OMEGA ENGINEERING, INC.
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Operating Instructions

Rotary Torque Transducer

Model TQ 503 (with standard square connections)
Model TQ 503 X (including rangle measurement)
Model TQ 503 R (with shaft ends)

Operating Instructions no. 1333
Model TQ 503

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Contents

See datasheet for technical details.

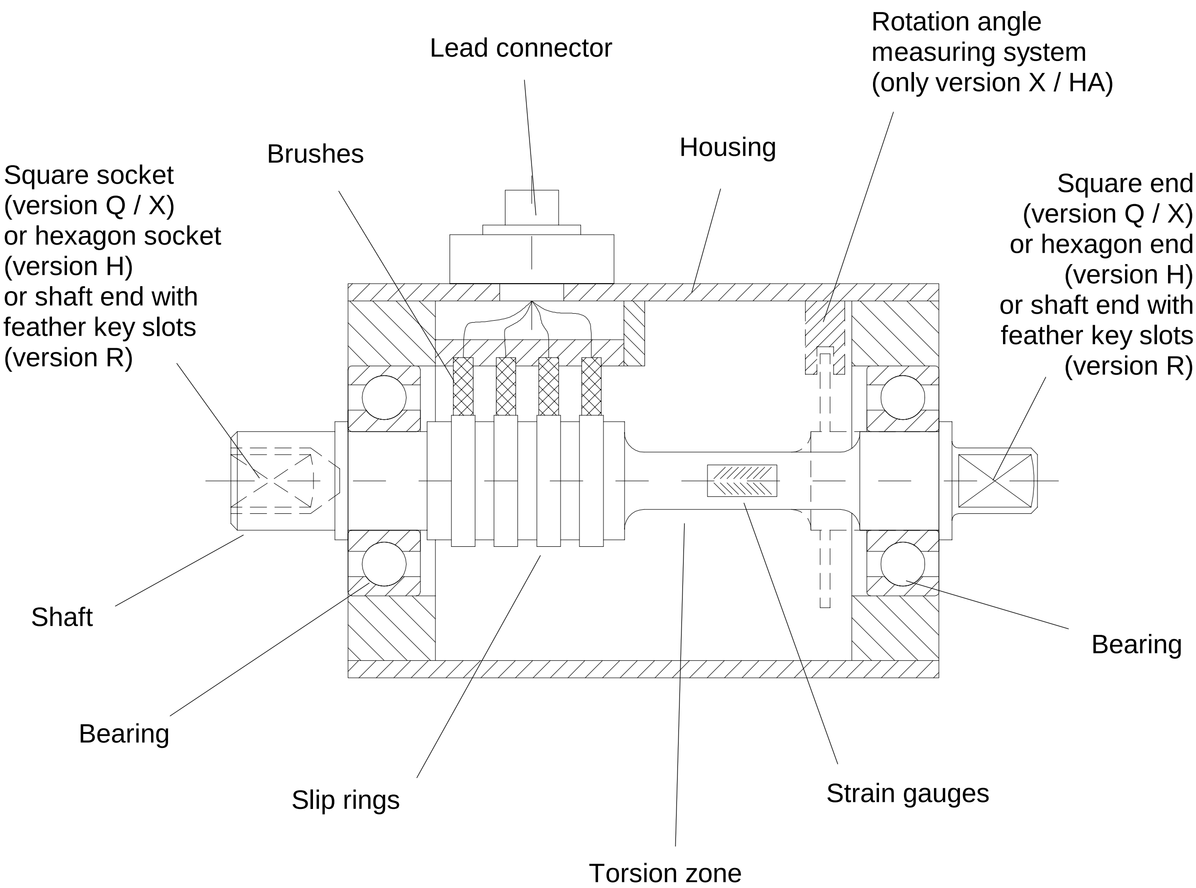
2. Application and key features

- Torquemeter with strain gauges
- Signal transfer by sliprings
- Measurement of constant and variable torque
- Measurement of torque from the rotating shaft
- Integrated system for rotation angle measurement (only version X)
- Suitable for laboratory use and quality control
- Ideal for use with power tools
- Primarily suitable for low speed ranges
- Suitable for momentary measurement of torque (intermittent duty)

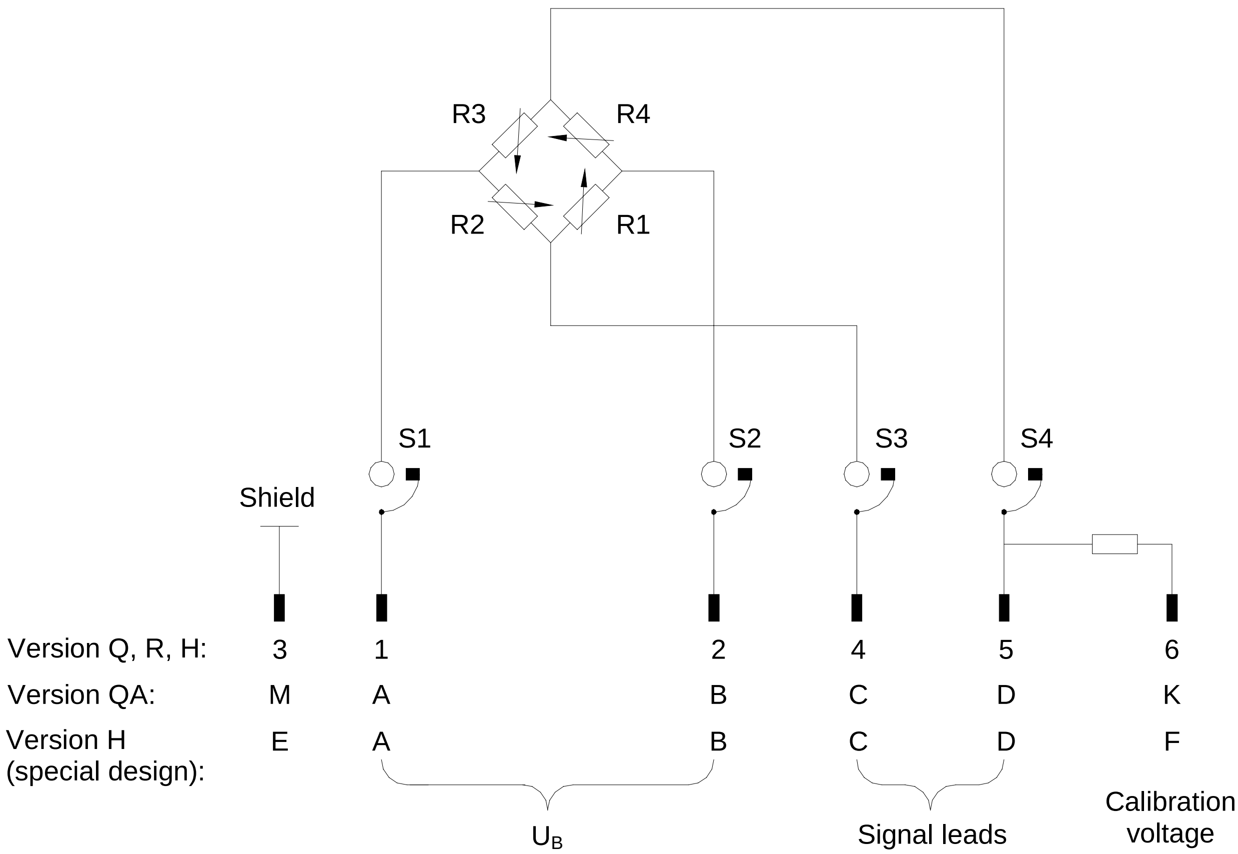
3. Description

3.1 Mechanical design

Torquemeters type SD comprise a rotating shaft mounted on bearings inside a housing. The shaft has a necked section - called the torsion zone - to which strain gauges are attached and connected in a full bridge circuit. Sliprings and brushes provide the link between rotor and housing with two sliprings carrying the electric power supply to the strain gauges on the rotating shaft. Two other sliprings serve to transfer the measuring signals from the rotating shaft to the stationary housing. The full bridge circuit is connected directly through the sliprings and brushes to the lead connector which is mounted on the housing of the torquemeter.
In version X torquemeters an optical rotation angle measurement system is integrated. It consists of a pulse disk on the rotating shaft with 360 light-dark stripes. Two light barriers are installed into the stator. Inside the torquemeter there is a small electronics for processing of the angle pulses.



3.2 Electrical design



- R1 ... R4 = Gauges for measuring mechanical strain
- S1 ... S4 = Sliprings with brushes

3.3 Rotation angle measuring system (only version X)

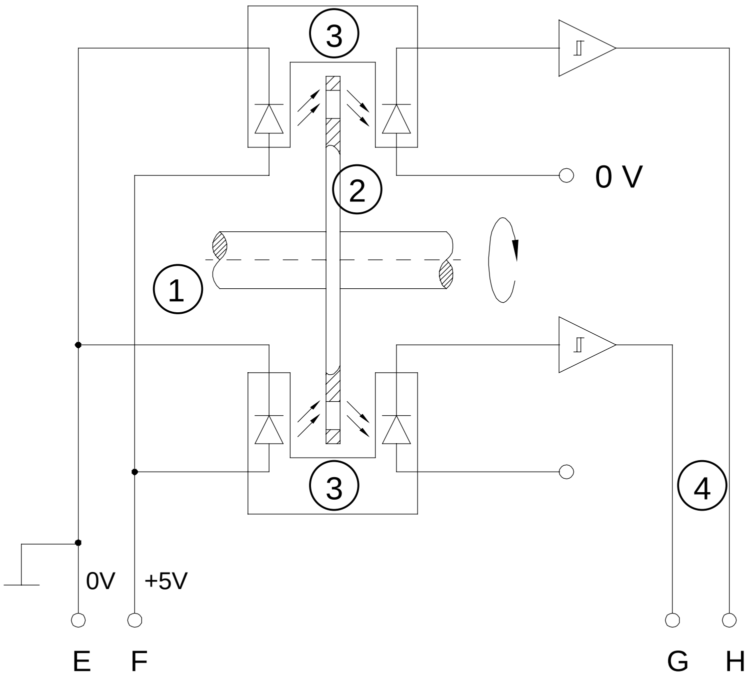


Diagram showing the design of the rotation angle measuring system

1 rotating shaft

2 pulse disk

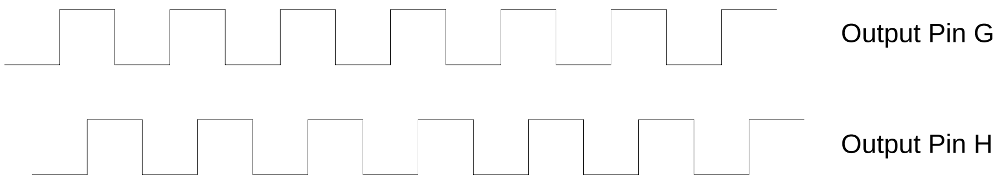
3 forked light barrier with LED and photo diode

4 operation amplifier

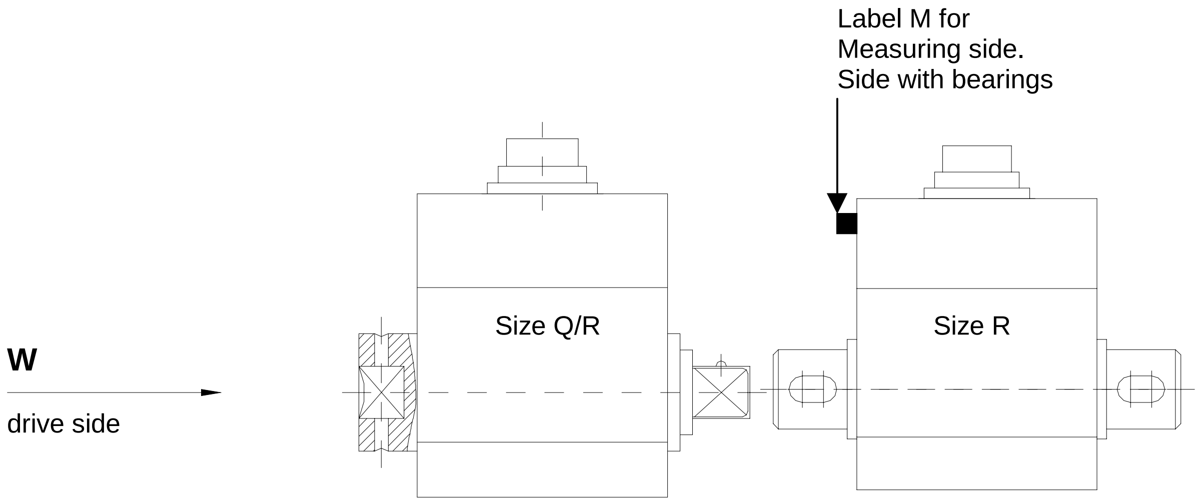
Features

- 360 light-dark stripes on the pulse disk
- two forked light barriers shifted by phase angle 90°
- pulse number proportional to the rotation angle

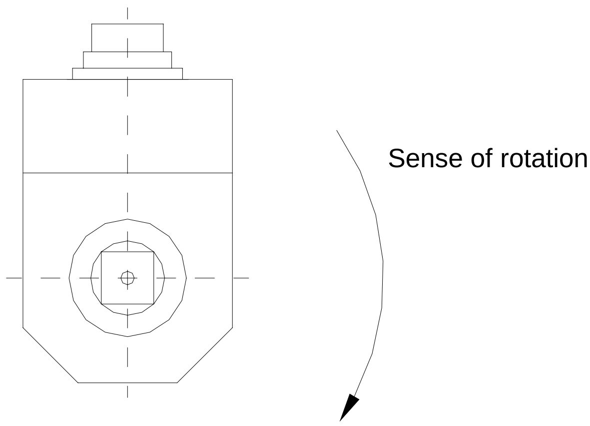
Adjustment for angle-pulse output (only version X)



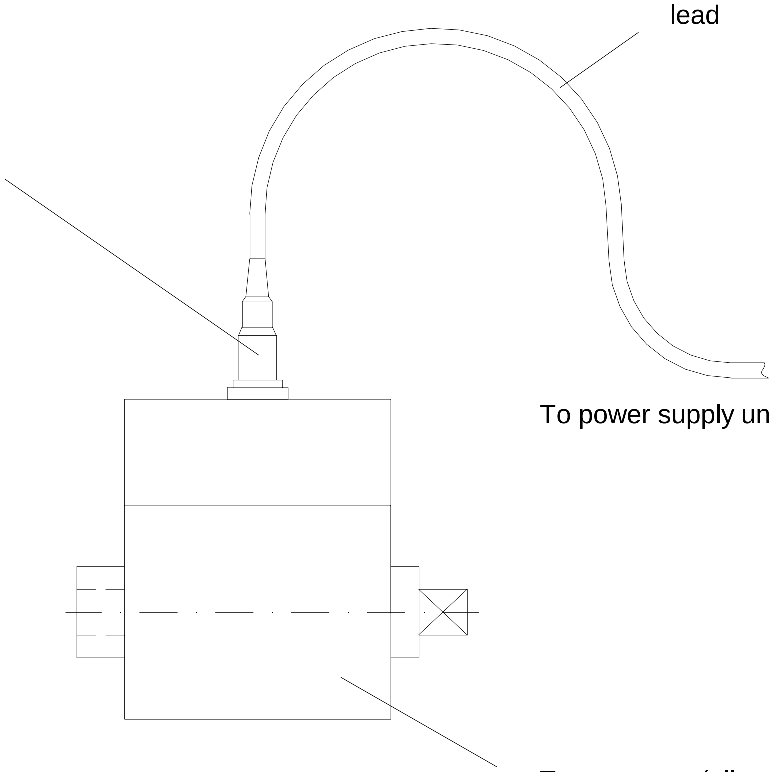
with drive on square socket
sense of rotation cw



View W:



4. Electrical connections



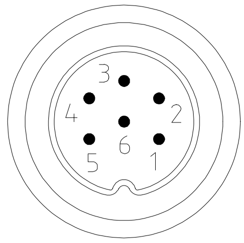
- Shielded lead of 0,25 mm² (version X: 0.14 mm²) cross section
- Factory-calibrated with 5 m of lead. A change in length of 2.5 m will cause an error of approximately 1 %

4.1 Description of interfaces

Versions Q / R / H:

Function	Pin	Description
- Power supply	1	e.g. -6 V DC
+ Power supply	2	e.g. +6 V DC
Shield	3	not connected
+ Signal	4	2 mV/V approx. 350 Ω *)
- Signal	5	2 mV/V approx. 350 Ω *)
- Power supply (Calibration voltage)	6	100% calibration causes 100% signal

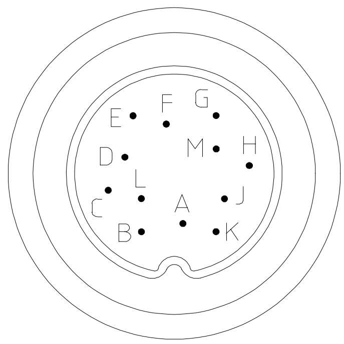
Top view built-in plug



Version X:

Function	Pin	Description
- Power supply	A	Strain gauge full bridge
+ Power supply	B	
+ Signal	C	
- Signal	D	
0 V	E	Rotation angle pulses
+ 5 V ± 10 %	F	
Pulse l, leading, TTL	G	
Pulse r, lagging, TTL	H	
0 V	I	
- Power supply (Calibration voltage)	K	100% calibration causes 100% signal
Shield	M	not connected

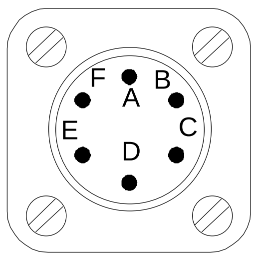
Top view built-in plug



Version H (special design):

Function	Pin	Description
+ Power supply	A	e.g. +6 V DC
- Power supply	B	e.g. -6 V DC
- Signal	C	e.g. 2 mV/V approx. 350 Ω *)
+ Signal	D	e.g. 2 mV/V approx. 350 Ω *)
Shield	E	not connected
- Power supply (Calibration voltage)	F	100% calibration causes 100% signal

Top view built-in plug



*) customized, see calibration certificate

4.2 Installing the signal lead

- Do not run the lead parallel to power cables or control circuits.
- Do not place the lead close to equipment producing strong electromagnetic fields, e.g. transformers, welders, contactors, electric motors, etc.
- If such situations cannot be avoided, run the lead inside earthed steel conduit.
- Make a loop in the lead when fixing it at the torquemeter so that it is not damaged by vibration.

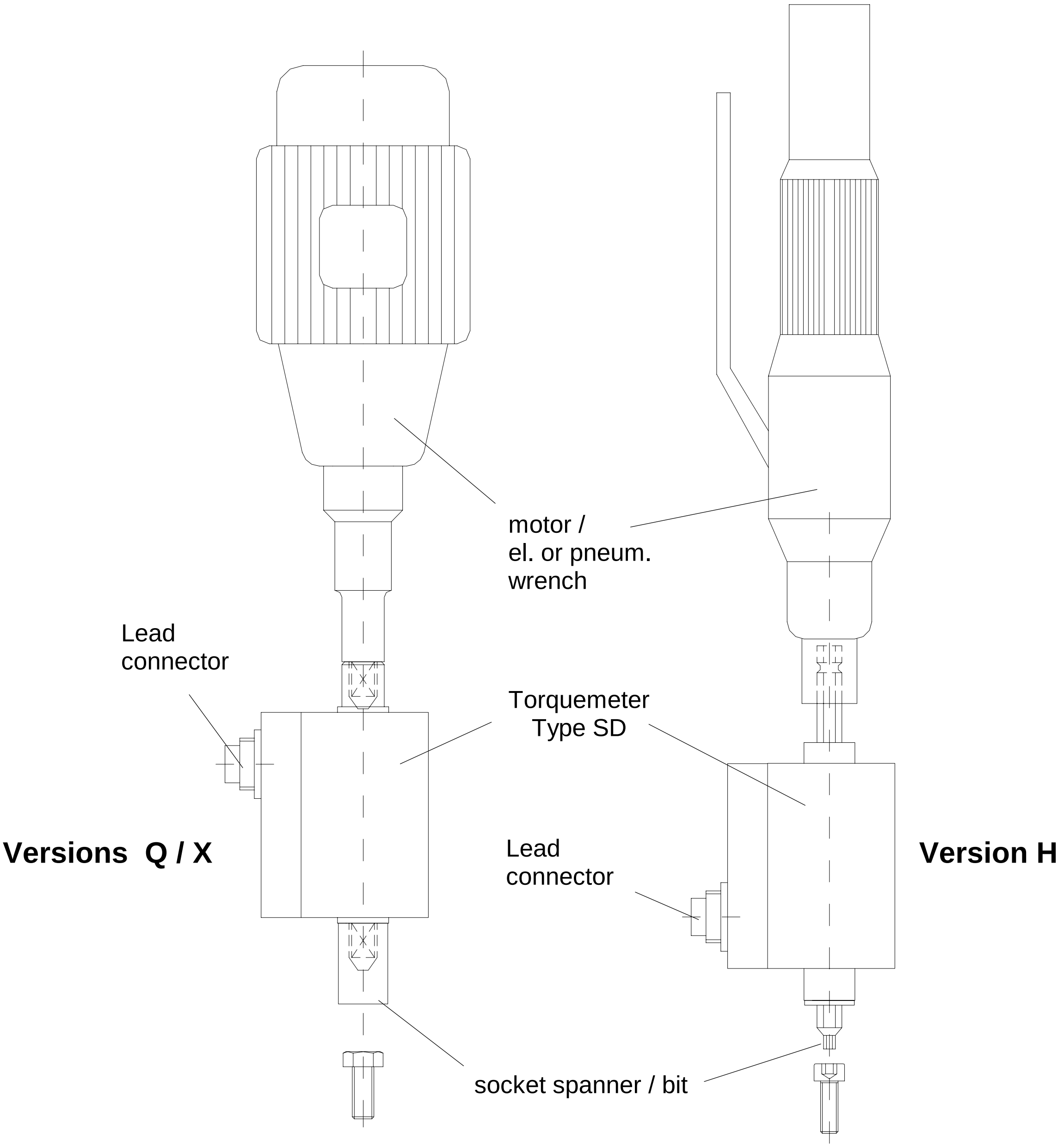
5. Using the torquemeter

5.1 Versions Q, X and H

- Torquemeters of version Q and X have square connections for plug-in tools acc. to DIN 3121
- Torquemeter of version H have hexagon connections acc. to DIN 3126, form E/F.

- The torquemeters are plugged on to the drive spindle as shown below.

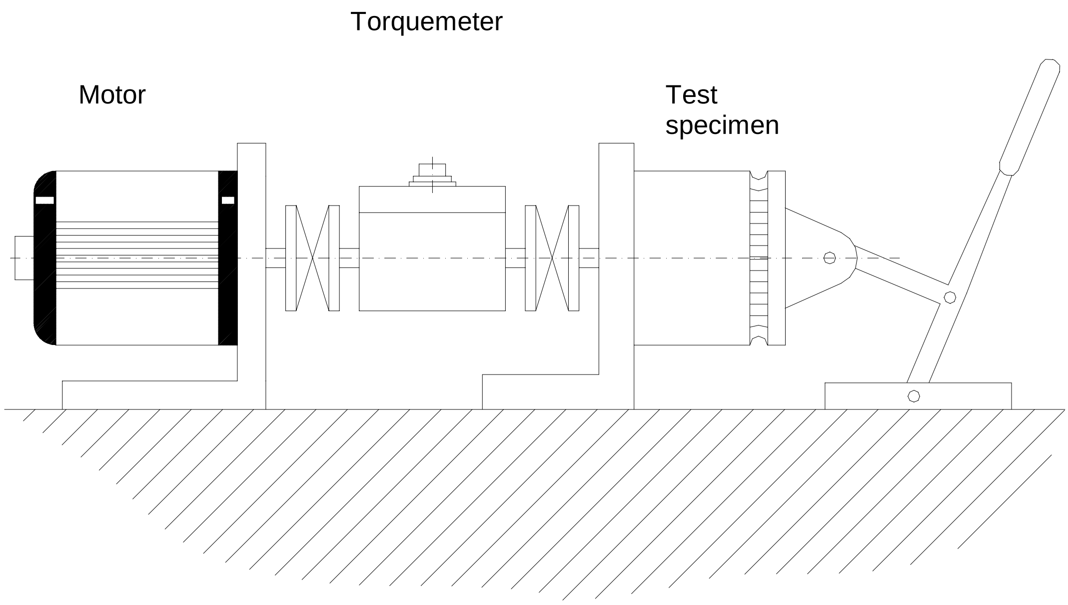
Application examples:



5.2 Version R

- The torquemeter is adapted to th measuring application by couplings.
- For a free floating installation we recommend two torsioally rigid half couplings.

Application example:



6. Static calibration

This procedure requires the use of a calibration device with a lever arm and weights for producing specific values of torque.

The calibration procedure is as follows:

a) Apply the rated value of torque to the torquemeter and then remove it again.

b) Adjust the zero reading accurately.

c) Apply a known value of torque to the torquemeter.

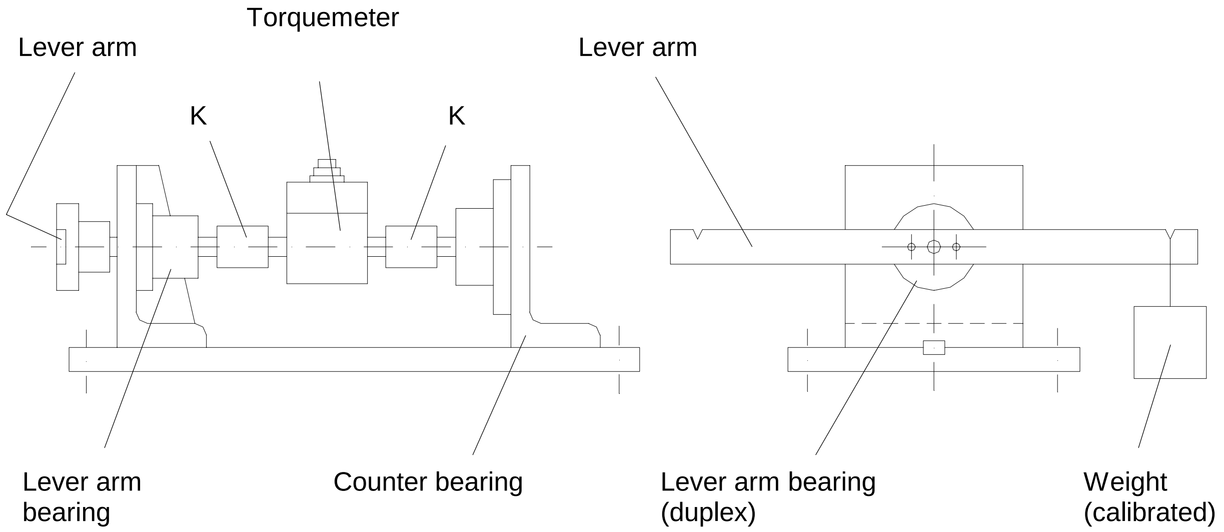
d) Adjust the displayed reading to the corresponding value.

Plotting a calibration curve

a) Calibrate the torquemeter as described above.

b) Apply torque in 1/10 steps up to the full rated value and then remove it again in the same way. A delay of at least 30 seconds must be allowed between the individual 1/10 steps so that each reading can stabilize before it is recorded.

6.1 Making a simple calibration device

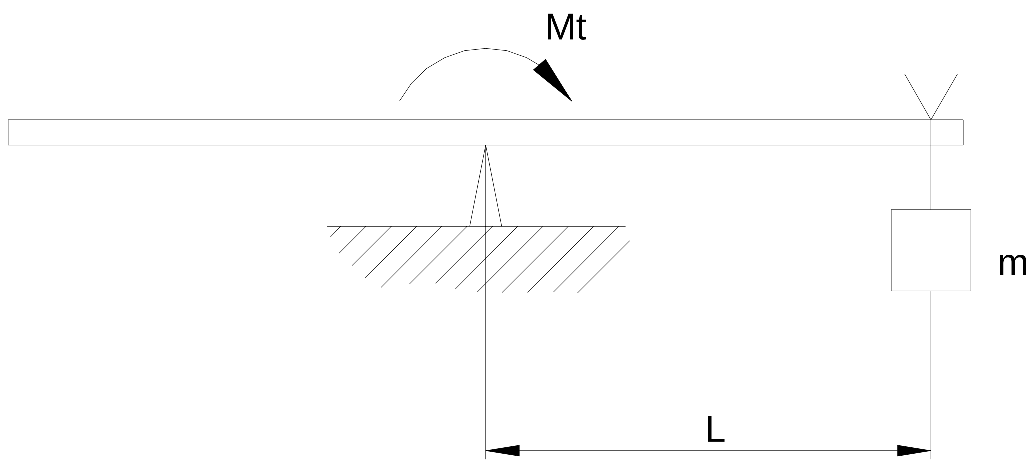


K = Loose half-couplings

6.2 Calculation example for lever arm length

$$\mathbf{L = \frac{Mt}{m \times g}}$$

Mt = Torque
L = Length of lever arm required
m = Mass required
g = 9.80665 m/s² (= standard gravity - varies with location)



Example: m = 1 kg
Mt = 10 Nm

$$\Rightarrow \quad \mathbf{L = \frac{10\ Nm\ \ s^2}{1\ kg \times 9{,}80665\ m} = 1{,}0197\ m}$$

7. Maintenance

- Gradual wear of the brushes and sliprings produces an electrically-conductive dust inside the torquemeter which might cause an electrical short between the sliprings and cause instability of the zero reading during rotation. Therefore, it is important to clean the torquemeter regularly.
- The recommended cleaning cycle is approximately 10^6 revolutions
- In order to clean the interior, loosen the 4 fixing screws and remove the cover plate
- Use a soft linen cloth, a fine hair brush or oil-free compressed air to clean the dust from the sliprings and the spaces between them
- Carefully clean the brushes and the plastic part with the springs using a hair brush or oil-free compressed air
- Version X: Be careful when cleaning, do not scratch the pulse wheel.
- Also clean the lead connector
- Measure the brush thickness; it should be more than 0.5 mm. New brushes can only be fitted at the factory.
- Replace the cover plate carefully and re-tighten the fixing screws
- Check the torquemeter:
  Zero reading stable during rotation.
  Produce a torque by twisting the meter by hand and note the reading.
- If the torquemeter is used for precision work it should be recalibrated every year (either at the factory or by means of a suitable calibration device)

8. Repairs

Fault	Cause	Remedy
Shaft stiff to turn	Bearing defect due to: a) Torsional or flexural vibration b) High axial or radial loads c) Worn bearings d) Bent shaft	Return to factory
Zero shift less than 2%	Torsional vibration Torsional shock	The zero reading can be readjusted at the display
Zero shift between approx. 2 and 5% of full scale	Torquemeter has been overloaded Torsional vibration Torsional shock	The zero reading can be readjusted once at the display
Hysteresis between clockwise and anticlockwise torque	Torquemeter over-loaded by high alternating loads or torsional vibration	Return to factory
Zero unstable during rotation	Sliprings and/or brushes dirty	Open and clean the torquemeter (see section 7)
Angle pulses roll out (only version X)	Pulse disk and optical sensor are soiled by coal dust	Clean carefully