FUTEK
ADVANCED SENSOR TECHNOLOGY, INC.

TFF Series

Torque Sensor Family Manual

Sensor Solutions Source
Load · Torque · Pressure · Multi-Axis · Calibration · Instruments · Software

www.futek.com

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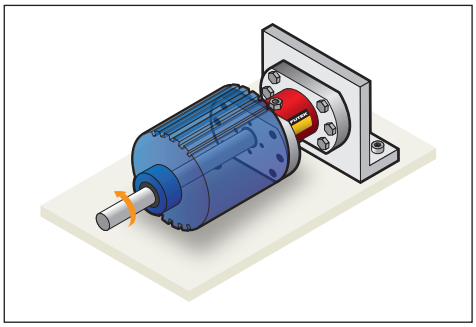
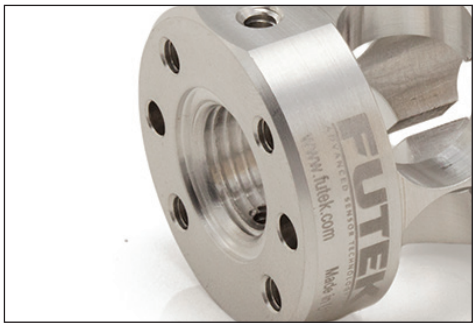
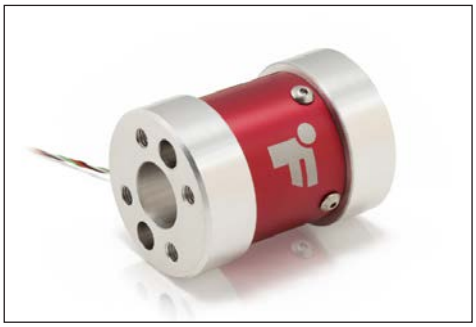
Key Features



The TFF (Torque Flange to Flange) sensor series measures the torque between a stationary or resistive moment or torque. Since the TFF sensor measures a static moment, it does not fully rotate with an applied torque.



The TFF series features a through hole design with tapered edges, which helps to center the sensor.



The through hole design allows for a shaft (or other rotating items) to pass through the sensor.

The updated TFF400 has a built-in overload protection system allowing up to 300% for the 5 to 1,000 in-oz capacities, and 150% for the 100 to 500 in-lb capacities.

Although not officially part of the TFF line, our QTA141 is a unique micro reaction torque sensor. It features a 1Nm capacity with a 0.866 in. outer diameter and 0.394 in. height.

In order to create the optimal solution for your application, our team has designed a large selection of fixtures for the sensor including square-drives, and flanges.

The standard TFF line can be modified or customized to meet your requirements. Contact FUTEK's application team for further information.

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Mechanical Installation

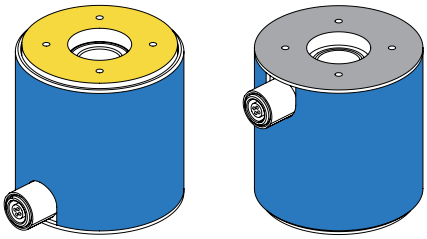
The following precautions should be observed to avoid damage to the TFF sensor during installation and usage.

- Avoid conditions that exceed the sensor's spec sheet IP rating.
- Store in a dry area without fixtures.
- Sensors with overload protection wire cut gaps, if exposed, should be regularly cleaned to maintain proper deflection path.

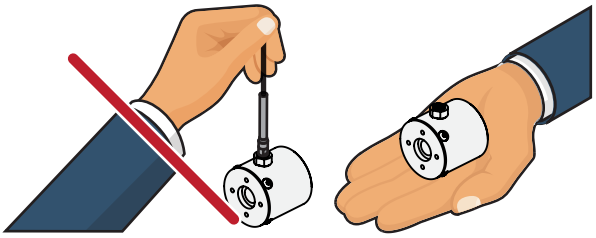
Non-loading surface (cover), do not contact while loading

Active end (top of loading flexure)

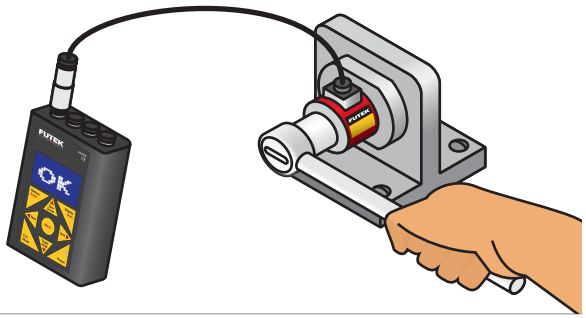
Fixed end (bottom support of flexure)



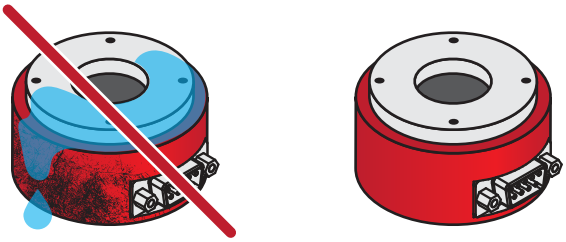
1. Do not pull on or carry sensor by cable.



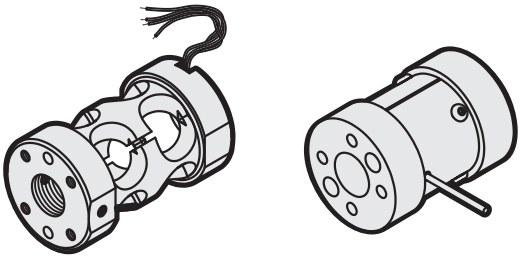
2. Monitor sensor output for effects on zero output during installation to avoid damage.



3. Install in a dry, clean environment.



4. TFF325 and TFF350 are OEM type sensors and require extra care in handling as they have exposed elements.



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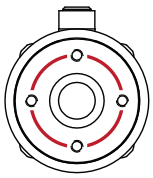
Mounting and Installation

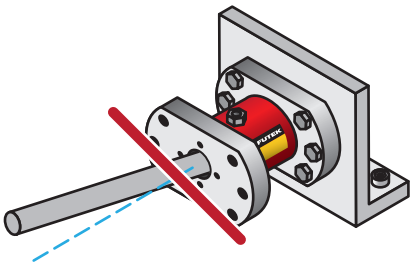
- Refer to the sensor spec sheet for information on proper torque sensor orientation for best performance and to limit cable influence.
- Measurements are called out on the sensor spec sheet and have the following tolerances based on the number of decimal points present.

DECIMAL FORMAT	TOLERANCE
0.x	±0.1"
0.xx	±0.01"
0.xxx	±0.005"
0.xxxx	±0.001"

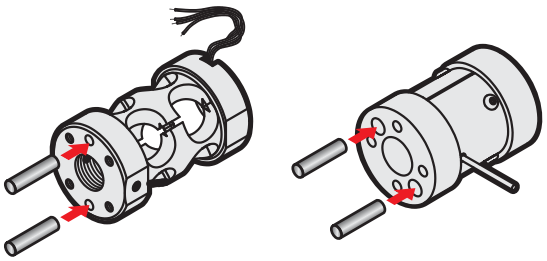
- Bolt hole placements are called out in a Bolt Circle Diameter (BCD) which is an imaginary circle passing through the centers of all the bolts in a round pattern.



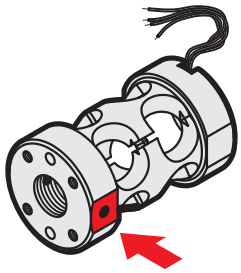
- Maintain inline torque if the fixture doesn't include coupling or flexible joints



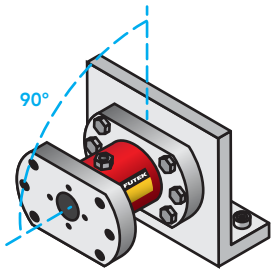
1. TFF325 and TFF350 come with dowel pin holes to help with alignment.



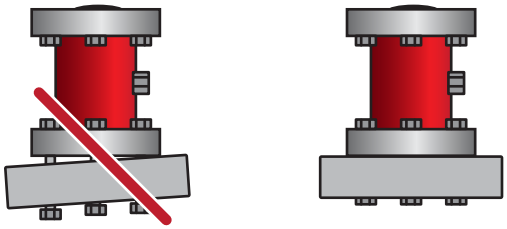
2. TFF325 had additional flats that can assist with fixture attachment and sensor placement.



3. Loading surface must be flat and inline.



4. Support surfaces must be flat and inline



Maximum moments and off-axis loading

- Use extraneous load information to determine if the sensor can withstand any unavoidable off-axis loads and moments. Extraneous load information can be found at: http://www.futek.com/extraneous-load-factor
- An Extraneous how-to-guide can be found at: http://www.futek.com/files/pdf/Extraneous_Load_Factors/How_To_Calculate_Extraneous_Loads.pdf
- **Torsional stiffness** is an indication of how much torque will result in one radian of angular deflection. The torsional stiffness can be found on the sensor's spec sheet.
- **Note:** To avoid damage when applying torque, only constrain the flange attached to the fastener.

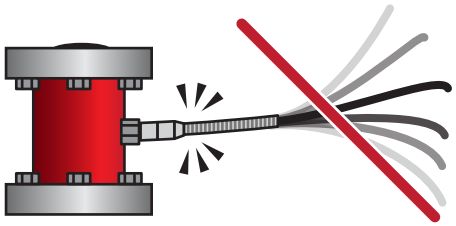
INSTALLATION TORQUE

MODEL	CAPACITY	RECOMMENDED TORQUE (lbf-in)
TFF325	20 in-oz	3-5
	50 in-oz	3-5
	12 in-lb	5-10
	50 in-lb	10-15
	100 in-lb	15-20
TFF350	100 in-lb	10-15
	500 in-lb	20-30
	1300 in-lb	40-50
TFF400	5 in-oz	5-10
	10 in-oz	5-10
	50 in-oz	5-10
	160 in-oz	15-20
	400 in-oz	15-20
	1000 in-oz	15-20
	100 in-lb	25-30
	200 in-lb	25-30
	500 in-lb	25-30
TFF425	5 in-oz	5-10
	10 in-oz	5-10
	50 in-oz	5-10
	160 in-oz	15-20
	400 in-oz	15-20
	1000 in-oz	15-20
	100 in-lb	25-30
	200 in-lb	25-30
	500 in-lb	25-30
TFF500	100 in-lb	5-10
TFF600	2000 in-lb	150-200
	10000 in-lb	150-200

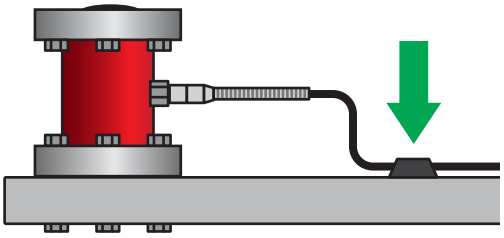
Cable Care and Routing

- Cable material type and length can be found online in the sensor description page.

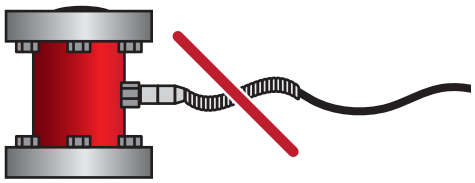
1. Avoid stress and movement on cable to avoid damage.



2. Properly secure sensor cable to limit cable movement influence



3. Avoid bending the strain relief. Bends in the cable should not exceed a radius of 10 times the diameter of the sensor cable for dynamic, or moving, applications. When permanently routing a cable in a static installation, the minimal bend radius should not fall below 2-3 times the diameter of the cable.



Electrical Installation

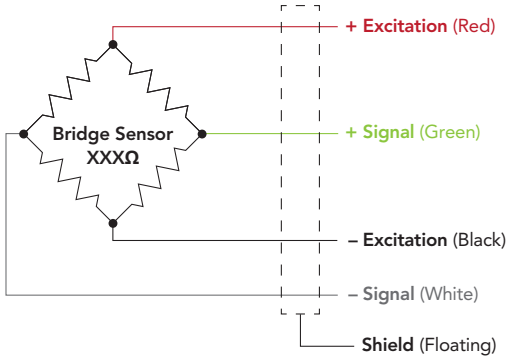
WIRING AND CONNECTIONS

- The TFF torque sensor series utilizes a four-wire bare lead connection, a four-pin Lemo connection or a DB9 with TEDS.
- Standard four-wire connections are +Excitation, –Excitation, +Signal, and –Signal. The standard coloring code for the above listed connections are Red, Black, Green, and White.
- **Note:** the Lemo connection is considered a quick release connection and is slipped out rather than twisted for removal.
- A right angle exit Lemo connector is available. **Note:** Connection position is not standard, and position may vary.

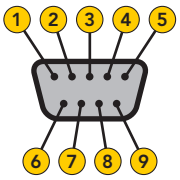
TFF EXCITATION VOLTAGE LEVELS	
SENSOR FAMILY	**MAX. EXCITATION**
TFF325	18 V
TFF350	18 V
TFF400	18 V
TFF425	18 V
TFF500	18 V
TFF600	18 V

WC1

STANDARD 4-WIRE

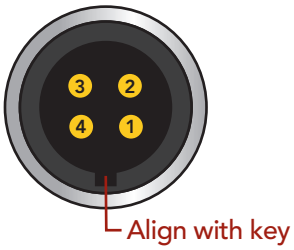


TFF500 Non-Amplified



DB9 9-PIN		
PIN	**COLOR**	**DESCRIPTION**
1	Green	+ Signal out
2	Red	+ Excitation
5	Orange	TEDS data
6	White	– Signal out
7	Black	– Excitation
9	Blue	TEDS gnd

CC4



LEMO 4-PIN		
PIN	**COLOR**	**DESCRIPTION**
1	Red	+ Excitation
2	Green	+ Signal
3	White	– Signal
4	Black	– Excitation

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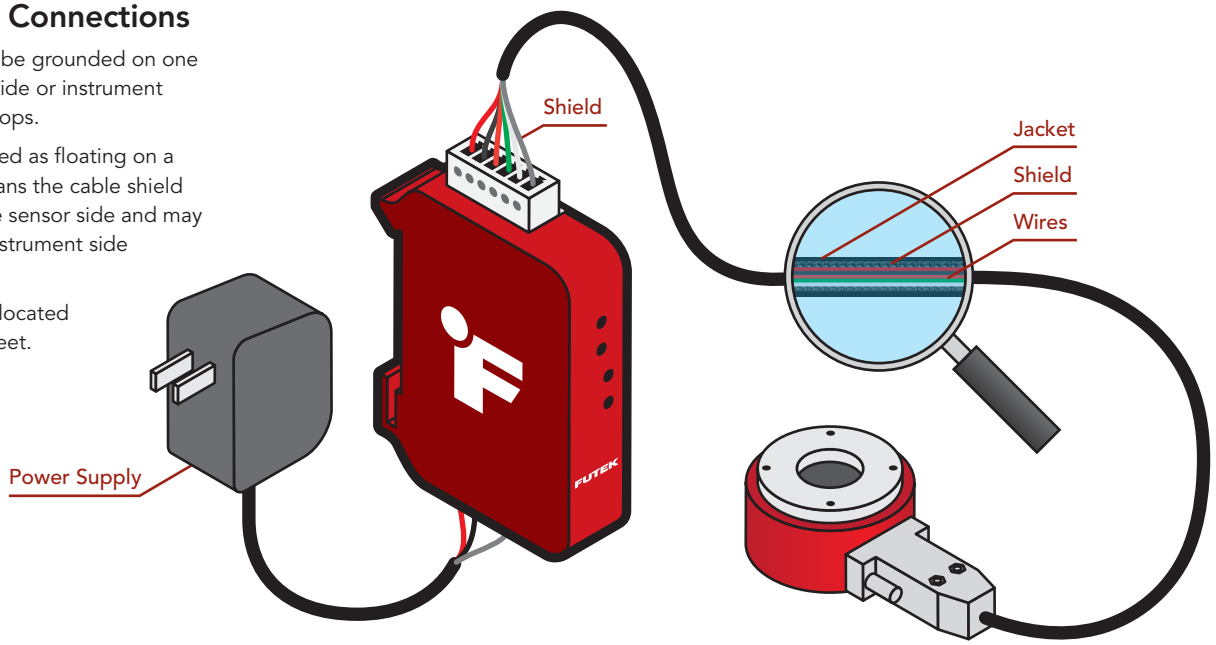
Shield Usage and Connections

- Cable shielding should be grounded on one end, either the sensor side or instrument side to avoid ground loops.
- A shield connection listed as floating on a sensor's spec sheet means the cable shield is not connected on the sensor side and may be connected on the instrument side to ground.
- Shield connections are located on the sensor's spec sheet.



Calibration

- A yearly calibration is recommended. But verification and calibration period shall be defined based on application, conditions, endurance and usage.
- FUTEK offers NIST calibrations as well as A2LA certified calibrations for total uncertainty.
- For more information on available calibrations visit FUTEK calibration web page at: http://www.futek.com/calibration-services.aspx
- For recalibration orders visit the FUTEK recalibration page at: http://www.futek.com/recalibration.aspx
- An online summary of calibration results is available at: http://www.futek.com/calibrationData.aspx

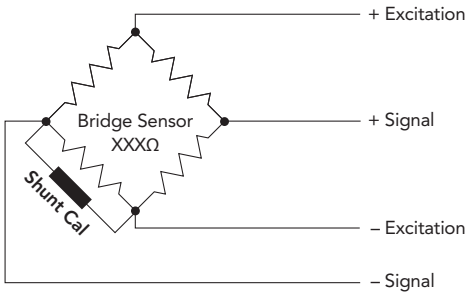
SHUNT

A shunt is an external resistance applied across two points on the load cell's Wheatstone bridge to generate a known, fixed output from the sensor.

Shunt results can be used to set up instruments as well as compare changes to the load cell output over time and usage.

When selecting the appropriate shunt resistance for your load cell, we recommend a resistance that generates an output of about 80% of the sensor's rated output. It is important to have a shunt resistance that results in an output that is less than the full output of the load cell.

An online shunt calculator can be found at http://www.futek.com/shuntcalc.aspx to find a resistance that will generate a certain shunt output level, or to estimate the output for a known shunt resistance.



TEDS

Transducer Electronic Data Sheet (TEDS) standard is available for FUTEK sensors and is utilized by select FUTEK instruments.

Through the use of TEDS load cell calibration information can be stored with sensor, or sensor cable, for use with TEDS capable instruments.

FUTEK utilizes the Bridge Sensor template 33 for the TFF family.

The following FUTEK instruments are TEDS and TFF compatible:

IPM650
Panel Mount Display

IHH500
Handheld Instrument

Troubleshooting

When troubleshooting, we recommend that the sensor be removed from any fixtures. In order to confirm that that sensor is operating correctly, we suggest placing the sensor on a firm surface, and to apply a known load.

We also recommend using a volt meter with a clean power supply to confirm the sensor is operating correctly.

SYMPTOM	POSSIBLE CAUSE	CHECK	REPAIRABILITY
High zero output	• Sensor is under preload • Sensor has been overloaded from too much load, off axis load, or moment.	• Fixtures or bolting stress for causes of pre-load. • Loading and support placement for off axis loads. • Avoid excessive moments during installation.	• Overload shift would not be repairable. • If zero offset is stable it may be possible to use sensor by use of Tare or subtracting zero from sequential readings.
Non-responsive zero output	• Sensor or instrument is not powered. • Sensor is not properly connected. • Load is not displaced properly onto sensor. • Sensor is not supported correctly and not allowing deflection to occur to measure load. • Internal disconnect or short.	• Power and wiring to sensor and instrument. • Sensor bridge resistance for possible opens or shorts. • Perform continuity test on cable. • Load is placed correctly on sensor loading surface. • Sensor loading surface is not obstructed or supported and able to flex under load. • Sensor support is not giving while sensor is loaded.	• Internal disconnections or shorts would not be available for repair. • Sensor cable repair may be available if disconnect or short is not too close to sensor.
Non-responsive high output	• Sensor is disconnected from instrument. • An opening has occurred in sensor or cable connection. • Sensor has been overloaded and deformed causing permanent high stress on internal gauges. • Fixture, applied load, or mounting is causing a high pre-load on sensor.	• Power and wiring to sensor and instrument. • Sensor bridge resistance for possible opens or shorts. • Perform continuity check on cable. • Sensor zero output to see if sensor returns to zero or has a high zero load output due to overloading. • Remove load and loosen mounting bolts or fixtures to check if sensor is being preloaded.	• Overload shift would not be repairable. • Internal disconnections or shorts would not be available for repair. • Sensor cable repair may be available if disconnect or short is not too close to sensor.
Incorrect output for applied load	• Load is not applied correctly to sensor loading surface or is off axis. • Fixtures are not secure or obstruct loading. • Sensor loading surface is not able to deflect with applied load. • Sensor support is not ridged and firm. • Incorrect sensor output is utilized.	• Placement of load on sensor. • Fixtures are not impeding ability to load. • Support surface is not giving with applied load. • Calibration verified outputs are being used.	• Recalibration is available for confirmation of sensor performance.

SYMPTOM	POSSIBLE CAUSE	CHECK	REPAIRABILITY
Zero output drift	• Unstable power supply, or noisy power supply, to sensor. • Sensor exposed to temperature change. • Sensor exposed to pre-load from fixture or mounting. • Sensor exposed to liquid or humidity.	• Stability of power supply and noise levels. • For temperature changes or unevenly distributed temperature changes. • Possible loose fixtures and bolts	• Internal damage from liquid exposure is not repairable. • Recalibration is available for confirmation of sensor performance.
Creep in output while under load	• Load or fixtures are not stable. • Power supply is unstable or noisy. • Sensor is exposed to temperature change. • Sensor support is not rigid and firm. • Sensor exposed to liquid or humidity.	• Stability of power supply and noise levels. • Fixtures for stability. • For temperature changes or unevenly distributed temperature changes. • Confirm support surfaces are not giving while under load.	• Internal damage from liquid exposure is not repairable. • Recalibration is available for confirmation of sensor performance.
Noisy or unstable output	• Power supply is noisy. • Load is not stable. • Sensor or cable is placed close to high power equipment. • Sensor or instrument is exposed to ground loop with other equipment grounds.	• Power supply stability. • Load is stable and fixtures are secure. • Reroute cables away from high power equipment. • Confirm wiring and grounds are not connected to unintended equipment ground.	• There are no active electronics in a load cell, such as capacitors or IC chips that may contribute to noise.

Further Support Resources

- Support information for FUTEK instruments can be found online at: http://www.futek.com/manuals.aspx
- A one year recalibration is recommended. But verification and calibration period shall be defined based on application, conditions, endurance and usage. Calibration data may be available online at http://www.futek.com/calibrationData.aspx
- To send in your sensor or system for recalibration visit our FUTEK calibration web page at: http://www.futek.com/recalibration.aspx
- FUTEK Technical Support may be reached at: http://www.futek.com/contact.aspx?form=technical
- To send in your sensor or system for evaluation and repair visit our FUTEK RMA web page at: http://www.futek.com/contact.aspx?form=repair
- FUTEK contact information can be found online at: http://www.futek.com/contact
- Warranty information can be found online at http://www.futek.com/remWarranty.aspx

Drawing Number: EM1040