INSTRUCTION MANUAL
(MAN-70251)

CLEVELAND-KIDDER ®
ULTRA CARTRIDGE TRANSDUCER
FOR USE WITH STATIONARY SHAFTS

MODELS: EC, ECM, SC & SCM

Cleveland Motion Controls
An IMC Company

REVISION
AA

Industrial Products Division

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REVISION HISTORY

Rev	ECO	Author	Date	Description of Change
AA	XXX	DJM	11/16/2004	As Released

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WARRANTY

Cleveland Motion Controls warrants the goods against defects in design, materials and workmanship for the period of 12 months from the date of delivery on the terms detailed in the Cleveland Motion Controls, Inc. Terms and Conditions of Sale, document number AO-90131

Cleveland Motion Controls, Inc. reserves the right to change the content and product specification without notice.

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INTENDED USERS

This Instruction Manual is to be made available to all persons who are required to configure, install or service the equipment described in this manual or any other related activity.

ADDITIONAL INFORMATION

ATTENTION: The following information is provided merely as a guide for proper installation. Cleveland Motion Controls cannot assume responsibility for the compliance (or failure to comply) to any code (national, local or other) that prescribes the proper installation of this electro-mechanical device or associated equipment. A hazard of personal injury and/or property damage can exist if applicable codes are not adhered to.

CE EMC RESPONSIBILITY

The Cleveland-Kidder Ultra Transducer may be used by a manufacturer as a component of a larger system, along with other components, which may or may not bear the CE mark. The system assembler is responsible for the compliance of the system as a whole with the EMC Directive.

Before installing the Transducer you must clearly understand who is legally responsible for conformance with the EMC Directive. Misappropriation of the CE mark is a criminal offense.

1 IMPORTANT INFORMATION

1.1 ORDER NUMBERS

Use the following example and Tables A, B and C to determine order numbers for:

- Ultra Series Transducers
- Mounting Kits
- Split Bushings

Figure 1 – Example for Determining Transducer, Mounting Kit and Split Bushing Order Numbers

If you needed to Purchase a Transducer, Mounting Kit and Split Bushing corresponding to following description:	Then, you would use Catalog Numbers:
• Size 2 cartridge body. • Bore diameter of 1.25 in. (to allow direct use of Cleveland-Kidder split-bushings). • Side connection (to allow flange mounting). • Maximum Working Force (MWF) of 150 lbs. • Bushing to accommodate 3/4 inch (outside diameter) shaft	Ultra Series Transducer = MO-13327-00 Mounting Kit = MO-04498 (Refer to Table B) Split Bushing = MO-00988-1 (Refer to Table C)

Having the following information at hand will help you to easily determine which of the Ultra Series Cartridge Transducers for Stationary Shafts is right for your application:

- The desired diameter of the shaft bore
- The type of electrical connection
- Maximum working force

Use Table A to determine the catalog number for the proper Stationary Shaft Transducer.

Table A – Determining a Catalog Number for the Ultra Stationary Shaft Transducer

Cartridge Size	Bore Diameter of Shaft Coupling (inches)	Side Connector (SC)	End Connector (EC)	Order Code Suffix, M.W.F.				
				-00	-10	-20	-30	-40
1T	1.25	MO-13333	MO-13332	25 lb	50 lb	75 lb	100 lb	150 lb
1T	1.50	MO-13335	MO-13334					
2T	1.25	MO-13327	MO-13326	150 lb	250 lb	400 lb	600 lb	1000 lb
2T	1.50	MO-13329	MO-13328					
3T	1.94	MO-13331	MO-13330					
Metric								
Cartridge Size	**Shaft Diameter (millimeters)**	**Side Connection (SCM)**	**End Connection (ECM)**	**Order Code Suffix , Metric M.W.F**				
				-00	**-10**	**-20**	**-30**	**-40**
1T	30	MO-13431	MO-13429	100 N	200 N	350 N	450 N	650 N
2T	30	MO-13432	MO-13430	650 N	1000 N	1800 N	2500 N	4500 N

Table B – Determining a Mounting Kit Catalog Number for the Ultra Series Cartridge Transducer

Mounting Style	Size			
	1T (inch)	2T or 3T (inch)	1T (millimeter)	2T or 3T (millimeter)
Bearing (BR)	MO-04495	MO-04500	MO-05175	MO-05174
Flange (FL)	MO-04493	MO-04498	MO-05176	MO-05177
Pillow Block (PB)	MO-04494	MO-04499		

Table C – Determining a Split Bushing Catalog Number for the Ultra Series Cartridge Transducer

If Finished Bore Diameter (nominal I.D) equals:	Use Catalog number:	Additional Information:
1/2 inch	MO-00988-7	All Cleveland-Kidder split bushings have an outside diameter of 1.25 inches.
5/8 inch	MO-00988-0	
3/4 inch	MO-00988-1	
7/8 inch	MO-00988-2	
1 inch	MO-00988-3	
1-1/8 inches	MO-00988-4	
1-3/16 inches	MO-00988-5	
15 millimeter	MO-00988-9	
20 millimeter	MO-00988-6	
25 millimeter	MO-00988-8	

1.2 CONTACT INFORMATION AND SERVICE ASSISTANCE

For service assistance, have the following information available:

- Type of Cartridge Transducer you are using
- Maximum working force
- Purchase order number

You can contact Cleveland Motion Controls at:

Phone: 216.524.8800
Fax: 216.642.5155

For the latest product information, technical literature etc., visit our website at www.cmccontrols.com

Disassembly by improperly trained personnel may result in additional damage to these units. Should repairs be required or for warranty repairs, contact the Customer Service Department for a return authorization number before returning the units.

1.3 RECEIVING AND UNPACKING

After receiving the Ultra Slim Cell Cartridge Transducer you should:

- Carefully, unpack and inspect the equipment
- Compare the received shipment with the packing list
- Report any damage to the carrier and your CMC representative
- Store equipment that will not be used in a clean, dry location
- Take appropriate precautions to prevent moisture, dust and dirt from accumulating in storage and installation areas

1.4 PRE-INSTALLATION PRECAUTIONS

1.4.1.1 SHIPPING

Shock and the vibration transmitted to the transducers by the sensing roll during transportation can damage the transducers. It is essential that you remove the sensing roll when the machine is shipped with the transducers mounted.

1.4.1.2 ROLL BALANCE

The sensing roll should be adequately balanced. Understand that the balance of the sensing roll will be more demanding than that typically needed in general rotating machinery. The goal goes beyond just limiting the force to which bearings will be subjected, but rather to minimize the generation of an unintended noise component in the transducer tension signal. The centrifugal force caused by imbalance can be estimated using the following formula:

$$F = (1.77 \times 10^{-6}) \times W \times R \times (RPM)^2$$

Where:

F = centrifugal force (in units of lb-f)
W = weight imbalance (in units of ounces)
R = radius of displacement, distance of imbalance weight from roll axis of rotation (in inches)
RPM = Revolution per minute

The force increase is equal to the square of the RPM, or in other words, doubling the RPM causes four times the imbalance force. Because rolls tend to have a high length-to-diameter ratio, two-plane (dynamic) balancing is recommended. Balancing is particularly needed where higher RPMs and lower web forces are involved.

To illustrate how much imbalance induced “noise” could be generated, the following table shows the force disturbance for various ISO balance grades for an illustrative case of a 20 pound roll (4” diameter x 36” long, aluminum) rotating at 1500 RPM.

Balance Grade (ISO 1940/1)	Residual Imbalance	Resultant Force due to Residual Imbalance
G16	1.25 oz-in	+/- 5 lb-f at 25 Hz
G6.3	0.5 oz-in	+/- 2 lb-f at 25 Hz
G2.5	0.2 oz-in	+/- 0.8 lb-f at 25 Hz
G1	0.08 oz-in	+/- 0.3 lb-f at 25 Hz

1.4.1.3 CRITICAL ROLL SPEED

Even with a balanced roll, a vibration can be set up in a stationary shaft. If this vibration (in cycles per minute) occurs at the harmonic frequency of the shaft, the transducers can be damaged. To determine critical roll speed, use the following formula:

$$\text{Critical roll speed in RPM} = \frac{4.8 \times 106 \times \text{Shaft O.D.}}{(\text{Shaft Length})^2}$$

(Dimensions are in inches)

To assure that this issue is avoided, the critical roll speed should be at least 20% above the roll speed attained at maximum web speed.

1.4.1.4 AVOIDING DAMAGE TO THE TRANSDUCERS

To avoid damaging the transducers, refrain from repetitive overloading above the maximum working force or severe overloading.

1.4.1.5 EXCITATION VOLTAGE

Maximum Excitation Voltage for the Ultra Series transducers must be limited to 5.6 VDC or 5.6 VRMS. ***Do not use*** *10 Volt excitation or possible damage to the semiconductor strain gage elements can occur. Before applying power to the amplifier, verify that the amplifier excitation voltage has been set to 5.0 VDC.*

2 SPECIFICATIONS

Item:	Specification:			
Transducer Weight		**1T**	**2T**	**3T**
		2.9 lbs. 1.32 kg.	4.0 lb. 1.81 kg	5.0 lb. 2.27 kg
Weight + Mounting Kit		**1T**	**2T**	**3T**
	Flange	3.9 lbs. 1.77 kg.	5.6 lbs. 2.54 kg	6.6 lbs. 2.99 kg
	Bearing	3.3 lbs. 1.50 kg.	4.5 lbs. 2.04 kg.	5.5 lbs. 2.49 kg.
	Pillow Block	5.8 lbs 2.63 kg.	8.2 lbs. 3.72 kg.	9.2 lbs. 4.17 kg.
Material	Strain Sensing beam - heat treated 4140 alloy steel Body - 1117 Low Carbon steel			
Finish Material	Corrosion resistant Zinc plated with clear Chromate			
Bridge Resistance	135-147 Ohms @ 20 °C			
Gage Type	Semi-conductor strain gage, gage factor equals 95 (nominal)			
Connector Type	M12 Quick-disconnect, 4 conductor, DC keyed			
Excitation Voltage	5.6 VDC or VAC (RMS) maximum (Excess voltage can cause permanent damage)			
Nominal Output Signal at Rated MWF	+/- 350 mV per Transducer (with 5 VDC or VAC rms excitation voltage)			
Output Impedance	Approximately 64 Ohms per Bridge leg			
Non-destructive Overload	150% MWF			
Ultimate Overload	300% MWF (typ)			
Maximum Voltage, Gage to Beam or Base (Ground)	50 Volts peak			
Operating Temperature Range	0° F to +200° F			
Alignment	+/- 1 degrees angular displacement			
Accommodation of shaft expansion/contraction	+/- 0.04" (+/ - 1mm) per transducer			

2.1 FORCE RATINGS

Refer to Table A in this document for Transducer Maximum Working Force Ratings.

2.2 BEFORE INSTALLING THE TRANSDUCER

Before installing the Transducer, perform the following steps:

1. Review the Installation Precautions (Section 2.2.1 on page 9).
2. Review the Safety Considerations (Section 2.2.2 on page 9)
3. Review the Mounting Configurations (Section 2.2.3 on page 10)
4. Assemble the Mounting Hardware and review the Fastener and Torque information (Section 2.2.4 on page 11).
5. Reference the Mounting Dimensions (Section 2.2.5 on page 12).

2.2.1 INSTALLATION PRECAUTIONS

To ensure proper installation and operation of the system, keep the following points in mind:

- Exercise care to avoid overstressing the transducer when handling partially mounted rolls. Even relatively short rolls can afford an impressive mechanical advantage over the transducer.
- Bolting the transducer to a non-flat surface can cause deformation of the transducer body and degrade the quality of the tension signal.

Failure to follow precautions can result in serious damage to the Ultra Series Transducer and possibly void the warranty!

2.2.2 SAFETY CONSIDERATIONS

Safety practices should not be an afterthought. Before installing, servicing or calibrating review and follow applicable policies and procedures to ensure worker safety. Machinery must be in a safe state and be aware of any additional hazards that can arise when installing and calibrating higher force transducers.

The following points are also important to remember:

- Check that all hardware is mounted with appropriate fasteners (thread size and pitch, fastener grade, length of thread engagement).
- When “dead-weights” are used to produce calibration forces, always wear steel-toed shoes.
- When manually handling calibration weights and rolls, use safe lifting practices to avoid injury.
- Size cordage or straps with ample safety factors to reduce the chances of failure and falling weights.
- Consider where the cords and weights will travel to should a failure occur.

2.2.3 MOUNTING CONFIGURATIONS

Ultra Series Cartridge Transducers can be mounted on either the inside or outside of the machine depending on the model type purchased (refer to Figure 1 and Table D). When choosing a mounting configuration, evaluate your options by taking the following points into consideration:

- Model type
- Safety
- Machine Frame orientation
- Ease of Assembly

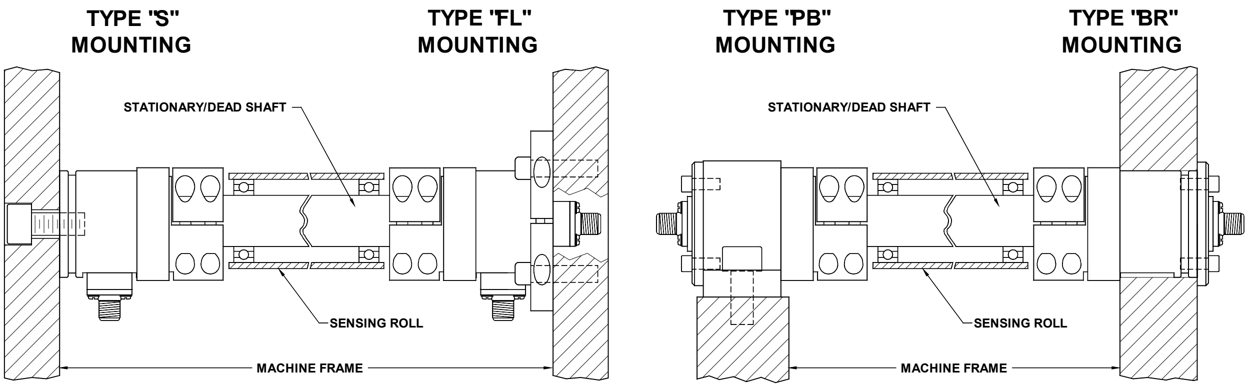


Figure 2 – Types of Mounting Configurations

Table D – Mounting Type and Connector Compatibility

When using this type of Mounting Configuration:	The Connector can be located at:	
	End	Side
Flange (FL)	X	X
Stud (S)		X
Pillow Block (PB)	X	
Bearing (BR)	X	

The tension-sensing roll *must not* be mounted where the web wrap angle can vary, or the transducer will not interpret the tension properly. If a variance in the wrap angle occurs, it is sensed by the transducer as a tension change and the change is indicated on the tension indicator. In cases where it is impossible to mount the transducer where the wrap angle does not vary, the change in indicated tension that results should be calculated and if small, can be disregarded.

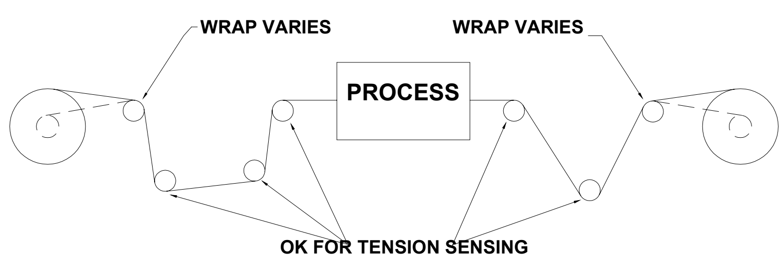


Figure 3 - Example of Varying Wrap Angles

2.2.4 MOUNTING HARDWARE AND FASTENER TORQUE RECOMMENDATIONS

The Table E provides you with guidelines to refer to when determining torque values for clean and dry fasteners. Keep in mind, however, that several variables can influence the “optimum” torque to be used in a given situation, and Table E should be used only as a general reference. If you are unsure of the proper torque values to use, consult the machine manufacturer for specific recommendations.

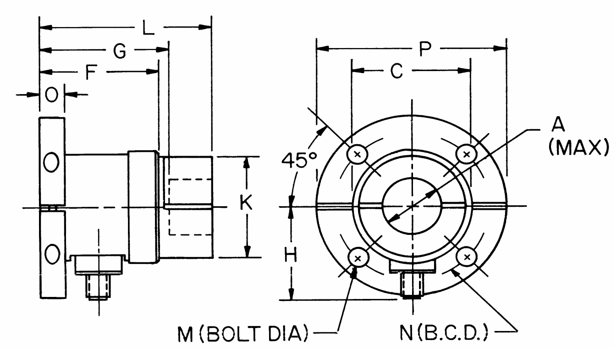
- Use quality alloy steel fasteners (SAE Grade 8, ISO property grade 10.9).
- If the fastener threads are lubricated, reduce the torque amount. Use a torque value that is 70 percent of that listed in Table E. For example, if you are using a lubricated 1/2-13NC base stud on a SC-1T transducer, reduce the torque amount of 45 ft-lb to 31 ft-lb.
- Transducers operated at lower forces may not require the higher clamping forces obtained at the cited torque values.

Table E – Torque Value Guideline Tables

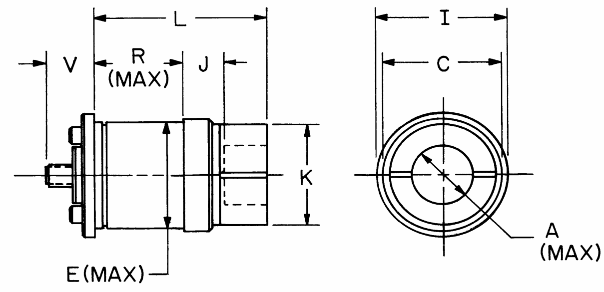
Transducer Models:	Fastener Type:	Fastener Thread (SAE):	Torque:
SC-1T EC-1T	Base Stud	1/2-13 NC	45 lb-ft
	Base Bolt (Bearing and Pillow Block)	1/4-20 NC	70 lb-in
	Shaft Coupling Cap	1/4-20 NC	70 lb-in
	Split-Flange Clamp (Flange)	1/4-20 NC	70 lb-in
	Flange Bolt	3/8-16 NC	15 lb-ft
	Pillow Block Bolt	1/2-13 NC	45 lb-ft
SC-2T, SC-3T EC-2T, EC-3T	Base Stud	5/8-11 NC	85 lb-ft
	Base Bolt (Bearing and Pillow Block)	1/4-20 NC	95 lb-in
	Shaft Coupling Cap	1/4-20 NC	70 lb-in.
	Split-Flange Clamp (Flange)	5/16-18 NC	12 lb-ft
	Flange Bolt	1/2-13 NC	25 lb-ft
	Pillow Block Bolt	1/2-13 NC	45 lb-ft
Transducer Models:	**Fastener Type:**	**Fastener Thread (Metric):**	**Torque (N-m):**
SCM-1T ECM-1T	Base Stud	M12-1.75	35
	Base Bolt (Bearing and Pillow Block)	M6-1	4
	Shaft Coupling Cap	M6-1	4
	Split-Flange Clamp (Flange)	M6-1	3
	Flange Bolt	M10-1.5	11
SCM-2T ECM-2T	Base Stud	M16-2	65
	Base Bolt (Bearing and Pillow Block)	M8-1.25	8
	Head Clamp	M6-1	5
	Split-Flange Clamp (Flange)	M8-1.25	9
	Flange Bolt	M12-1.75	18

Mechanisms used for industrial automation can tax even the best threaded fasteners. You can improve the likelihood that bolts and shafts remain secure by using suitable anaerobic “thread lockers” during the final assembly.

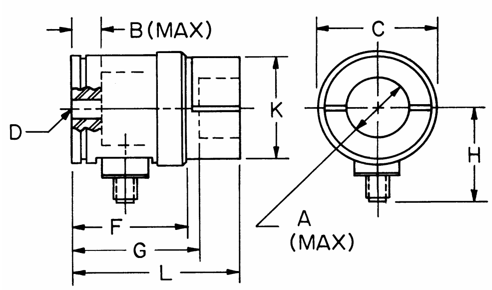
2.2.5 MOUNTING DIMENSIONS



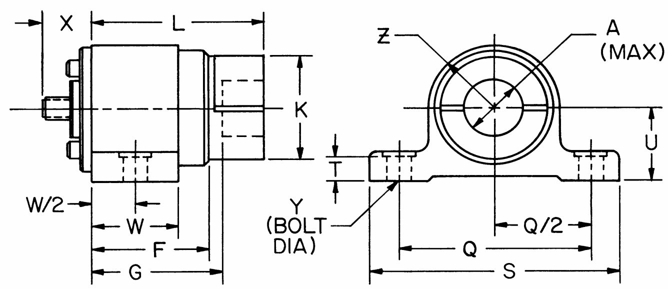
TYPE SC and SCM Cartridge with FL Mounting Kit



TYPE EC and ECM Cartridge with BR Mounting Kit



Type SC and SCM Cartridge



Type EC and ECM Cartridge with PB Mounting Kit

Mounting dimensions in Inches:

Designator:	1T	2T	3T
A*	1.250	1.250	1.938
B	0.55	0.60	0.60
C	2.50	2.75	2.75
D	1/2-13	5/8-11	5/8-11
E	2.375	2.625	2.626
F	2.44	2.85	2.85
G	2.60	2.98	3.48
H	2.10	2.23	2.23
I	2.75	3.00	3.00
J	0.87	1.11	1.61
K	2.25	2.25	2.95
L	3.63	4.04	4.54
M	3/8	1/2	1/2
N	3.25	3.50	3.50
O	.50	.62	.62
P	4.00	4.50	4.50
Q	4.00	5.00	5.00
R	1.74	1.87	1.87
S	5.38	6.12	6.12
T	0.58	0.68	0.68
U	1.63	1.94	1.94
V	1.02	1.02	1.02
W	1.75	1.88	1.88
X	1.02	1.02	1.02
Y	1/2	1/2	1/2
Z	1.50	1.70	1.70

*Bushings are available for smaller shaft diameters

Mounting dimensions in Millimeters:

Designator:	1T	2T
A*	30.00	30.00
B	14.0	15.2
C	63.5	69.9
D	M12-1.75	M16-2
E*	60.32	66.67
F	62.0	72.4
G	66.0	75.7
H	53.3	56.6
I	69.9	76.2
J	22.1	28.2
K	57.2	57.2
L	92.2	102.6
M	M-10	M-12
N	82.55	88.90
O	12.7	15.9
P	101.6	114.3
Q	101.6	127.0
R	44.2	47.5
S	136.7	155.4
T	14.7	17.3
U	41.3	49.2
V	25.9	25.9
W	44.5	47.6
X	25.9	25.9
Y	M-12	M12
Z	38.1	43.2

*Maximum shaft diameter 30.00 mm

Figure 4 – Mounting Dimensions

3 INSTALLING THE CARTRIDGE TRANSDUCER

The following sections provide you with detailed information and steps to correctly install the Ultra Series Cartridge Transducer for use with stationary shafts.

3.1 MOUNTING THE TRANSDUCER

The mounting surfaces for the transducer should be flat and parallel to each other. Remove any loose paint, rust or scale from the machine frame before mounting.

Table F – Steps for Mounting an Ultra Series Transducer

If you are using this type of Mounting style:	Then, perform these steps:
Stud (S)	1. Before tightening the mounting bolt, rotate the transducer body until the force direction (indicated by the arrow on the label) is aligned with the vector of the web force. The vector of the web force is the bisector of the wrap angle. Refer to Figure 5. *Rolls often have an uninterrupted shaft that extends to form the journals. Though the roll may be described as having a "dead shaft", neither journal end can rotate independently of the other. Attempting to rotate one transducer, while the other end of the roll is clamped can result in damage to the transducer.*
Pillow Block and Bearing Replacement (PB, BR)	1. Loosely mount the transducer by lightly tightening the four (4) socket head cap screws that hold the lock plate to the back of the transducer. 2. Rotate the body of the transducer body until the direction of the force (indicated by the arrow on the label) is aligned with the vector of the web force. 3. Tighten the four (4) socket head cap screws to securely clamp the transducer in position.
Flange (F)	1. Before drilling the four (4) mounting holes, contemplate the orientation of the transducer taking into consideration the location of the mounting screws. Be sure that the screws do not interfere with the position of the connector. An optimal location for mounting holes also lets you maximize rotational alignment range. Do not use the flange assembly as a drill template while not mounted to the transducer. The spacing between flange halves is different when the transducer body is added. 2. Adjust the alignment of the transducer. First, be sure that the four (4) flange bolts are loose and then, loosen the two (2) bolts that draw the flange halves together. 3. Rotate the body of the transducer body until the direction of the force, indicated by the arrow on the label, is aligned with the vector of the web force. 4. Secure the flange to the transducer. Tighten the two (2) socket head cap screws that draw the flange halves together. 5. Tighten the four (4) bolts that draw the flange to the mounting surface.

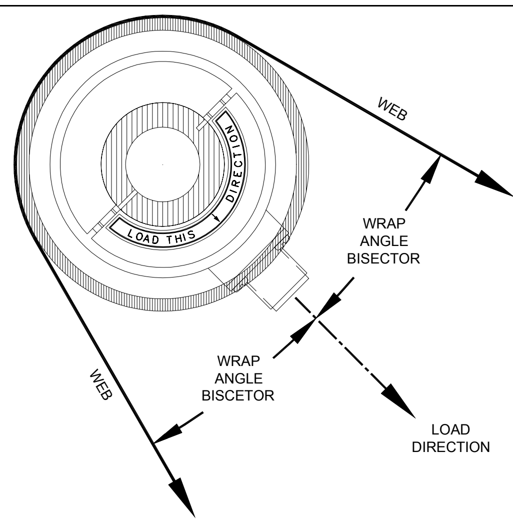


Figure 5 - Proper Orientation of the Cartridge Transducer

3.2 MOUNTING THE SENSING ROLL

The following steps take into consideration the risk and difficulty of handling large rolls and help to minimize the number of failed attempts at mounting the roll.

1. Before mounting the sensing roll, confirm that the transducer bodies are securely mounted and that they are “in line” with each other (coaxial).
2. Measure the roll shaft diameter, the shaft coupling bore diameter and any bushings (if used) to be sure that they fit properly.
3. If you are using bushings, be sure that they are split on their circumference so that they readily yield to hold the roll shaft. Refer to Figure 6.
4. Remove the four (4) socket head cap screws and then remove the shaft coupling cap.
5. Measure the overall length of the roll shaft to verify that it fits correctly between the transducer bodies. The journal must be long enough to fully engage the transducer’s shaft coupling, but not so long that it makes contact with the bottom of the coupling bore. A clearance of approximately 1/16” (1.6 mm) per side should ensure against bottoming.
6. Install coupling bushings on the roll shaft (if being used) and place the roll onto the stationary portion of the shaft coupling. To be sure that the clamping force is properly transmitted to the roll shaft align the bushings so that the split coincides with the split of the shaft coupling. Refer to Figure 6.
7. Install the coupling cap loosely using the socket head cap screws. Do not completely tighten the screws until you have performed Preloading steps outlined in section 3.3 of this document.

3.3 PRELOADING

The design of the gimbaled shaft coupling incorporates a feature to accommodate shaft expansion and contraction. Temperature changes and material differences can cause the shaft to expand or contract, therefore the coupling needs to provide a degree of axial “free-play” so that the strain beams in the transducer are not subjected to excessive force. Performing the preloading steps outlined below lets the transducer accommodate limited amounts of contraction or expansion. As a point of reference, a 100 degree Fahrenheit rise in temperature can cause an aluminum shaft to expand by nearly 0.016” per foot of shaft. Steel expands only about 60% as much as aluminum.

To pre-load the transducer:

1. Confirm that there is clearance between the end of the roll shaft and the bottom of the coupling bore (described above) then, tighten the shaft in the coupling at one transducer by tightening the four (4) socket head cap screws.
2. Check the remaining transducer to be sure that the shaft is loose in the coupling and then, press the coupling inward by approximately 1/16” (as if pushing it into the transducer body). Hold the coupling in the pre-loaded state while tightening the cap screws. When you release the coupling, the free play that you established is evenly distributed between the transducers (half at each transducer).

Do not defeat the expansion capability by bottoming both transducer couplings while tightening the cap.

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3. Tighten the shaft coupling cap. Be sure that the size of the gap on each side of the roll shaft is equal in width. Refer to Figure 6.

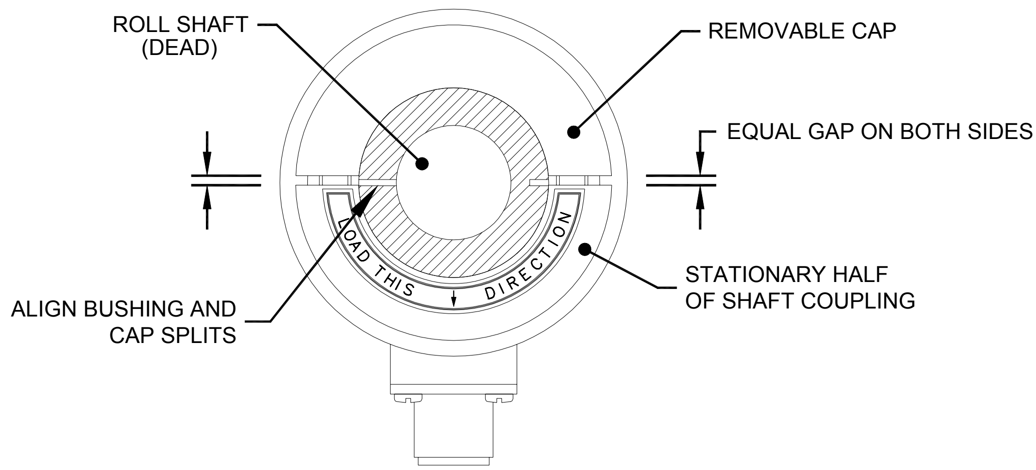

Figure 6 - Correct Shaft Coupling Installation

3.4 MINIMIZING BEAM TORQUE

Rolls often have an uninterrupted shaft that extends to form the journals. Even though the roll may be described as having a “dead shaft”, neither journal end can rotate independently of the other. Because of the twisting force, attempting to rotate one transducer while the other end of the roll is firmly clamped can result in damage to the transducer. Even though the force may not large enough to cause permanent damage, they can impair the accuracy and stability of the transducer tension signal.

To minimize the potential for having accidentally stored a residual twisting force in the beams when the transducers and roll were mounted, we recommend that you use the following steps to adjust and verify your transducer.

1. Slightly loosen the mounting bolts that secure one of the transducers to the machine frame so that the transducer is free to rotate about the axis of the roll. Note that a small amount of rotation is possible using only moderate force. At the outer diameter of the transducer housing, the rotation might amount to roughly 1/8” of circumferential travel, as each transducer contributes just over two (2) mechanical degrees of rotational play.
2. Position the transducer at the approximate midway position before re-tightening the mounting screws. This helps to ensure that the transducers shaft coupling is free to float rotationally. The residual torsional forces are minimized on the beam assembly.
3. Lightly, twist the roll back-and-forth by hand to verify the amount of available free play. Approximately one or two degrees angular free play should be evident.

3.5 CHECKING THE TRANSDUCER MOUNTING

Before preparing to apply force to the transducer(s) and calibrating the amplifier, inspect the load cell to confirm that it is oriented and mounted in accordance to the installation instructions. Common problems include:

- Failure to mount transducers on flat (machined) surface.
- Poor shaft alignment that exceeds allowable limits.
- Fastener torque either excessive or insufficient.
- Transducer mis-oriented so that the axis of sensing is not true to the applied force vector (bisector of the wrap angle).
- Roll is mounted without allowance for shaft expansion/contraction at shaft coupling.
- The transducer is positioned in the web path so that the wrap angel is not constant.

3.6 ELECTRICAL CONNECTIONS AND WIRING

Refer to the installation wiring diagrams supplied with the Cleveland-Kidder tension indicator or controller for making the transducer to amplifier connections. Make certain that:

- The cables do not interfere with the web path, and that they are away from gearing or other moving parts.
- You exercise care when routing the cables to avoid pick-up from noise-radiating power cabling (motor armature leads, AC main wiring, etc).
- In environments with severe electromagnetic noise, it may be necessary to route the cables inside metallic conduit.
- Polarity changes are accommodated by reversing the orientation of the transducer or by interchanging the black and white output wires.

Figure 7 illustrates a typical full bridge transducer configuration.

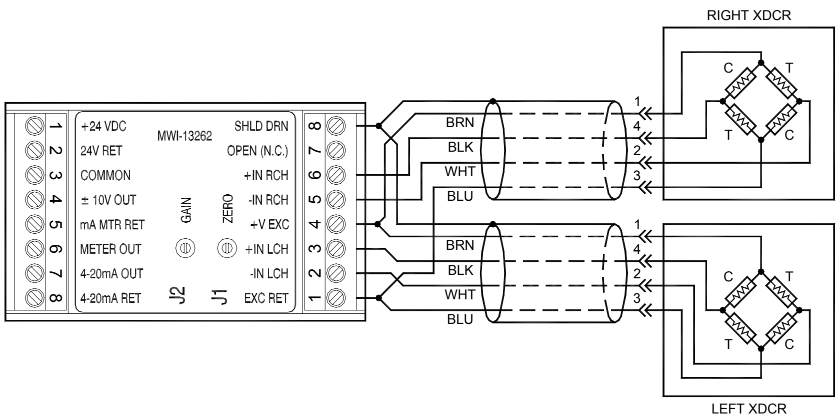

Figure 7 – Full Bridge Transducer Wiring

3.7 MATING CONNECTORS

The M12 connector used on the Ultra Series Slim Cell transducer is a four-pin, DC keyed, male connector that mates directly with the molded corsets offered by Cleveland Motion Controls. The following table lists the pin numbers and cable colors that apply:

Pin Number	Wire Color	Signal
1	brown	Excitation Voltage
2	white	Output - (low going)
3	blue	Excitation Return
4	black	Output + (high going)

If you choose to make your own cables or need to repair damaged connectors, you can purchase a separate mating connector from Cleveland Motion Controls. To order, use CMC part number, X44-34338.

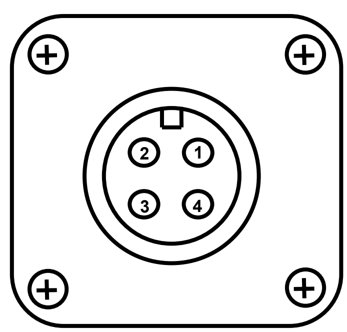

Figure 8 - Front View of M12 Connector

When mating the connector, align the keying mechanism and pins so that they enter the socket without you having to apply excessive force. Use your fingers to sufficiently tighten the coupling nut enough to ensure an adequate seal and to discourage accidental loosening.

3.8 CALIBRATION

For the proper calibration procedure, refer to the Instruction Manual that accompanied your amplifier or tension controller.

4 TROUBLE SHOOTING

Safety should not be an afterthought. Before installing, servicing or calibrating review and follow applicable policies and procedures to ensure worker safety. Machinery must be in a safe state and be aware of any additional hazards that can arise when installing and calibrating higher force transducers.

The following table provides you with a list of typical issues that you may encounter and possible solutions:

If you are having this issue:	Then:
Low Output Signal	The transducer may have too large a maximum working force (MWF) in relation to the force to be sensed, or the wrap angle may be insufficient and is not able to generate an optimum resultant force on the transducer. Or The transducer may be improperly orientated such that the transducer's axis of sensitivity is not aligned with the bisector of the wrap angle. Or, Check the amplifier to confirm that the signals from each transducer will combine additively. Otherwise, the two signals will work against each other, and only minute differences between signals appear.
Wrong Polarity of Output Signal	Transducers may have been incorrectly oriented. Refer to Section 3.1 for proper load direction. Alternately, change the signal sense by interchanging the white and black transducer leads into the amplifier.
No Output Signal	Check to be sure that all connections have been made completely and properly. Inspect the connecting cables for crimps or cuts. Verify that the appropriate excitation voltage is being issued by the amplifier with the load cells connected. Disconnect the transducer output wires from the amplifier's input terminals (to eliminate any potential for accidental loading) and check the output signal using a voltage meter. Check the transducer (refer to Section 4.1.1 - DC Resistance Check in this document).
Excessive Output Signal with Minimal or No Load	There may be a high degree of misalignment of the transducers causing a severe pre-load. Or The sensing guide roll assembly may be excessively heavy. The sensing guide roll should not weigh more than ½ the maximum working force of the transducers in most cases. Or The transducer may have too small a maximum working force for the application. Replace with a higher maximum working force transducer or decrease the web wrap angle. Also, Check cables and connectors for intended connections using an ohm-meter or continuity checker. Inspect not only for continuity where expected, but also disconnect pluggable connectors and check for unintended resistances (shorts) between conductors. Inspect the transducers for mechanical reasons why there is a reported overload. Possibilities include, debris wedged in the transducer's shaft seal area, or a roll shaft bottoming inside the transducer body.
Poor Linearity	Check for mechanical reasons such as rubbing or binding that interferes with the force being properly transmitted to the load cell. Or Your calibration efforts may have been conducted while either the transducer or the amplifier was in a non-linear mode (i.e. under the effects clipping or saturation). Try and recalibrate the amplifier using a lower force. To determine whether the clipping is being caused by the transducer or the amplifier, apply a series of intermediate forces and record the unamplified tension signal. If the data demonstrates that the transducer is linear then, investigate the amplifier.

4.1.1 DC RESISTANCE CHECK

If you have attempted to resolve your issue using the table above and have been unsuccessful, use the following checks to determine the viability of the transducer.

The following nominal DC resistances table indicates a normal load cell, with no load applied at room temperature. The resistances are cited using both the wire color and the M12 connector pin numbers (Figure 8). Often, it is best to begin by measuring the resistances at the amplifier end of the cable. Then, if a problem is indicated, un-mate the transducer end of the connector and check the resistances. Following this procedure, allows you to readily and initially check the resistances without disturbing the transducer or M12 connections and inadvertently disturbing the interconnect condition.

Measurements taken between the following wires:	Corresponding M12 Connector Pins:	Target Resistance
WHT - BLK	2-4	118 Ohm
BRN - BLU	1-3	140 Ohm Varies slightly based on load cell temperature
WHT - BLU	2-3	112 Ohm
WHT - BRN	2-1	88 Ohm
BLK - BRN	4-1	88 Ohm

Resistance should **NOT** be indicated (> 10 M-ohm) between any of the transducer connections and the metal body of the transducer when the M12 transducer connector is un-mated. A low resistance indicates a possible breakdown of an insulation component, and could be caused by excessive voltage between the body and electrical connections of the transducer.

4.1.2 DC VOLTAGE AND CURRENT CHECKS

When 5VDC excitation is applied to a correctly wired transducer, the output to ground voltage for each of the bridge outputs should be approximately 2.8 VDC. The difference in voltage between the two output leads (BLK and WHT) is the un-amplified tension signal. It should be only tens of millivolts with little applied force, increasing to approximately 350 mV at the transducers MWF.

The current flow through the bridge Excitation connections (into BRN and out the BLU wire) should be approximately 35 mA and equal in each wire. Non-equal currents indicate that the current is being diverted, indicating a potential wiring error, short circuit, or ground loop.