

### Description

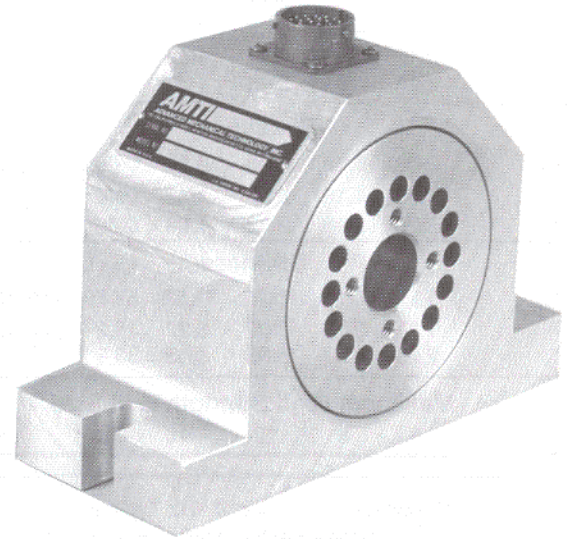
AMTI's model BOLT-3 transducer simultaneously measures the torque applied to a bolt, the torque at the threads, and the axial tension in the bolt. This unique instrument isolates these three quantities and allows a detailed study of the loads on a bolted element.

The BOLT-3 provides data for studying the effect of lubricants, pitch size, thread form, material, and contact pressure on bolted elements. Thread-locking compounds and both self-locking inserts and self-locking threads can be examined. This instrument also measures the torque and thrust characteristics of lead screws.

The BOLT-3 measures the two torques and the one force needed to analyze fastener stress. It measures  $T_A$ , the applied torque,  $T_T$ , the torque at the threads, and  $F_B$ , the bolt tension. The friction torque under the bolt head,  $T_H$ , is calculated by subtracting  $T_T$  from  $T_A$ .

Each BOLT-3 model has the sensitivity needed to accommodate a range of bolt sizes. For example, the lowest-capacity transducer has an axial-load sensitivity of  $0.38 \mu\text{V/V-lb}$  ( $0.09 \mu\text{V/V-N}$ ) and can resolve 0.3 pounds (1.3 Newtons) using 10V excitation, a gain of 4000, and a typical data-acquisition system. This sensitivity allows screws as small as #4 or 3 mm to be tested at much less than one-percent of their rated strength.

This instrument can be used with conventional wrenches or with mechanical drivers; a torque wrench is not needed since the BOLT-3 measures the applied torque directly. The unbalanced torques and side loads obtained with standard wrenches do not affect this instrument's measurements. These unbalanced loads may be measured with additional optional measurement channels of the BOLT-3.



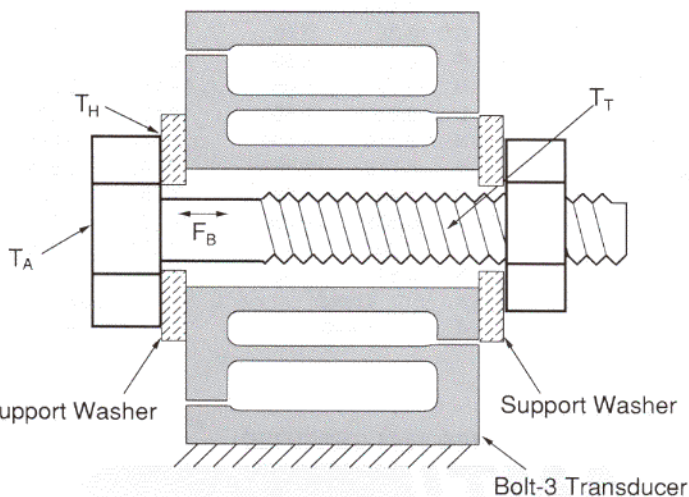
The BOLT-3 transducer can be attached to a table or machine tool base, clamped in a vise, or installed in equipment. Five capacities and two standard housing sizes are available, as listed in the specifications. AMTI can also provide custom units.

These rugged transducers are manufactured with high strength aluminum shells (alloy 7075-T6) and either aluminum or 17-4 PH stainless steel sensing elements. A durable anodized finish protects the aluminum from corrosion while elastomeric O-ring seals protect the strain gages and wiring.

### Amplification

The BOLT-3 uses strain gages and precision cylindrical elements to isolate and measure applied forces and torques. As with all conventional strain gage transducers, bridge excitation and signal amplification are required. AMTI's MCA series amplifiers are high-gain devices which provide excitation and amplification for multiple channels in one convenient package.

A single cable connects the BOLT-3 transducer to an MCA amplifier. The amplifier conditions the signals from the transducer and provides high-level analog outputs suitable for an A/D converter and computer or other recording instrument. A standard data-acquisition system or three-channel chart recorder can collect the data.



# BOLT-3

## Bolt Torque and Tension Transducer

### Metric Units

BOLT-3-	205	210	220	240	4100	Unit
<b>Capacity</b>						
F <sub>B</sub>	22.3	44.5	89.0	178	445	x10 <sup>3</sup> N
T <sub>T</sub>	0.17	0.34	0.57	1.13	3.39	x10 <sup>3</sup> N-m
T <sub>A</sub>	0.23	0.45	0.74	1.47	4.52	
<b>Sensitivity</b>						
F <sub>B</sub>	0.09	0.04	0.03	0.01	0.005	μV/V-N
T <sub>T</sub>	7.08	4.16	2.57	1.42	0.44	μV/V-N-m
T <sub>A</sub>	6.20	3.10	2.12	1.06	0.35	
<b>Stiffness</b>						
F <sub>B</sub>	5.25	10.51	15.76	31.52	57.79	x10 <sup>8</sup> N/m
T <sub>T</sub>	1.13	2.15	3.39	6.22	19.2	x10 <sup>5</sup> N-m/rad
T <sub>A</sub>	2.03	4.07	5.65	11.3	33.9	
<b>Maximum High Strength Bolt Size</b>						
	6	8	12	16	24	mm

### English Units

BOLT-3-	205	210	220	240	4100	Unit
<b>Capacity</b>						
F <sub>B</sub>	5.00	10.0	20.0	40.0	100	x10 <sup>3</sup> lb
T <sub>T</sub>	1.50	3.00	5.00	10.0	30.0	x10 <sup>3</sup> in-lb
T <sub>A</sub>	2.00	4.00	6.50	13.0	40.0	
<b>Sensitivity</b>						
F <sub>B</sub>	0.38	0.17	0.13	0.06	0.02	μV/V-lb
T <sub>T</sub>	0.8	0.47	0.29	0.16	0.05	μV/V-in-lb
T <sub>A</sub>	0.7	0.35	0.24	0.12	0.04	
<b>Stiffness</b>						
F <sub>B</sub>	3.00	6.00	9.00	18.0	33.0	x10 <sup>6</sup> lb/in
T <sub>T</sub>	1.00	1.90	3.00	5.50	17.0	x10 <sup>6</sup> in-lb/rad
T <sub>A</sub>	1.80	3.60	5.00	10.0	30.0	
<b>Maximum High Strength Bolt Size</b>						
	1/4	3/8	1/2	5/8	1	inch

Resonant Frequency: 4 kHz Typical

Safety Factor: Minimum x2 rated capacity all loads applied simultaneously

Non-Linearity: Less than 0.2% FSO

Hysteresis and Non-Repeatability: Less than 0.2% FSO

Recommended Excitation: 10 V

Bridge Resistances: 700Ω

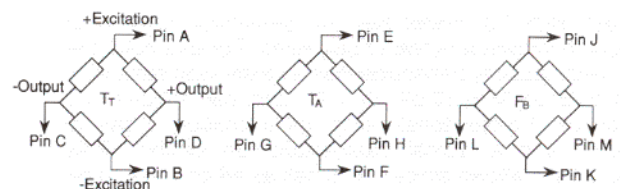
Temperature: 0 to 125 F (-18 to 52 C)

Crosstalk: T<sub>A</sub> ↔ F<sub>B</sub> or T<sub>T</sub> < 0.2%

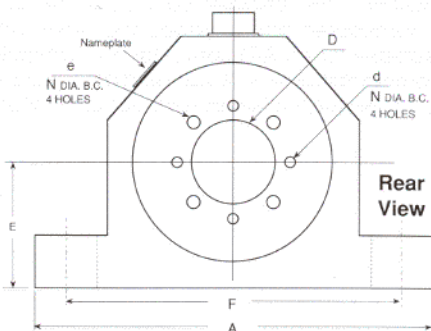
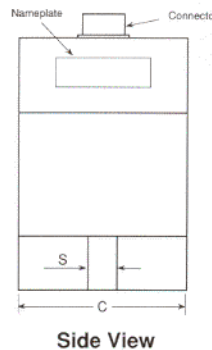
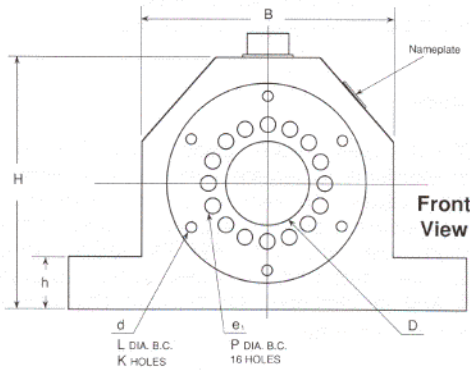
F<sub>B</sub> → T<sub>T</sub> < 0.5%

T<sub>T</sub> → F<sub>B</sub> < 2%

### Wiring



Connector Type: Burndy BTO2E16-26P



### Bolt-3-2XX

	cm	in	Bolt-3-4XXX	cm	in
A	19.05	7.50		24.13	9.50
B	12.70	5.00		15.24	6.00
C	7.493	2.950		10.033	3.950
D	2.545	1.002		5.085	2.002
E	6.35	2.50		7.62	3.00
F	16.51	6.50		20.32	8.00
H	12.70	5.00		15.24	6.00
L	3.810	1.500		10.160	4.000
N	3.810	1.500		6.668	2.625
P	5.715	2.250		7.142	2.812
S	1.42	0.56		1.75	0.69
e	0.635	0.250		0.792	0.312
e <sub>1</sub>	0.792	0.312		0.953	0.375
h	2.54	1.00		2.84	1.12
K	4 Holes			6 Holes	
d	1/4-20			5/16-18	

ISO 9001 CERTIFIED

# AMTI

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