High-Rigidity Torque Transducer TPH-A
INSTRUCTION MANUAL

1. Safety precautions

⚠ WARNING!

Be sure to observe the warnings below. Failure to observe may lead to a serious injury of the operator.

- Detach the L-shape spacer. Make sure that the gap and concentricity are proper. If not, the transducer may break.
- Do NOT touch the torque transducer installation during operation, or you may be caught in it.
- Do NOT give a torque load larger than the allowable load, or the torque transducer may fracture.

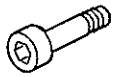
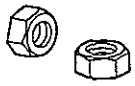
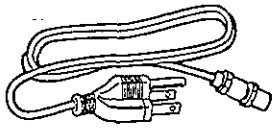
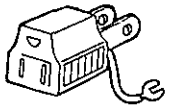
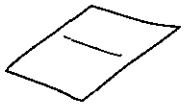
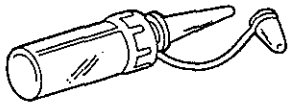
⚠ CAUTION!

Be sure to observe the cautions below. Failure to observe may lead to an injury of the operator.

- Check to be sure that the shaft is free from eccentricity.
- Prepare a protection cover, and cover the revolving mechanism with it.
- Check to be sure that the screws on the mainframe are tight.
- Do not approach the rotor under revolution.
- An improper shaft coupling connected to the torque transducer may run out due to revolution, thereby leading to a damage of the torque transducer. Select a suitable shaft coupling matched with the measuring system.

2. Confirmation of the accessories

The TPH-A torque transducer comes with the following accessories. When unpacking, check to be sure that all the accessories are included.

Decicated bolts: 42 (incl. 2 spares)	
Dedicated nuts: 42 (incl. 2 spares)	
Hexagon socket head bolts: 4 (to fix base)	
Power cable: 1	
Power cable adaptor: 1	
Calibration sheet: 1	
Instruction manual: 1	
Screw lock: 1 (to lock cover fixing screw)	

3. Torque measuring sequence

Installation of the torque transducer

Remove the cover.
↓
Remove the fixture.
↓
Set the torque transducer.
↓
Fix the base.
↓
Combine the torque transducer with the mating flanges.
↓
Remove the L-shape spacer.
↓
Confirm a gap in the rings and ring concentricity.
↓
Attach the cover.

Connection

Connect the power cable.
↓
Connect the output cable.

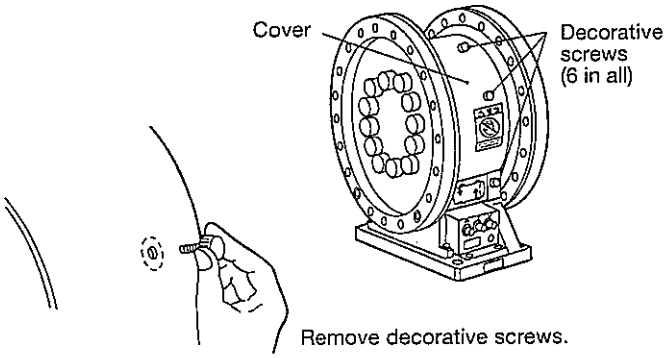
Measuring

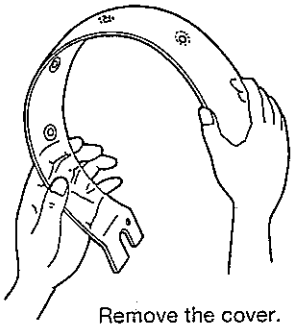
Make a trial run of the torque transducer by turning it by hand or with no load applied.
↓
Make sure again of a proper gap between rings.
↓
← Confirm the field balancing of measuring system.
↓
Run the torque transducer to measure.

4. Installation of the torque transducer

4.1 Remove the cover.

With the hand, loosen 6 decorative screws that fasten the cover, then remove the cover.

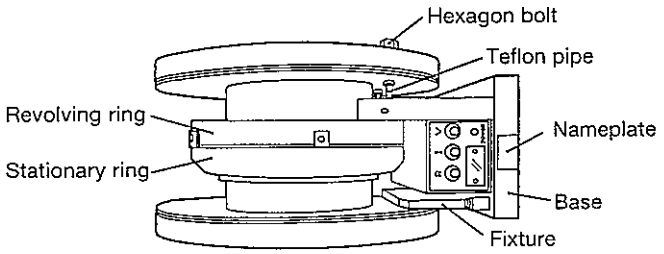


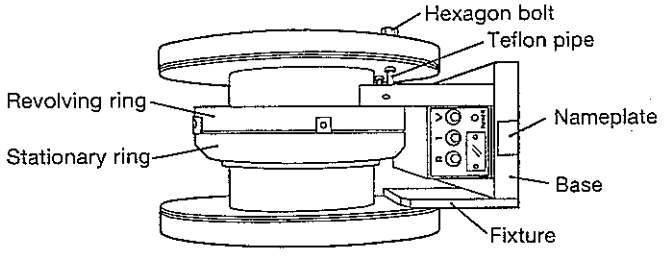


4.2 Remove the fixture.

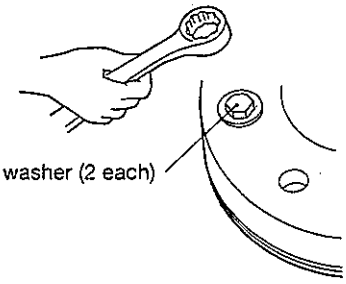
(1) TPH-1TMA to TPH-5TMA

The front of the torque transducer has the nameplate labelled at the base. Viewed from the front, bring down the torque transducer to the left so that the coupling to which the fixture is fixed seats on the floor. Using a closed wrench or spanner, loosen off two hexagon bolts which go through Teflon pipes. Remove Teflon pipes too.

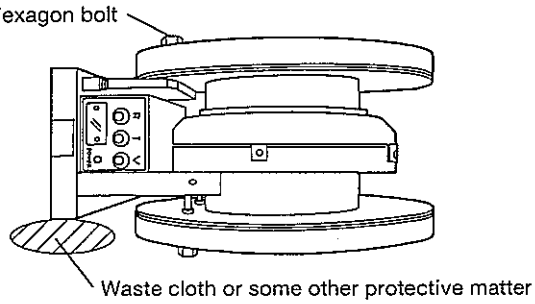


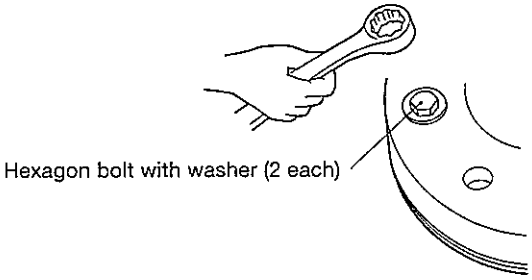


Note: The upper figure is for 2TMA and 4TMA and the lower, for TPH-1TMA and 5TMA. Though description hereinaftter uses the upper figure, Procedures are common to all models.

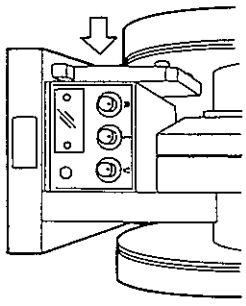


Turn over the torque transducer so that the coupling to which the fixture is attached comes upward. Put a waste cloth or some other protective matter between the base and the floor. Using a closed wrench or spanner, carefully loosen off two hexagon bolts which fix the fixture to the coupling. The base will drop onto the waste cloth.

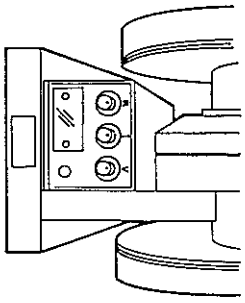




If removing two hexagon bolts does not drop the base, remove the waste cloth and gently move the base downward to remove the pin of fixture from the hole on the coupling.

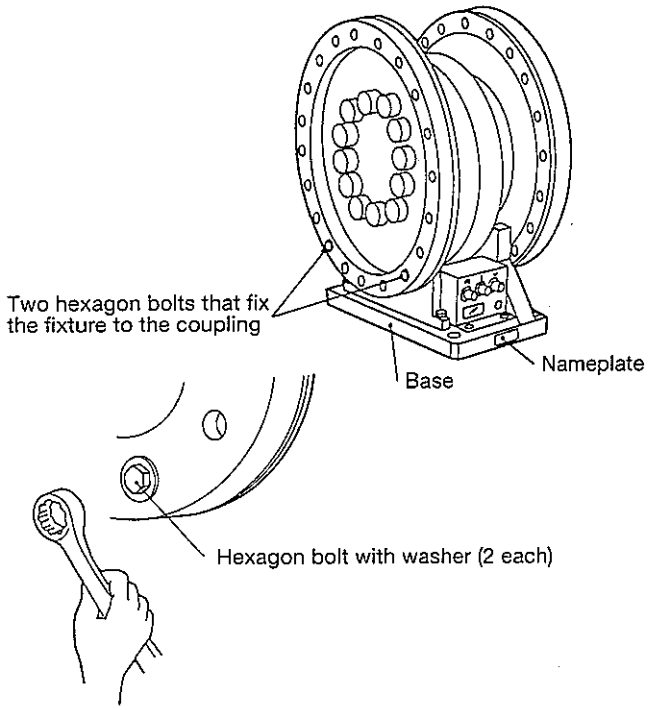


Loosen off two hexagon socket bolts which fix the fixture onto the base. Then remove the fixture.

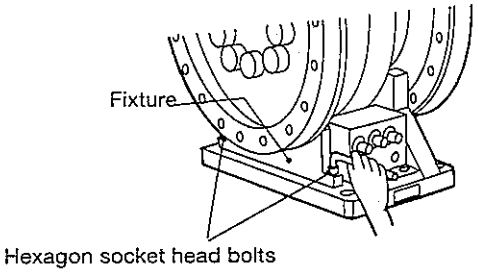


(2) TPH-50KMA to TPH-500KMA

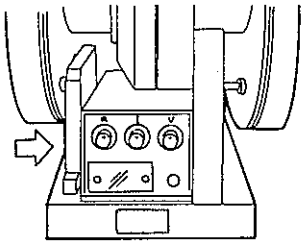
The front of the torque transducer has the nameplate labelled at the base. On the left viewed from the front, loosen off two hexagon bolts which fix the fixture to the coupling. Use a closed wrench or spanner to loosen.



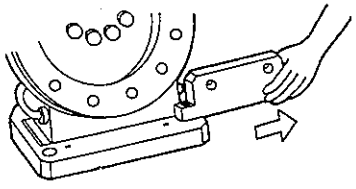
Remove two hexagon socket head bolts (M5 x 15) which fix the fixture onto the base



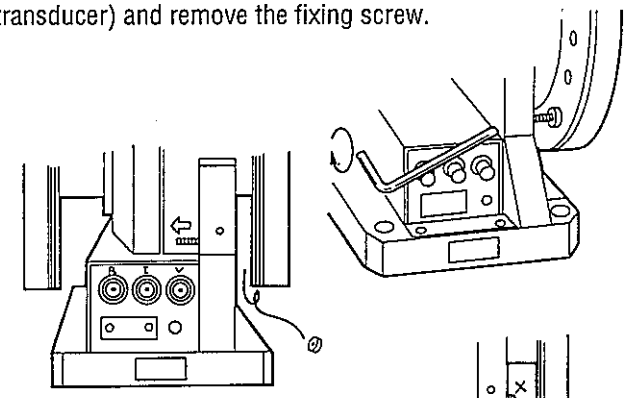
Move the fixture about 4-5mm toward the transducer's inside, and the fiture's pin will get out from a reamer hole.



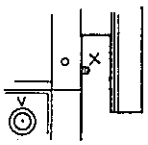
Now pull out the fixture, which you have moved toward the inside.



Next, loosen two hexagon socket head setscrews (M5) at the opposite side to the fixture (at the right viewed from the front of transducer) and remove the fixing screw.



Take care that the end of a setscrew will come out on the side of amplifier box. Avoid the screw end sticking out on the side of diaphragm coupling.



4.3 Set the torque transducer.

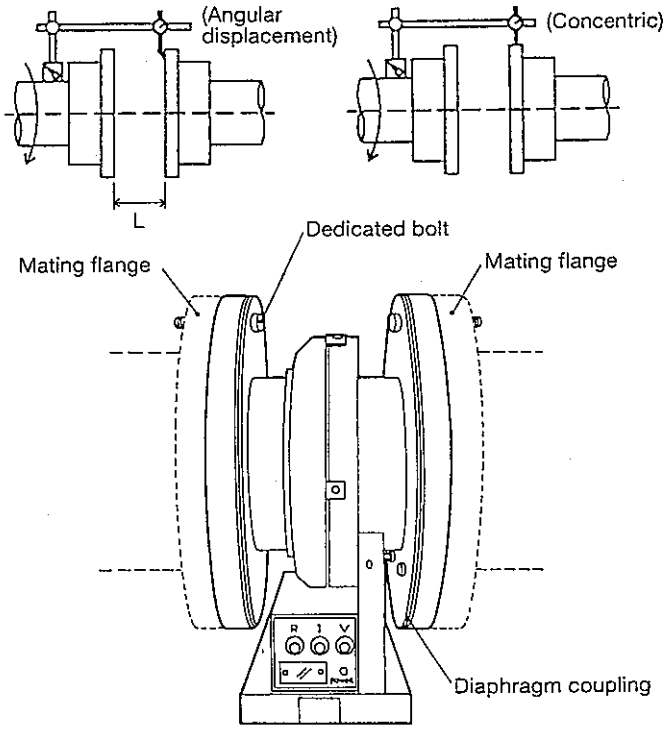
Confirm the center of the driving side and that of the load side, between which the torque transducer is to be installed.

Misalignment of the diaphragm couplings, standard accessories, must be below 1/4 degrees in angle and 0.5mm in distance. If not, the transducer can be damaged to cause serious danger.

Also note that the transducer will not perform to the specifications if misalignment exceeds 0.05mm. Make sure therefore to achieve possibly highest accuracy of centering, in order to ensure highly accurate measurement.

Aim at a centering accuracy of <0.1mm and define the distance L between mating flanges as (length of torque transducer) + (0.1 to 0.2 mm).

Place the torque transducer between the mating flanges (which will be prepared by the user). Fix each coupling of transducer to the mating flange by inserting the dedicated accessory bolt from the coupling side. (Under the condition, the ring at the stationary side and the base are not yet fixed. Take care therefore that these components may not hit against any other matters.)



4.4 Fix the base.

Using a spacer (which should be prepared by the user), fill the gap between the base and the platform onto which the base is fixed. Make sure the platform is parallel to the center of axis. Then fix the base with four hexagon socket head bolts.

4.5 Combine the torque transducer and the mating flanges

Using the dedicated accessory bolts and nuts, fasten the torque transducer to the mating flanges at 40 joints. For tightening torque, see the table below.

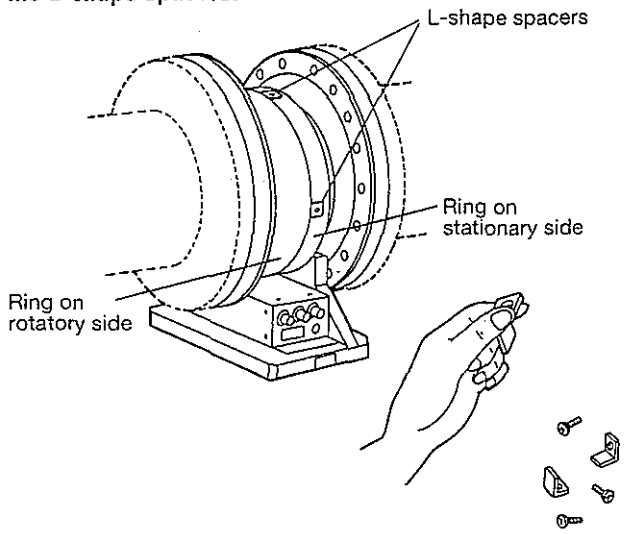
Transducer model	Tightening torque (N·m)
TPH-50KMA	7.4
TPH-100KMA	7.4
TPH-200KMA	7.4
TPH-500KMA	30.4
TPH-1TMA	36
TPH-2TMA	71
TPH-4TMA	125
TPH-5TMA	125

Do NOT use bolts and nuts other than the dedicated accessory bolts and nuts.

4.6 Remove the L-shape spacers.

You will find L-shape white spacers inserted at three places between the two rings, rotatory and stationary. They are fastened to the stationary ring with screws.

Remove these screws using a screwdriver, then remove **the L-shape spacers.**



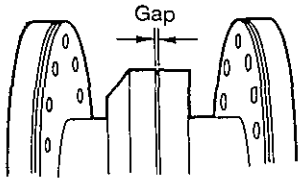
4.7 Confirm the rings' gap and concentrity.

Confirm a gap between the two rings, rotatory and stationary.

Confirm that a gap of 0.5mm to 2.5mm is provided between the rotatory and stationary rings.

For caution's sake, the L-shape spacer is 2mm thick.

Make sure that during rotation a gap of :
0.5mm to 2.5mm
is provided between the rotatory and stationary rings.



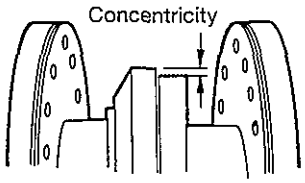
Confirm the rings' concentricity.

Confirm that the rotatory ring and the stationary ring are concentric (to a torelance of below 0.5mm). The two rings have a same external diameter, therefore bring their top edges to a same level to ensure their concentricity.

Make sure that during torque measurement, the rotatory ring and the stationary ring are concentric to a tolerance of below 0.5mm

If necessary, loosen the screws, which fasten the base (see 4.4 [Fix the base]), adjust the gap in the rings and their concentricity, and after that, fasten the base again with the screws.

If these two are out of the stated range/tolerance, outputs can be disabled, or the rotatory and stationary rings come into contact, thus causing serious danger.



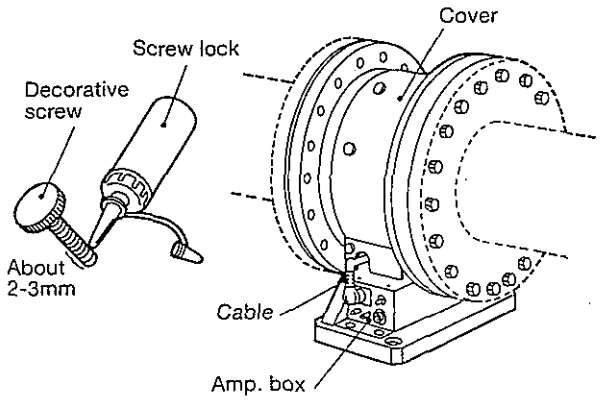
4.8 Attach the cover

Now attach the cover, which was removed in Item 4.1 [Remove the cover], back to its place, taking care that the cables at the rear of the amplifier box are kept from going inside the cover. After this, fasten the cover using the accessory decorative screws.

Apply a small quantity of accessory screw lock to the end of each decorative screw, in order to prevent loosening.

Avoid using screws other than the accessory screws, or else transducer output can be affected by noise.

Do NOT fail to attach the cover before rotation, or else danger is caused during rotation.



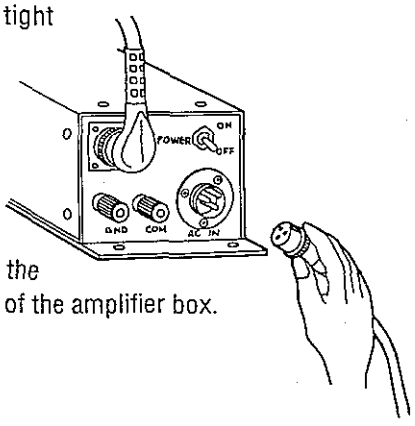
5. Connection

5.1 Connection of the power cable

Insert the connector of the accessory [power cable] in the [AC IN] terminal provided on the rear of the amplifier box. Turn the screw knob to ensure tight connection.

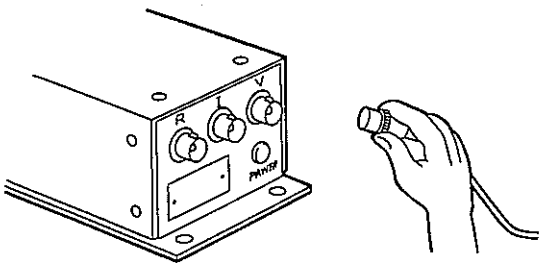
Connect the [power cable] plug to an outlet of 90~240Vac, 50 or 60Hz.

In case grounding is impossible using the *[power cable] plug, ground the* [GND] terminal on the rear of the amplifier box.



5.2 Connection of the output cable

[R], [L] and [V] on the front of the amplifier box respectively form output terminals to output number of revolutions, current and voltage in the stated order. Connect a cable equipped with a BNC connector to the receptacle of each output terminal.



☆ **Connection of voltage output**

Using a cable equipped with a BNC connector, connect an indicator, etc. to the [V] on the front of the amplifier box. Use an indicator whose input impedance is 10kΩ or higher.

☆ **Connection of current output**

Using a cable equipped with a BNC connector, connect an ammeter to the [L] on the front of the amplifier box. In case current-voltage conversion is necessary, use a resistor of 500Ω or lower.

☆ **Connection of output of number of revolutions**

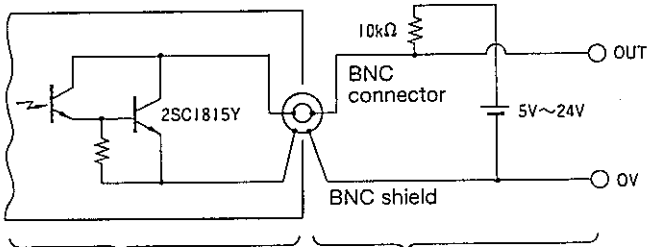
Using a cable equipped with a BNC connector, connect a tachometer to the [R] on the front of amplifier box.

Recommendable tachometer: 3925, a product of Tsuruga Electric Co., Ltd. (#6 open-collector; #9, 0V)

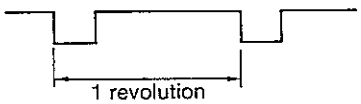
Because open-collector output is adopted, connect a BNC cable's conductor to the open collector input terminal, and a shield wire to the 0V input terminal of a tachometer.

To detect the number of revolutions, set 1 pulse per 1 revolution.

To output pulse signals, refer to the following figure.



Circuit diagram



Sample waveform output

5.3 Connection of a terminal box

Use the [GND] terminal on the rear of the amplifier box to ground the box.

The [COM] terminal has the same electric potential as Output [V] and [L]'s shield side. So use it for common connection of other instruments.

6. Measuring

6.1 Trial run by turning manually or with no load applied

Before starting the torque transducer measuring, make a trial run at a low speed by turning it manually or with no load applied.

6.2 Reconfirm a proper gap between rings.

While making a trial run as above, make sure the rings do not contact with each other.

Also, for high-precision measurement or operation at high speeds, be sure to confirm the field balancing of the whole measuring system.

6.3 Start the torque transducer measuring.

Push the [POWER] switch to the [ON] position, and the transducer is powered to get ready for measuring while the [POWER] indication LED lights up in red.

Let the switch stay in the [OFF] position when you do not measure.

☆ **Measurement in voltage output**

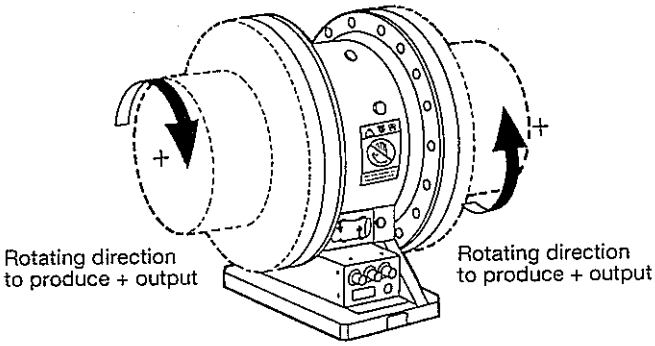
Transducer outputs –

0V against no load affected, and

±10V against a rated torque load

The polarities of torque transducer signals are as follows:

A plus voltage against a clockwise load, and a minus voltage against a counterclockwise load, respectively given to the transducer whose one end is fixed.



☆ **Measurement in current output**

Transducer outputs –

12mA against no load affected, and

4mA or 20mA agasint a rated torque load

The calibration sheet expresses outputs in Span. According to this expression, the torque transducer outputs –

±8mA against a rated torque load

The polarities of torque transducer signals are:

A current output increases (plus in Span expression) against a clockwise load, and

decreases (minus in Span expression) against a counterclockwise load, respectively given to the transducer whose one end is fixed.

☆ **Measurement of number of revolutions**

The transducer outputs 1 pulse signal per one revolution.

7. Handling precautions

7.1 Output against no loads

As shipped, this torque transducer has been so adjusted that it outputs 0V (12mA) against no revolutions and no loads. If this

output value is found to be largely different, it is necessary to perform centering anew and install the transducer avoiding unwanted external forces, thereby reading an approximately 0V.

To perform measurement with a reading value of 0 against no loads, use the zero-shift function provided on an indicator.

7.2 Output against overloading

If a given load exceeds an allowable overload, not only a residual strain causes a drift of the zero point but also serious danger can be caused. Take the utmost care to avoid overloading.

The torque transducer's output saturates against an approximately 110% rated capacity.

Therefore if the reading of an output does not change despite an added load, it is the indication of possible overloading. If this is found, stop giving a torque load and check to be sure that the a given load does not exceed the transducer's rated capacity.

7.3 External noise affected on the torque transducer

The torque transducer's output can be affected by a nearby inverter motor and alike which generates large noise. Take care to place the torque transducer as much apart as possible from a noise source.

If you cannot tell whether or not the driving motor is the source of noise, you may switch the motor off during rotation, thus letting it run by inertia, and you will then know if or not the motor is the problem.

But if a torque load of connected equipment is large, this method will not be of help.

Where noise is affected on the transducer's output, try remedies as follows. Short-circuit the [COM] terminal and [GND] terminal provided on the rear of the amplifier box, or ground the [COM] terminal. Noise can then be reduced occasionally.

7.4 Protection of the rings in transit of the installation

Where the transducer installation has to be moved, make sure to attach the L-shape spacer beforehand so as to prevent contact of the rotatory and stationary rings.

The both rotatory and stationary rings comes with magnets and glass parts. If a solid matter like metal is inserted between the two rings, it can cause damage to them.

Therefore use the accessory L-shape spacer absolutely, in order to protect them against damage.

7.5 Do NOT disassemble the torque transducer.

What you can remove from the torque transducer are the cover, L-shape spacer and the fixture only. Never try disassemble the transducer.

As shipped, the amplifier box has gone under matching adjustment. Therefore if the box is replaced by another, alteration of all this – the zero point, span and temperature characteristics – will take place. As the result, measuring accuracy cannot be guaranteed.

Also note that as shipped, the set screws on the diaphragm coupling have been fixed. If the user loosens or further tightens these screws, it will cause a change in the characteristics, thus disabling it to perform to the specifications. It will also remove screw locking from the screws to allow them to easily loosen, thus leading to danger. Carefully avoid it. If any of these screws is loosened, stop operation and contact your nearest Kyowa respresentative.

7.6 If parts are lost

The torque transducer adopts dedicated parts, in order to ensure its performance. If any of the parts listed below is lost, inform your KYOWA representative of the model name of your torque transducer, names and quantities of the parts that you need.

Do NOT use parts other than the accessories that accompany the transducer. The accessories are:

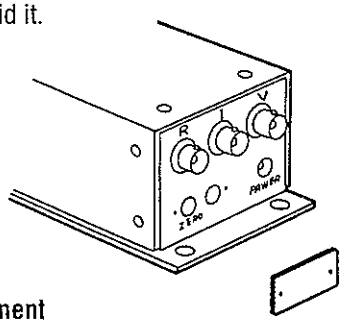
Dedicated bots, Deciated nuts, L-shape spacer,
Cover and Decorative screws used to fasten it, and
Power cable.

7.7 Zero and span adjustment

Zero adjustment

If you desire fine adjustment of a voltage output to 0.000V or that of a current output to 12.00mA, do it as follows. Remove two screws from the acrylic plate on the front of the amplifier box, then remove the plate, and you will gain access to the ZERO control provided in the [ZERO] hole. Properly turn the control with a precision screwdriver.

At this time, take care NOT to turn the [SPAN] control, which is at right next to the [ZERO] control. If turned, it changes the preset calibration value, which is stated in the calibration sheet. Carefully avoid it.



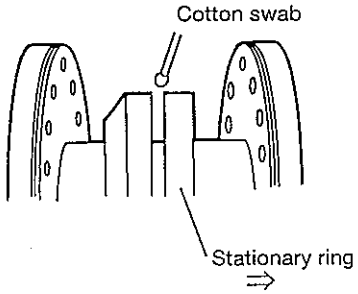
Span adjustment

If fine span adjustment is desired using your own torque calibration system, turn the [SPAN] control. Fine adjustment will then be possible in either side, plus or minus. Once this adjustment has been made, the value stated in the calibration sheet and the specifications as well cannot be guaranteed.

Also, you can no longer restore the [SPAN], which was available when shipped. Note these matters when you turn the [SPAN] control.

7.8 Cleaning the rings.

Both rotatory and stationary rings have light-emitting diodes on the inside. If the light-emitting diodes and the related parts are stained, measuring characteristics may be graded down. In such a case, remove base fixing bolts and move the base and the stationary ring to widen the clearance between the stationary ring and the rotatory ring. Then clean light-emitting diodes and the related parts with an alcoholic cotton swab, taking care not to break them.



8. Reference data

8.1 Spring constant per entire torque transducer, inertia moment and mass of rotatory section

The table below shows the spring constant per entire torque transducer as well as the rotatory section's inertia moment and mass.

	Torsion spring constant (N·m/rad)	Inertia moment ($kg·m^2$)	Mass of rotatory section, approx. (kg)
TPH-50KMA	6.37×10^5	0.032	7.8
TPH-100KMA	1.67×10^6	0.070	13.4
TPH-200KMA	3.04×10^6	0.070	13.4
TPH-500KMA	2.25×10^6	0.120	15.8
TPH-1TMA	7.35×10^6	0.65	36.4
TPH-2TMA	1.47×10^7	0.81	46.7
TPH-4TMA	2.94×10^7	1.58	74.5
TPH-5TMA	4.90×10^7	1.70	94.5

9. Danger

The torque transducer revolves at a high speed, and should therefore be handled with the utmost care to prevent danger.

The user is requested to prepare a steel cover that accommodates the entire torque transducer installation, in order to ensure safety.

WARNING

It is very dangerous to stand in the rotating direction of the transducer or to touch it during rotation. Absolutely avoid it.

10. Specifications

Model	Rated capacity	Resonance frequency, approx.	Max. rotating speed	Mass, approx.
TPH-50KMA	500N·m (50.99kgf·m)	1.0kHz	10000 rpm	10.7kg
TPH-100KMA	1kN·m (102.0kgf·m)	1.0kHz	10000 rpm	15.9kg
TPH-200KMA	2kN·m (203.9kgf·m)	1.4kHz	10000 rpm	15.9kg
TPH-500KMA	5kN·m (509.9kgf·m)	1.5kHz	10000 rpm	18.4kg
TPH-1TMA	10kN·m (1.020tf·m)	1.6kHz	5000 rpm	40kg
TPH-2TMA	20kN·m (2.039tf·m)	1.7kHz	3000 rpm	53kg
TPH-4TMA	40kN·m (4.079tf·m)	2.3kHz	3000 rpm	83kg
TPH-5TMA	50kN·m (5.099tf·m)	2.4kHz	3000 rpm	100kg

Note: Each model has the rated capacity (CAP.) labelled in a conventional unit. For your reference, therefore, the rated capacity in a conventional unit is cited here in parentheses.

Allowable overload
- TPH-50, 100, 200, 500KMA: 150% (however, the output is saturated with an overload of approximately 110%.)
- TPH-1, 2, 4, 5TMA: 120% (however, the output is saturated with an overload of approximately 110%.)

Rated output
- ±10 ±0.02V (with load resistance higher than 10kΩ) and ±8 ±0.04mA (with load resistance lower than 500Ω)
- (4mA for rated capacity in minus – 12mA for zero – 20mA for rated capacity in plus)

Non-linearity
- TPH-50, 100, 200, 500KMA: Within ±0.2%RO
- TPH-1, 2, 4, 5TMA: Within ±0.5%RO

Hysteresis
- TPH-50, 100, 200, 500KMA: Within ±0.2%RO
- TPH-1, 2, 4, 5TMA: Within ±0.5%RO

Repeatability
- TPH-50, 100, 200, 500KMA: 0.1%RO max.
- TPH-1, 2, 4, 5KMA: 0.5%RO max.

Guaranteed temperature range:
- –10 to 60°C (no dew condensation)

Thermal effect on zero: Within ±0.03%RO/°C
Thermal effect on output: Within ±0.03%/°C
Frequency response of amplifier: DC to 1kHz, within +1, –3dB
SN ratio: Better than 50dB p-p (noise lower than 60mV p-p)
Power requirement: 90 to 240V AC

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