OPERATION MANUAL

Torque sensor
Model 8625

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Note:

Components, devices and measured value sensors made by burster präzisionsmesstechnik (hereinafter referred to as "product") are the results of targeted development and meticulous research. As of the date of delivery, burster provides a warranty for the proper condition and functioning of these products covering material and production defects for the period specified in the warranty document accompanying the product. However, burster excludes guarantee or warranty obligations as well as any liability beyond that for consequential damages caused by improper use of the product, in particular the implied warranty of success in the market as well as the suitability of the product for a particular purpose. Furthermore, burster assumes no liability for direct, indirect or incidental damages as well as consequential or other damages arising from the provision and use of the present documentation.

Warning!

The following instructions must be observed to prevent injuries:

- ➔ Observe all safety notices, instructions and regulations
- ➔ Safety equipment must be in working order during operation
- ➔ The sensor must only be used if it is undamaged

Caution!

The following points must be observed to prevent injuries and damage to property:

- ➔ Avoid excessive torques, bending moments or axial forces.
- ➔ Protect the sensor from knocks.
- ➔ Make electrical connections to sensor during fitting. Check the measurement signal. It must stay within the permitted range.
- ➔ Support the sensor while it is being fitted.
- ➔ Avoid dropping the sensor.
- ➔ When measuring dynamic torques, operating the sensor close to natural resonance will result in permanent damage.
- ➔ The frequency of dynamic torques must lie below the natural frequency of the mechanical test setup.
- ➔ Limit the peak-to-peak variation of dynamic torques to 70 % of the rated torque.

Contents

1. Introduction

1.1 Intended use

Torque sensors are designed to measure torques. This measured quantity is suitable for open-loop and closed-loop control functions.

The torque sensor 8625 is **no** safety component.

Transport and store the sensors correctly.

The device must be fitted, commissioned, operated and removed properly.

Always follow the applicable regulations and safety instructions.

1.2 Personnel

The device must be set up, fitted, commissioned, operated and removed solely by qualified personnel. Personal must be familiar with regulations and safety instructions and must be able to apply them.

1.3 Conversions and modifications

We will not accept liability for any change to the sensor without our written agreement.

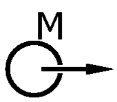
1.4 Terms

Measurement end

The measurement end is the mechanical connection of the torque sensor in which the torque to be measured is induced.

This end normally has the smaller moment of inertia.

A pictogram identifies the measurement end of the sensor.



or

M

Drive end

The drive end is at the opposite end from the measurement end and is used as a mechanical connection of the torque sensor.

This end normally has the larger moment of inertia. For non-rotating torque sensors, the case is fixed to this end.

Unfixed end

The "unfixed end" refers to the shaft of the arrangement (drive, load). You must be able to move this shaft with a torque that is far lower than the rated torque of the sensor.

i.e.

$$M \ll M_{nenn}$$

The torque direction

A torque is designated a clockwise torque if the torque acts in a clockwise direction when looking towards the shaft end. In this case you obtain a positive electrical signal at the sensor output.

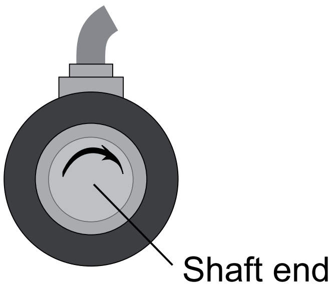


Figure 1: Torque, clockwise (looking towards the drive end)

You can use model 8625 torque sensors to measure both clockwise and counterclockwise torques.

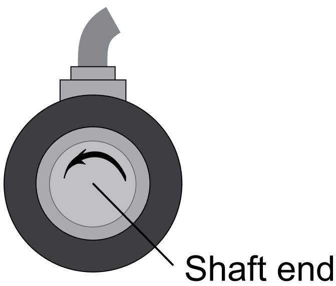


Figure 2: Torque, counterclockwise (looking towards the drive end)

2. Preparations for use

2.1 Transport and unpacking

- Only transport the model 8625 sensors in their original packaging or in packaging of equivalent quality.

  The sensor must not be able to move within the packaging.

- Protect the sensor from damp.
- Inspect the sensor carefully for damage when removing from the packaging.

  If you suspect that the unit has been damaged during shipping, notify the delivery company within 72 hours. Keep all packaging materials for inspection by the representative of the manufacturer or delivery company.

2.2 Storage

- Oil shafts and flanges lightly before storage.
- Pack the sensor in a clean piece of film.
- The sensor must only be stored in the following conditions:
  - dry
  - no condensation
  - no dust

3. Principle of operation

3.1 Mechanical structure

The sensor does not contain any rotating parts.

It comprises a torsion bar having shaft ends. The strain gauges are mounted on this torsion bar.

This arrangement is protected by a case that also carries the electrical connector or cable connection.

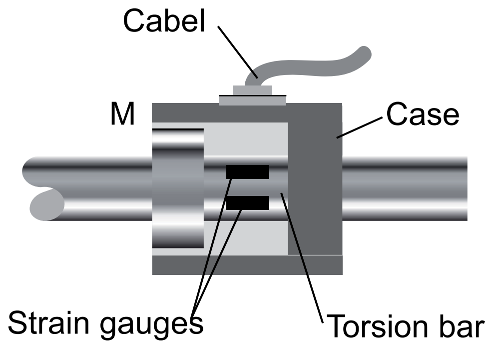


Figure 3: mechanical design of the sensor

3.2 Electrical design

The connections from the strain gauge full-bridge are taken directly to the electrical connector or the cable.

Sensors in the 8625 series include an optional check function.

This check function uses an external switch to shunt the strain gauge full-bridge so that it outputs a positive measurement signal that is equivalent to the rated torque.

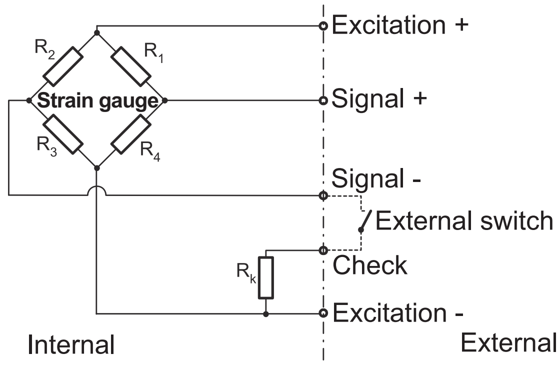


Figure 4: Circuit diagram of the strain gauge full-bridge with the "check" option

4. Installation

4.1 Mechanical installation

Caution!

Damage from excessive torques, bending moments or axial forces.

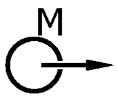
Support the sensor while it is being fitted. Avoid dropping the sensor.

Make electrical connections to sensor during fitting. Check the measurement signal. It must stay within the permitted range.

- Make sure you fit the sensor the correct way round.

  The case is attached to the **drive end** of the sensor.

  One of these pictograms identifies the **measurement end** of the sensor:



or

M

If you get the ends mixed up you must expect the following effects:

- In this case the cable connection affects the measurement.
- In this case the inertial masses of the case affect the measurement.

4.1.1 Alignment

- Before installation, align the shafts of the measurement arrangement.

  This avoids any unnecessarily high reaction forces, while also reducing the load on the coupling and any spurious forces acting on the sensor.

  It is often adequate to use a straight edge to align the arrangement in two mutually perpendicular planes.

4.1.2 Couplings

- For the 8625 series torque sensors use couplings that can correct an axial, radial and angular misalignment of the shafts.

  These couplings must protect the sensor from large forces.

Alignment options using half couplings

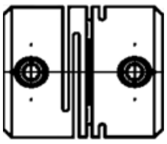


Figure 5: Half coupling

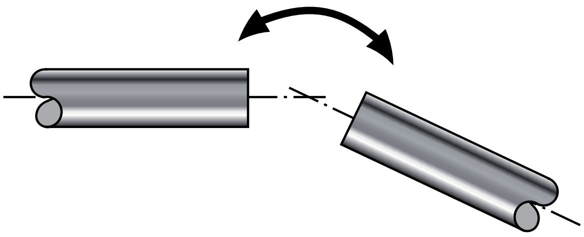


Figure 6: angular misalignment

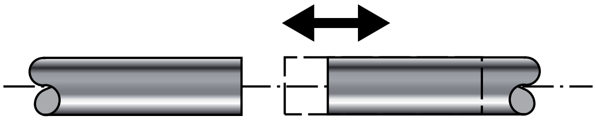


Figure 7: axial misalignment

Note:

Radial misalignments can only be corrected using the combination half coupling - torque sensor (as center piece) - half coupling.

In this arrangement, the torque sensor and the two half couplings form a full coupling.

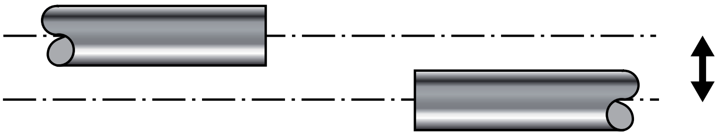


Figure 8: radial misalignment

If you wish to correct a radial misalignment using half couplings, you must use this arrangement:

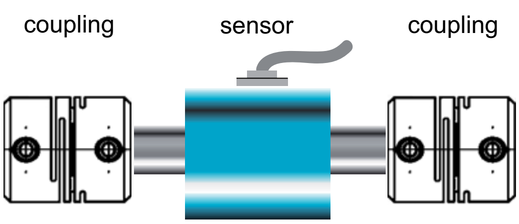


Figure 9: This is the only way to correct a radial misalignment using half couplings.

Alignment options using full couplings

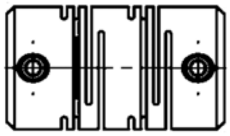


Figure 10: Full coupling

You can use full couplings to correct angular, axial and radial misalignments of the shafts.

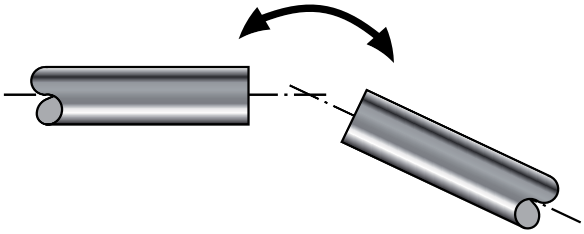


Figure 11: angular misalignment

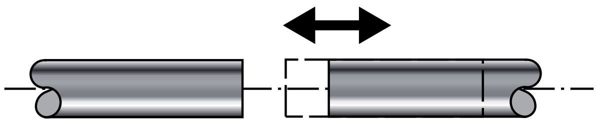


Figure 12: axial misalignment

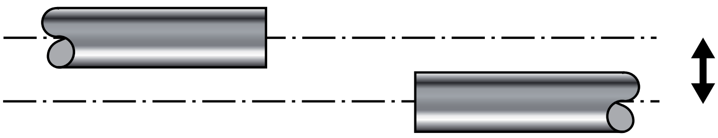


Figure 13: radial misalignment

4.1.3 Shaft connection: general information

- Before installation, clean the shafts using a solvent such as acetone.

  There must be no foreign matter on the shafts when fitted.

- Provide a collar with the correct fit for the connection.

If you are using clamping elements for connecting the shafts:

- Only use clamping elements that provide reliable transmission of the torques that arise.

4.1.4 Shaft connection: sensors with 0.005 Nm to 0.02 Nm range

Note:

Sensors with small rated torques are very sensitive to any overload. Handle these sensors with the necessary care.

- Connect up the sensor electrically.
- Check the signal output from the sensor throughout fitting.

  This signal must always remain within the permitted range.

- Before installation, clean the shafts using a solvent such as acetone.

  There must be no foreign matter on the shafts when fitted.

- Then slide the coupling onto the shaft.

  The coupling must be able to slide easily onto the shaft.

- Initially fit all parts together **loosely**.
- Align the shafts of the measurement arrangement precisely.

  This avoids any unnecessarily high reaction forces, while also reducing the load on the coupling and any spurious forces acting on the sensor.

  It is often adequate to use a straight edge to align the arrangement in two mutually perpendicular planes.

When you have aligned all the parts correctly:

- Assemble the sensor tightly together, except the shaft.
- Then clamp the coupling onto the shaft.

  Observe the following points when clamping the coupling:

  - If possible start with the "unfixed end".
  - Hold screws from the other end when tightening.
  - Be aware of the maximum forces that you apply. The resultant torques must lie below the rated torque of the sensor. The relevant values are listed below.

Maximum forces

The maximum forces for the sensor are shown below for a lever of length "r":

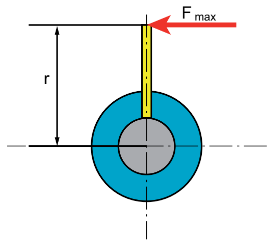


Figure 14: F_{max} applied at a distance "r" from the shaft axis

Sensor rated torque	F_{max} for r = 5 mm	F_{max} for r = 10 mm	F_{max} for r = 20 mm
0.005 Nm = 5 Nmm	1 N	0.5 N	0.25 N
0.01 Nm = 10 Nmm	2 N	1 N	0.5 N
0.02 Nm = 20 Nmm	4 N	2 N	1 N

These forces are equivalent to the weight exerted by a mass of:

Force		equivalent to the weight exerted by the mass
0.25 N	≙	25 g
0.5 N	≙	50 g
1 N	≙	100 g
2 N	≙	200 g
4 N	≙	400 g

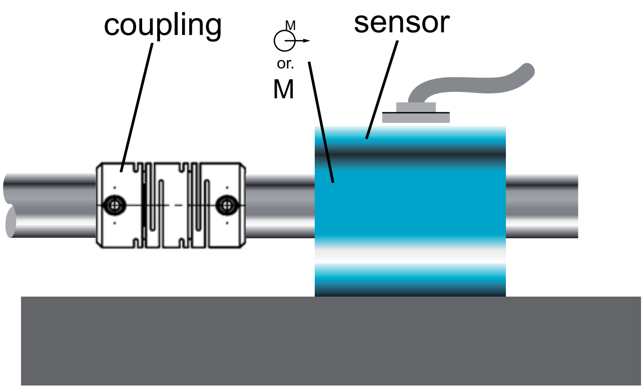


Figure 15: Mounting example: sensor supported on the case with the torque induced via a full coupling

4.1.5 Shaft connection: sensors with 0.05 Nm to 10 Nm ranges

Note:

The sensors are very sensitive to overload. Handle these sensors with the necessary care.

- Connect up the sensor electrically.
- Check the signal output from the sensor throughout fitting.

  This signal must always remain within the permitted range.
- Before installation, clean the shafts using a solvent such as acetone.

  There must be no foreign matter on the shafts when fitted.
- Initially fit all parts together **loosely**.
- Align the shafts of the measurement arrangement precisely.

  This avoids any unnecessarily high reaction forces, while also reducing the load on the coupling and any spurious forces acting on the sensor.

  It is often adequate to use a straight edge to align the arrangement in two mutually perpendicular planes.

When you have aligned all the parts correctly:

- Fit the sensor first at the unfixed end.

  Just use hand to apply opposing force.
- Then fit the sensor at the drive end.

  Just use hand to apply opposing force.

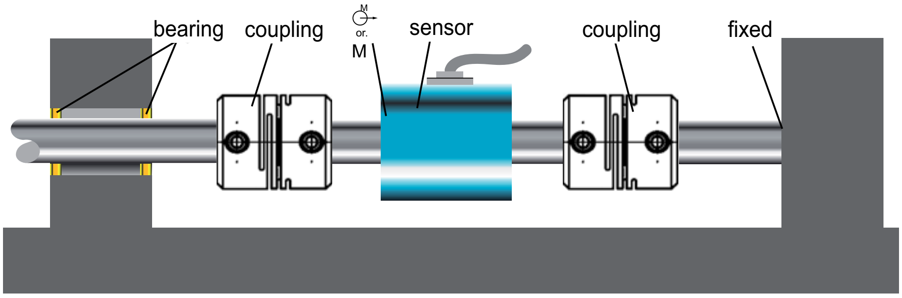


Figure 16: Mounting example: uncovered sensor between two half couplings

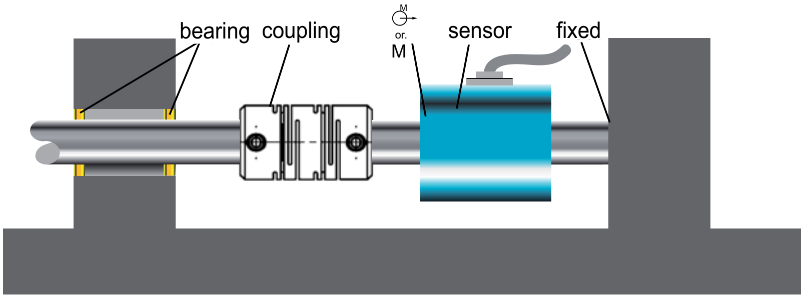


Figure 17: Mounting example: uncovered sensor with full coupling

Maximum forces

The maximum forces for the sensor are shown below for a lever of length "r":

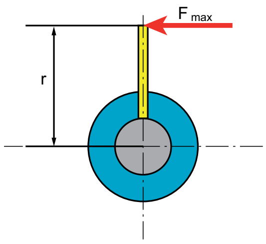


Figure 18: F_{max} applied at a distance "r" from the shaft axis

Sensor rated torque	F_{max} for r = 10 mm	F_{max} for r = 20 mm	F_{max} for r = 50 mm
0.05 Nm	5 N	2.5 N	1 N
0.1 Nm	10 N	5 N	2 N
0.2 Nm	20 N	10 N	4 N
0.5 Nm	50 N	25 N	10 N
1 Nm	100 N	50 N	20 N

4.1.6 Shaft connection: sensors with ranges greater than 20 Nm

If you are connecting the shafts using a clamping device

- Use a suitable clamping device
- Observe the specification given by the manufacturer of the clamping device.

In general:

The shafts must have an appropriate fit for the connection.

- Connect up the sensor electrically.
- Check the signal output from the sensor throughout fitting.

  This signal must always remain within the permitted range.
- Before installation, clean the shafts using a solvent such as acetone.

  There must be no foreign matter on the shafts when fitted.
- Initially fit all parts together **loosely**.
- Align the shafts of the measurement arrangement precisely.

  This avoids any unnecessarily high reaction forces, while also reducing the load on the coupling and any spurious forces acting on the sensor.

  It is often adequate to use a straight edge to align the arrangement in two mutually perpendicular planes.

When you have aligned all the parts correctly:

- Fit the sensor first at the unfixed end.

  Just use hand to apply opposing force.
- Then fit the sensor at the drive end.

  Just use hand to apply opposing force.

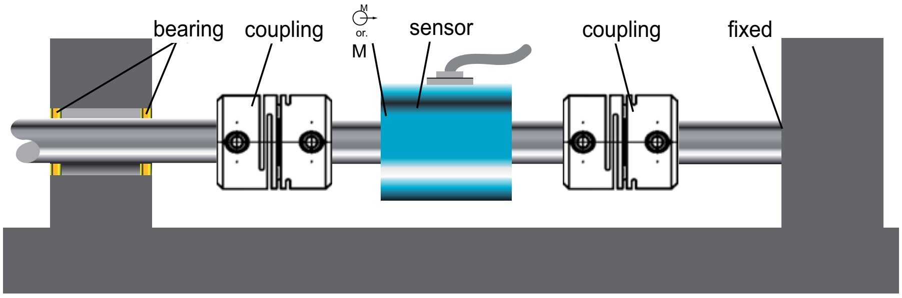


Figure 19: Mounting example: uncovered sensor between two half couplings

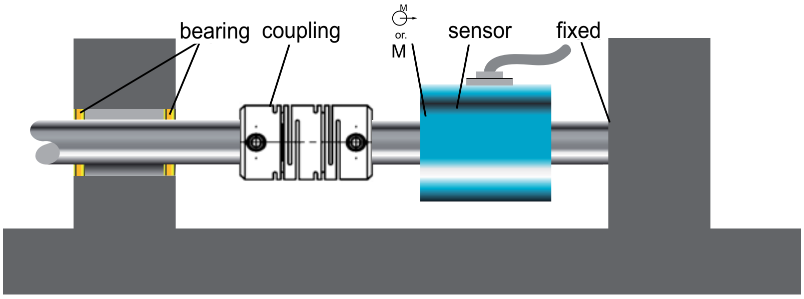


Figure 20: Mounting example: uncovered sensor with full coupling

4.2 Electrical connection

4.2.1 Pin-out of the electrical socket

6-pin connector

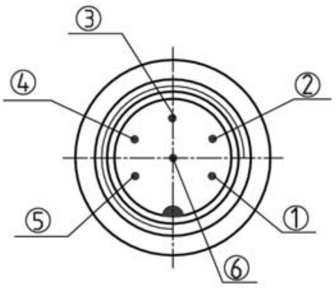


Figure 21: view from the solder side

6-pin electrical socket	Function
1	Sensor excitation (-)
2	Sensor excitation (+)
3	Shield
4	Sensor signal (+)
5	Sensor signal (-)
6	Check (option)

7-pin connector

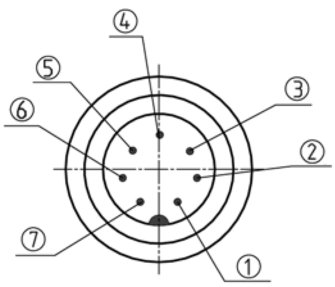


Figure 22: view from the solder side

7-pin electrical socket	Function
1	Sensor excitation (-)
2	Sensor excitation (+)
3	Shield
4	Sensor signal (+)
5	Sensor signal (-)
6	Check (option)
7	NC

4.2.2 Cable

- Always use shielded cable with as low a capacitance as possible.

  burster can supply cables that have been tested with our sensors and satisfy instrumentation requirements.

Relationship between sensitivity and cable length

Note:

With extension cables, the sensor sensitivity is affected by the cable length as a function of the bridge resistance and the conductor cross-section. So always order extension cables at the same time as the sensor. Get the sensor calibrated with the extension cables.

You must take into account both excitation conductors for the sensor when calculating the cable resistance.

i.e.

Kabelwiderstand = 2 x Widerstand der Kabellänge

burster präzisionsmesstechnik calibrates sensors in combination with the cable length ordered. In this case you do not need to take the cable length into account.

Difference per meter of cable length

Conductor cross section	Cable resistance per m	for bridge resistance 350 Ω	for bridge resistance 700 Ω	for bridge resistance 1000 Ω
0.14 mm²	0.28 Ω	0.08 %	0.04 %	0.028 %
0.25 mm²	0.16 Ω	0.046 %	0.023 %	0.016 %
0.34 mm²	0.12 Ω	0.034 %	0.017 %	0.012 %

4.2.3 Connecting the shield

The shield together with the sensor and the external electronic circuitry form a Faraday cage. Thanks to this cage, electromagnetic interference usually does not affect the measurement signal.

If, however, problems still arise with potential differences:

- Ground the sensor

4.2.4 Positioning the measurement cable

- Place the cable far enough away from high-power equipment.

  These include transformers, motors, contactors, frequency converters and so forth. Otherwise the electromagnetic fields from such equipment will act with their full effect on the measuring chain, causing incorrect measurements.

- Lay the instrument cables separately from signal lines and power cables.

  If the measuring lines are laid parallel to such cables, interference will be coupled in inductively and capacitively.

In some cases it will be helpful to place an extra shield as additional protection over the measuring cable, or to lay it in a grounded metal tube or pipe.

5. Calibration

The torque sensors from burster präzisionmesstechnik are already traceably adjusted and tested in the factory. As an option we offer manufacturer calibration of the sensor.

5.1 Manufacturer calibration

The manufacturer calibration involves checking sensor data against traceably calibrated measuring instruments. A range of measurement points are taken in this calibration.

Manufacturer calibration produces a calibration report

5.2 DKD calibration

DKD calibration involves calibrating the sensor in accordance with DKD directives in a calibration laboratory monitored by the DKD. With this calibration we define the measurement uncertainty of the sensor.

Please contact us for further information.

5.3 Recalibration

- Recalibrate the sensor after 26 months at the latest.

  Shorter intervals are recommended in the following cases:

  - sensor overload
  - after repair
  - after improper use of the sensor
  - when required by quality standards
  - where there is a specific traceability requirement

6. Measurement

6.1 Switching on

- Let the sensor warm up for about 5 minutes.

6.2 Torque direction

A torque is designated a clockwise torque if the torque acts in a clockwise direction when looking towards the shaft end. In this case you obtain a positive electrical signal at the sensor output.

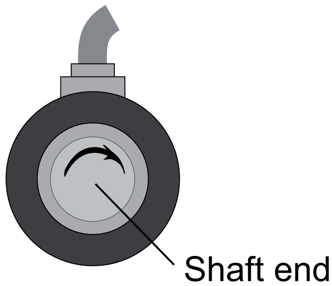


Figure 23: Torque (looking towards the drive end)

You can use model 8625 torque sensors to measure both clockwise and counterclockwise torques.

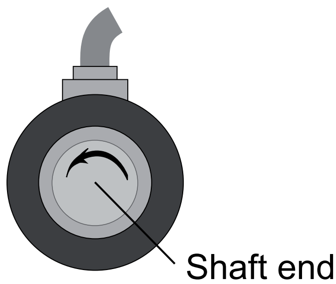


Figure 24: Torque, counterclockwise (looking towards the drive end)

6.3 Static / quasi-static torques

A static or quasi-static torque does not change or changes only slowly. This torque can assume any value up to the rated torque of the sensor.

6.4 Dynamic torques

Caution!

Operating the setup close to the natural resonance results in permanent damage.

The frequency of torques must lie below the natural frequency of the mechanical test setup.

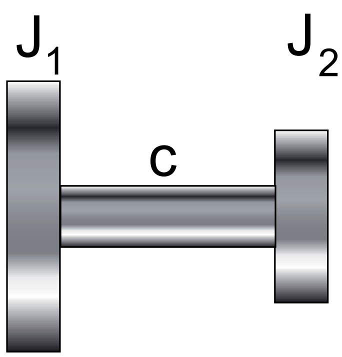
Limit the peak-to-peak torque variation to 70 % of the rated torque.

The calibration applies to measurements of both static and dynamic torques.

6.4.1 Estimating the mechanical natural frequency

$$f_0 = \frac{1}{2 \cdot \pi} \cdot \sqrt{c \left(\frac{1}{J_1} + \frac{1}{J_2} \right)}$$

f_0:	Natural frequency in Hz
J_1:	Moment of inertia 1 in kg m^2
J_2:	Moment of inertia 2 in kg m^2
c:	Torsional rigidity in Nm / rad



The Holzer method, for example, is another way of calculating the natural frequencies.

6.5 Interference

Interference is particularly likely to produce measurement errors for small torques.

Forms of interference include:

- Vibrations
- Air movements for small torques
- Temperature gradients
- Temperature changes
- Electrical interference
- Magnetic interference
- EMC (electromagnetic interference)

Remedy

- ➢ Take suitable measures to exclude interference, such as covers or vibration de-couplers.

6.6 Option: Check function

If your sensor includes this function you can check the sensor at the press of a button.

Note:
Only use the calibration check when the sensor is not under load.

To check the sensor:

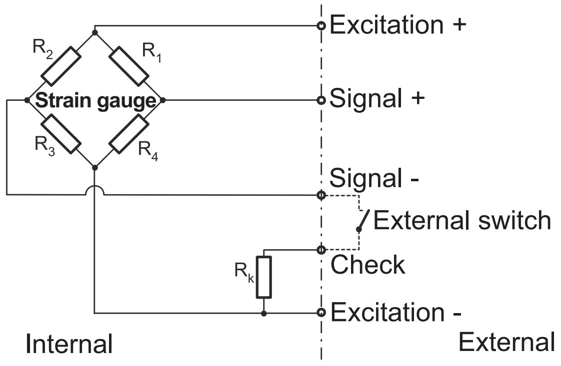
- ➢ Close the check switch.

  After the switch is closed, the sensor generates a signal equal to its rated value.

Benefits:

- You can use the check function to reduce the number of recalibrations.
- You can check the zero point and the rated value before every measurement.

Function:



Applying the positive strain gauge excitation voltage adjusts the measuring bridge electrically so that a measurement signal is output that equals 100 % of the rated value.

50 % and 80 % are also possible as an option.

7. Maintenance

7.1 Maintenance schedule

Action	Frequency	Date	Date	Date
Check cable and connector	1x annually			
Calibration	< 26 months			
Check the fitting (flange, shafts)	1x annually			

7.2 Troubleshooting table

This table contains the most common faults and corrective actions.

Fault	Possible cause	Remedial action
No signal	No power excitation	Connect excitation
	Outside permitted range	Check excitation
	No mains excitation	Connect excitation
	Cable faulty	Repair cable
	Signal output not connected correctly	Connect output correctly
	Electronic evaluation circuit faulty	Repair / replace
Sensor does not respond to torque	Shaft not clamped	Clamp correctly
	No power excitation	Connect excitation
	No mains excitation	Connect excitation
	Outside permitted range	Check excitation
	Cable faulty	Repair cable
	Connector not connected correctly	Connect correctly
Signal drops out	Cable faulty	Repair cable
Zero point out of tolerance	Cable faulty	Repair cable
	Shaft twisted when fitted	Fit correctly
	Shaft line twisted	Release twist
	Strong lateral forces	Reduce lateral forces
	Shaft overloaded	Return sensor to manufacturer
Torque reading incorrect	Calibration not correct	Recalibrate
	Sensor faulty	Get manufacturer to repair it
	Torque bypass	Remove bypass
Torque fluctuations	Vibrations	De-couple vibrations
	Air movements	Fit cover

8. Taking out of use

- Remove the sensors correctly.
- Protect the sensor from knocks.
- Protect the sensor from bending moments e.g. from levers.
- Support the sensor.
- Avoid dropping the sensor.

9. Disposal

- Observe the relevant regulations.