean and tidy.

7.2 Operation precautions

1. Please stop using the device when there is a problem in operation. Contact our after-sales engineer.
2. The input voltage shall be carried out in strict accordance with the wiring instructions. Failure to operate according to the regulations will result in product failure or other major accidents, which shall be borne by the buyer.

7.3 Long-term maintenance and maintenance

Long-term placement, maintenance maintenance methods, and daily maintenance, maintenance methods are the same.

8 Transportation, storage and warranty

8.1 Transportation precautions

Physical damage to the product caused by violent shaking and collision should be avoided during transportation.

8.2 Storage precautions

Room temperature, dry, cool environment.

8.3 Warranty period

The warranty period of this product is 12 months from the date of receipt of the goods by the buyer. Based on the date of receipt of documents for express delivery or the date of receipt of invoice.

9 Other

9.1 Phone number of the after-sales engineer

Contact: Mr.Xu
Tel: 18067343163

9.2 Company information

Manufacturer: Ningbo SHANBEI Technology Co., LTD
Address: A2-902, R&D Park, High-tech Zone, Ningbo
Postal Code: 310001
Tel: (0574) 87182781
Fax: (0574) 87182781

10 Appendix

10.1 Clarification on Measurement Deviations of Shaft Power Meters

During sea trials, chief engineers often report that the measured values from shaft power meters deviate significantly from their estimated figures—sometimes by as much as 20%, leading to doubts about the instrument's accuracy. This note provides a theoretical explanation to address such concerns.

10.2 The chief engineer estimates power based on "RPM + load"

This power is the main engine power, which is indirectly calculated from the engine end based on the main engine manufacturer's propulsion characteristic curves (revolution speed n - power P or throttle - power P). The main engine power is directly proportional to the cube of the revolution speed.
Load = (Current Power / Rated Power) * 100% = (Current Revolution Speed / Rated Revolution Speed)^3 * 100%
For example, for a bulk carrier with a main engine rated power of 6764 kW and a rated revolution speed of 105 rpm, if the current revolution speed is 86 rpm, then:
Load = (86 / 105)^3 * 100% = 55%
Power ≈ 55% * 6764 = 3716 kW
Similarly, Maximum Power / Rated Power = (Maximum Revolution Speed / Rated Revolution Speed)^3.
Since maximum power is generally 1.1 times the rated power, the maximum revolution speed is approximately 1.03 times the rated revolution speed.
This estimation method has two prerequisites:
1. It assumes that mechanical efficiency and transmission efficiency remain constant;
2. It does not consider real-time changes in the shafting system, hull, and sea conditions.
In reality, this estimation method has significant deviations, mainly including:
1. Engine internal losses, differences between indicated power and shaft power.
Four-stroke engines have mechanical losses of approximately 10% to 15%, while two-stroke engines have mechanical losses of approximately 6% to 10%. Manufacturer curves are often provided for new engines under ideal conditions; actual older engines experience greater losses due to wear.
2. Transmission and shafting losses.
The main engine drives the intermediate shaft through the transmission system, with power losses at each stage, including gearboxes (1% to 3%), intermediate shafts, bearings, and seals (1% to 2%), and couplings and misalignment (an additional 1% to 3%).
3. Errors inherent in the estimation model itself.
The model estimates power based on revolution speed, but there is a ±3% to ±8% deviation in the throttle/fuel injection - power curve. Additionally, there are issues with revolution speed fluctuations and non-linear load characteristics, which are more pronounced at low loads. Manufacturer curves are based on standard environments, clean hulls, and calm water; actual ship conditions, hull fouling, and wind waves all increase deviations.
Furthermore, regardless of whether Hall sensors or photoelectric sensors are used to measure revolution speed, there is an approximate 1% accuracy error.

10 Appendix

10.3 The accuracy of the v-axis power elf

Qualified marine shaft power meters analyze factors affecting accuracy from the product development stage, control them during production, and calibrate them during factory testing. Taking the strain gauge torque measurement method, which t the measurement results.
2. Speed measurement: There is approximately a 1% accuracy error.
3. Torque measurement: Deviations such as strain gauge bonding, fixed positioning of the stator-rotor bracket, and uncertainties in shaft parameters (e.g., shaft diameter, Poisson's ratio, Young's modulus) can lead to torque measurement deviations, resulting in a comprehensive error of ±3% to ±5%.
Ningbo Fanbei has done extensive work to ensure the accuracy of its shaft power meters:
1. Selected 16-bit AD sampling chips, achieving a theoretical precision of 0.0015%.
2. Conducted speed function tests before shipment using a test bench calibrated for speed measurement with a theoretical precision of 0.02%.
3. Performed torque strain simulation tests before shipment using a test bench that underwent comparative testing and initial strain value recording.
4. During on-board installation, required that the strain value change before and after strain gauge bonding does not exceed 1%.
In an ideal laboratory environment of a third-party CNAS institution, the axis power meters produced by Ningbo Fanbei achieved an accuracy error of no more than 1.5%. The national standard/sea trial requirements are ≤2% (95% confidence level), which is fully met.
In summary, the values measured by the shaft power meter can be considered close to the true shaft power. Considering all factors, the error typically does not exceed 5%.

10.4 Bias comparison

summarize the experience from tests on dozens of actual ships, and the deviation between the estimated main engine power and the measured intermediate shaft power is as shown in the table below:

Operating Load Range	Normal operating condition deviation	Aging/Dirty Bottom/ Wave Condition Deviation	Introductions
80%~10%rated load	5%~8%	8%~10%	Estimated values are generally higher than measured values, with the smallest deviation
50%~80%rated load	8%~12%	10%~15%	Losses gradually become more pronounced, and deviations steadily widen
20%~50%rated load	12%~15%	15%~20%	Low-load non-linear losses are significant, with large deviation peak intervals

Table 1.4

In other words, the estimated value is usually greater than the shaft power meter value because estimates are often based on the 'engine-end theoretical/rated power curve' without deducting real-time mechanical and transmission losses.

10 Appendix

10.5 Conclusion

1.he actual measured comprehensive error of the shaft power meter remains stable within ±5%, with an optimal case reaching 1.5%, ensuring high data credibility;
2. The primary causes of deviation are mechanical losses, shaft transmission losses, differences in operating conditions and environments, and parameter settings. A 20% deviation is possible, but this should not lead to the negation of the shaft power meter's measurement results;
3. For daily statistics, taking the interval midpoint and using relative values as the basis for accounting facilitates long-term comparison of main engine operating status and energy consumption changes on ships. There is no need to focus on differences in individual absolute values, which can meet the usage requirements for daily maintenance and energy efficiency accounting.

11 Appendix

11.1 Shaft Power Meter Installation Requirement Confirmation Form

【To ensure optimal device performance, all data in the table should be filled in completely】

Company Name			
Contact person		**Post**	
Contact telephone number		**Email**	
Number of sets per ship			
Ship Name			
Function	☐ Intermediate axis ☐ DG ☐ Dredge Pump ☐ Ejector Pump ☐ Propeller ☐ Others		
tallation Type	☐ Newly built ships ☐ Vessel conversion		
Measurement Output	☐ Torque, rotational speed, power ☐ Torque, rotational speed, power, thrust		
The centralized control room display	☐ Yes ☐ No		
Main engine	Manufacturer		
	Model		
	Rated power		KW
	Rated speed		RPM
Spindle Parameters	Main Shaft Outer Diameter		mm
	Main Shaft Inner Diameter		mm
	Main Shaft Material		
	Young's Modulus		
	Poisson's ratio		
Requirements for Torque, Speed, Power, and Thrust Output Signals			
Analog signal	Current Signal: 4 ~ 20mA [Default] Voltage Signal: 0 to 5V, 0 to 10V, ±5V, ±10V		
Digital Signal	RS485（NMEA-0183，Modbus-RTU） [Default] CAN Bus（NMEA2000）		

Sales Manager: _____ Confirm the time: _____ Confirm the location: _____

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HID TECHNOLOGY

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