DOVER FLEXO ELECTRONICS, INC.
ISO 9001 CERTIFIED

INSTRUCTION MANUAL

MODEL THN TENSION TRANSDUCERS

DOC 801-1752

5 YEAR WARRANTY

DOVER FLEXO ELECTRONICS, INC.

217 Pickering Road

Rochester, NH 03867 U.S.A.

For assistance, please call:

TECHNICAL SERVICE - Installations, Start-Up, Troubleshooting, Repairs, Field Service, Returns.

CUSTOMER SERVICE - Replacement Parts, Individual Products, Questions about Orders, Manuals.

SALES - Product Information, Systems Application Questions, Placing orders for standard products and special systems.

Telephone: (603) 332-6150

Fax: (603) 332-3758

E-Mail : info@dfe.com Internet: www.dfe.com

©2004 Dover Flexo Electronics, Inc. All rights reserved. Dover Flexo Electronics has made reasonable effort to ensure accuracy of this document. However, NO WARRANTY, whether expressed or implied, is given regarding the completeness or correctness of information in this document. Dover Flexo Electronics shall not be held liable for damages of any kind arising from the use of this document. Dover Flexo Electronics reserves the right to make changes, additions, and deletions to this document without notice and without obligation.

TABLE OF CONTENTS

SECTION ONE	**DESCRIPTION**	**PAGE**
1.1	General Description	1
1.2	Construction and Mechanical Operation	1
1.3	Specifications	2
1.4	Standard Features	3
1.5	Configuration Choices	3
1.6	Options	3
SECTION TWO	**INSTALLATION**	
2.1	Dimensions	4
2.2	Pre-Installation Requirements	4
2.3	Selection of Load Rating	6
2.4	Installation Instructions	7
2.5	Removal of Roll and/or Transducers	10
2.6	Electrical Operation	11
SECTION THREE	**CALIBRATION AND SET-UP**	
3.1	Introduction	12
3.2	Zero the Tension Meter	12
3.3	Calibrate the Tension Meter	12
SECTION FOUR	**CARE AND MAINTENANCE**	
4.1	Bearing Life	13
SECTION FIVE	**TROUBLESHOOTING**	14
SECTION SIX	**REPLACEMENT PARTS**	16
APPENDICES:	A. Transducer Electrical Connections	17
	B. Typical Tensions	18
	Terms and Conditions	19
	Index	21

LIST OF ILLUSTRATIONS

FIGURE:	1.	Model THN Cut-away View	2
	2.	Dimensions	4
	3.	Model THN Mounting Styles	5
	4.	Tension Zones	5
	5.	Load Rating Selection formulas	6
	6.	THN Load Rating Chart	7
	7.	Shaft Length Calculation Formulas	7
	8.	Dead Shaft End Clearance	8
	9.	Live Shaft End Clearance	9
	10.	Tension Force Direction	9
	11.	Adjusting for Axial Play	10
	12.	Axial and Rotational Play	10
	13.	Strain Gage Connections	11
	14.	Web Path	13
	15.	Model THN Transducer Wiring	18

SECTION 1 PRODUCT DESCRIPTION

1.1 GENERAL DESCRIPTION

The Model THN (thin) Tension Transducer is an electro-mechanical device that converts web tension into a dc voltage which is proportional to tension. The voltage is amplified in external electronic circuitry and displayed on an analog or digital meter which is calibrated to indicate actual web tension. The tension reading is expressed in pounds, ounces, grams, kilograms, newtons or any other desirable units. It can also be supplied to a regulator circuit to control tension automatically.

The narrow width of the THN transducer allows it to be installed in locations where other transducers will not fit. It has also been designed so that it is not necessary to remove the transducers from the machine when removing the idler roll. Installation is very easy because the transducers are installed on the machine frames first, and the idler roll is then installed in the transducers. A single bolt in the center of the transducer mounts it to the machine frame. Because only one bolt is used, the transducer can be oriented at any angle without the need of multiple bolt patterns.

The model THN can be used with both dead shaft and live shaft idler rolls, with a variety of shaft sizes.

The information in this section will help give a clear understanding of the Model THN Transducer, how it works and how it is used.

1.2 CONSTRUCTION AND MECHANICAL OPERATION (see Figure 1)

In a typical installation, a transducer is mounted on each end of a standard idler roll. The roll shaft may be stationary (non-rotating or dead) in which case the transducer is known as the dead-shaft, or D version. Or the roll shaft may be rotating (live) and the transducer is known as the live-shaft, or L version. Both versions have a removable cap that clamps the shaft and allows removal of the idler roll from the transducers without removing the transducers from the machine. The L version is the same as the D version except, instead of clamping the shaft, the cap clamps a bearing which is installed on the end of the roll shaft.

The transducer contains a universal joint which allows the THN to compensate for misalignment and deflection of the idler roll shaft. This compensation is extremely important because it prevents mechanical pre-loading of the transducer which causes inaccurate tension measurement and may damage the transducer. A small amount of axial movement is built into the transducer to compensate for variations in shaft length caused by temperature fluctuations and shaft bending.

Inside the transducer is a dual cantilever beam with long-life semiconductor strain gages mounted on the top beam surface. The shaft is attached to the free end of the beam. When web tension is applied the beam deflects a small amount, causing an electrical output from the strain gages.

A mechanical stop prevents damage from accidental overloads. The stop is functional through 360 degrees, so the overload condition may occur from any direction, not just the load direction. In all cases, the beam is prevented from deflecting far enough to cause any damage.

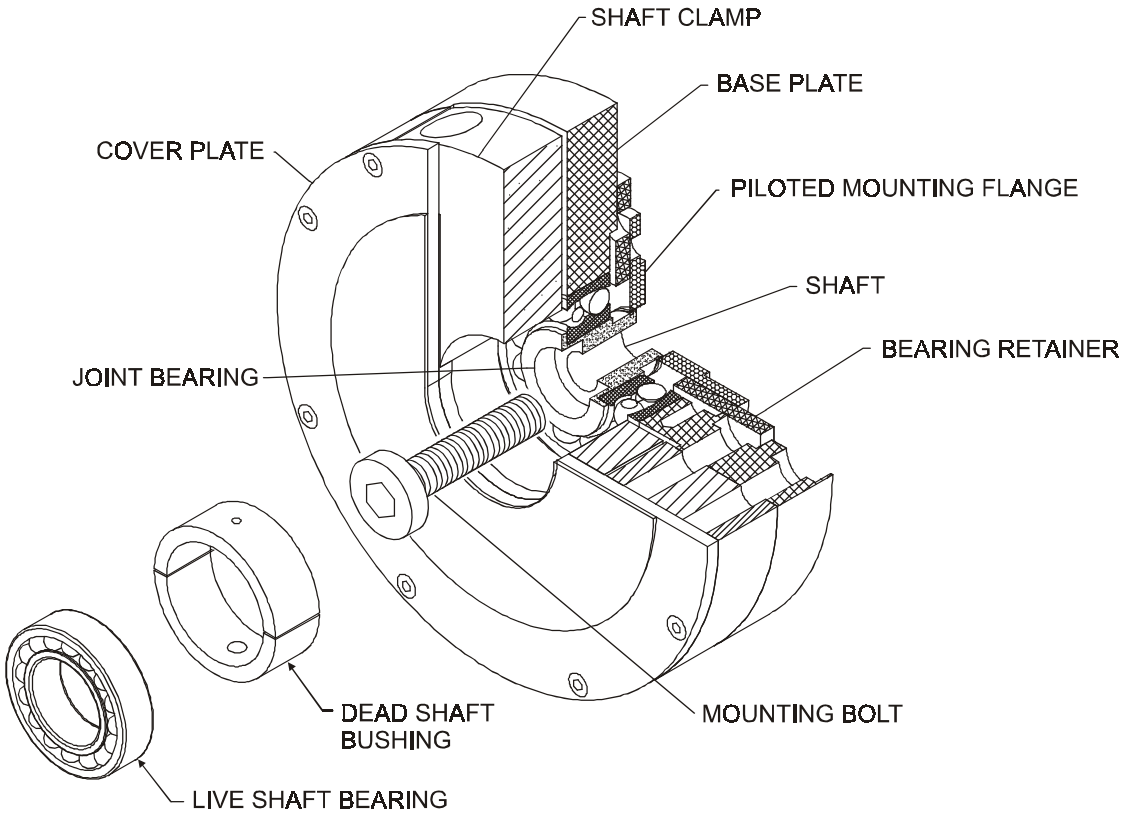


Figure 1 **- MODEL THN CUT-AWAY VIEW**

1.3 SPECIFICATIONS

Excitation Voltage:	5 Volts dc
Output:	250 mV, nominal, at 5V excitation
Strain Gages:	semiconductor, 100 ohms +/- 15 resistance
Repeatability:	+/- 1/4% full span (FS)
Linearity and Hysteresis Combined: . . .	+/- 1/2% FS
Temperature Range:	-10° F to +200° F (-23° C to +93° C)
Temperature Coefficient:	0.02% per degree F, typical (0.01% per degree C, typical)
Material:	303 stainless steel and 7075-T6 aluminum
Minimum Overload Capacity:	2500 lbs. (11121 N)
Deflection:	0.005" typical (0,127 mm typical)
Mis-alignment Capacity (degrees)	2°
Mating Electrical Connector:	Amphenol MS3106A-10SL-3S
Standard Connector Position:	1:30 o'clock with reference to force direction at 6 o'clock
Electrical Connections:	pin A - white wire = output pin B - black wire = +5V pin C - red wire = -5V
Maximum Shaft Sizes:	Dead (D) = 1.65" (42 mm), Live (L) = 0.98" (25 mm)
Shaft Size Tolerance:	nominal -0.002" (-0,051 mm) for D version
Load Ratings:	25, 50, 100, 200, 400, 800 lbs. (110, 225, 450, 900, 1800, 3550 N)
Mounting Bolt:	3/8-16 Low Head socket cap screw (M10 Low Head socket cap screw is optional)

1.4 STANDARD FEATURES

- **Only 1.76" (44.7mm) thick.** Fits where most transducers can not.
- **One-bolt installation.** Turn the transducer to the correct load orientation and tighten only one bolt.
- **Shaft clamp.** Allows quick removal of idler roll without removing transducers from machine.
- **Dual Cantilever Beam**. Provides high strength and accuracy at low tension.
- **Stainless Steel and Aluminum construction**. Excellent corrosion resistance.
- **Universal joint.** Corrects for misalignment and shaft bending.
- **Axial Movement.** For changes of shaft length caused by temperature variations.
- **Both dead shaft and live shaft versions.** Accommodates either stationary or rotating idler roll shafts.

1.5 CONFIGURATION CHOICES

These are explanations of standard choices of various configurations that were specified for your application.

- **Version Style.** L (Live) for rotating shafts, or D (Dead) for stationary or non-rotating shafts.
- **Mounting Style**. Screw or Bolt mount (S) uses a single bolt to mount flat against machine frame. The bolt must have a "low head" to avoid interference with the idler roll shaft. The THN transducer can also be installed very precisely by using a shallow pilot hole in the machine frame.
- **Load Ratings.** 25, 50, 100, 200, 400, 800 lbs. (110, 225, 450, 900, 1800, 3550 N)
- **Bore/Shaft Size**. Choices are as follows:

  D Version: 3/4, 7/8, 1, 1 1/8, 1 3/16, 1 1/4, 1 1/2, inches, 25mm, 30mm

  L Version: 20mm, 25mm

  Note: Cannot exceed maximum size listed in Specifications in section 1.3.
- **Connector Position**. 1:30 o'clock with tension force direction at 6 o'clock

1.6 OPTIONS

- **Environmental Connector (EC)**. Seals with mating cable electrical connector to protect against contact oxidation; especially useful in corrosive environments.
- **Extended Range (XR)**. Produces twice the output signal for a given load rating. Used in applications requiring a full scale tension force that is as low as 6% of the transducer rating.- 12% is standard. Must be used with electronics having the **XRE**, extended range option.
- **Full Bridge (FB)**. Four strain gauges instead of two to form a Wheatstone Bridge connection. Applies only if one transducer is used.
- **Metric Mounting Stud (MMS).** Metric screw for installation. Must have low head.
- **Vacuum Compensation (VAC).** Transducer has special screws and features for fast and complete air evacuation. Used for transducers installed in vacuum metallizers.

SECTION 2 INSTALLATION

2.1 DIMENSIONS inches (mm)

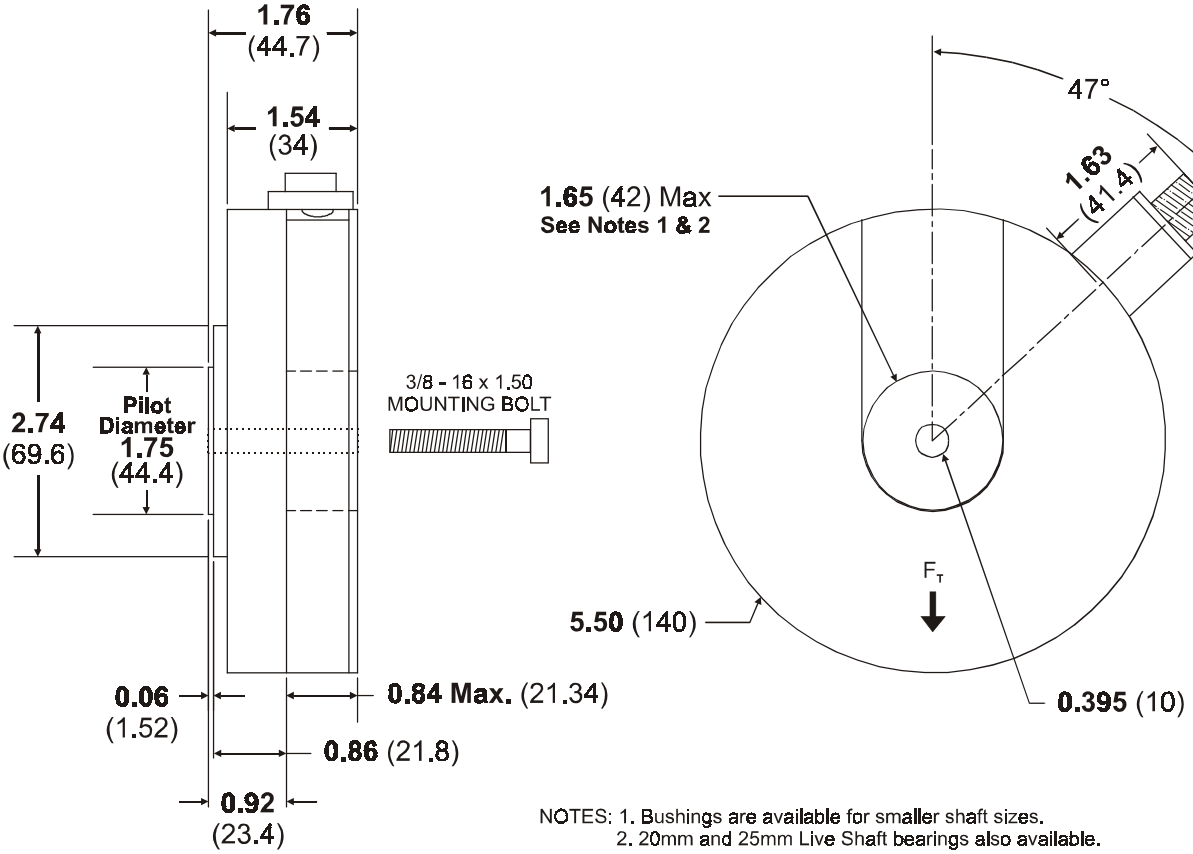


Figure 2 **- THN DIMENSIONS**

2.2 PRE-INSTALLATION REQUIREMENTS

A. TRANSDUCER ROLL

The Model THN Transducers are used in pairs. One is mounted at each end of an idler roll shaft. The roll chosen is called the Transducer Roll.

1. **The Transducer Roll MUST be a true idler!** It can NOT be a driven roll! There can be NO brakes, clutches, belts, chains or gears attached to it or its shaft. It can not be a nip roll or be in contact with a nip roll. It can not be filled with water or have pipes or hoses attached to it. **Nothing must contact the roll or its shaft except the web!**
2. The Transducer Roll shaft may be non-rotating (use the D version transducer) or rotating (use the L version transducer). If the shaft rotates, it must be designed and built for rotating service. Usually this means that it is straight, dynamically balanced and strong enough to resist bending from web tension forces.
3. The roll must be **Dynamically Balanced** if web speed is over 300 FPM! Refer to **Section 2.4.B** for specifications. An unbalanced roll will reduce the accuracy of the tension signal and may **DAMAGE** the transducers.

B. WRAP ANGLE

The web must always contact the transducer roll in exactly the same way. The wrap angle must not change as the unwind or rewind roll diameter changes. Therefore there must be at least one idler roll between the transducer roll and the unwind or rewind shaft. If the machine has more than one webbing path, be sure to choose a roll that is wrapped the same for each. Otherwise it will be necessary to install an additional pair of transducers, or dual calibration circuitry, or both. If the wrap angle is allowed to change, the transducer output will change with angle as well as tension, and accuracy will be reduced. Minimum wrap angle of 20° is required in most cases.

C. MOUNTING SURFACE

The structure on which the transducers are mounted **MUST** be very stable and strong. Any movement of the structure may be sensed by the transducers and may cause inaccurate tension readings. The surfaces must also be smooth and flat so the transducers won't be misaligned when they are installed.

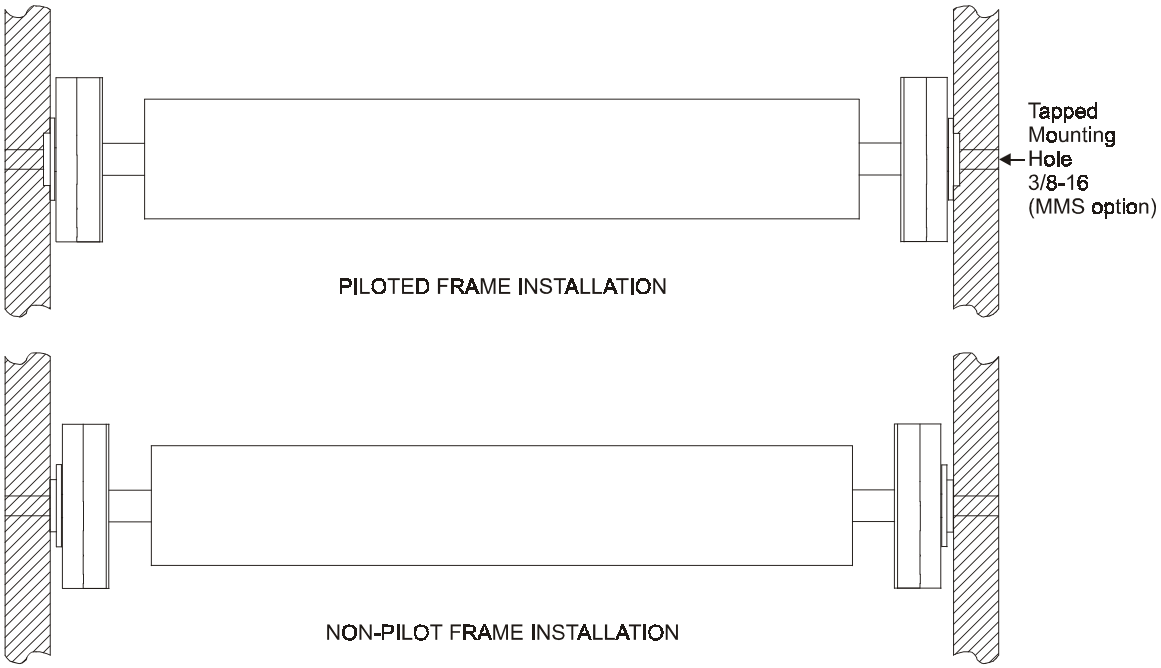


Figure 3 **- MODEL THN MOUNTING STYLES**

D. TENSION ZONE

The roll must be located in the tension zone which is to be monitored or controlled. The beginning or end of any tension zone is always at a nip (driven or braked), unwind shaft, rewind shaft or drag bar. Any element in the web path that can change web tension is at one end of a tension zone.

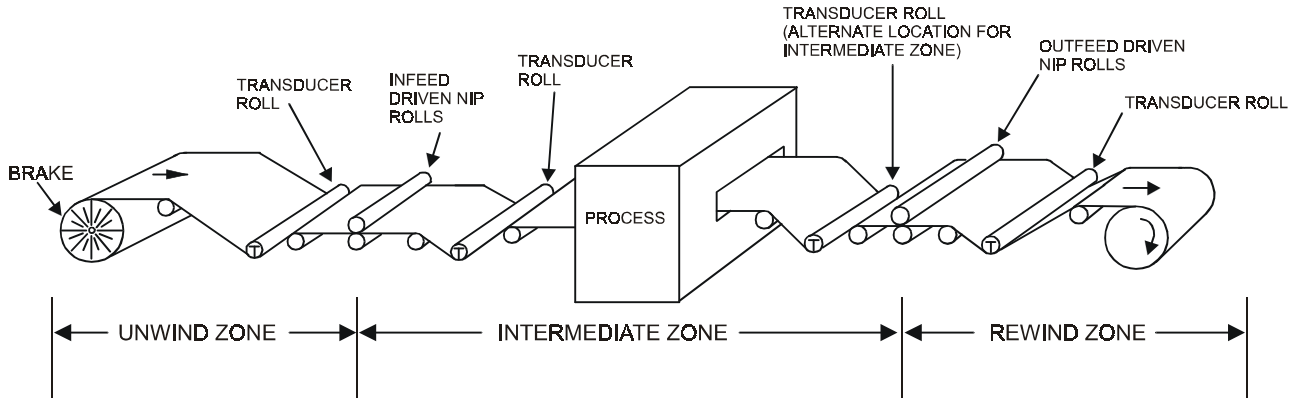


Figure 4 **- TENSION ZONES**

2.3 SELECTION OF LOAD RATING

A. LOAD RATINGS

The Model THN Transducer is available in several standard load ratings, ranging from 25 lbs. to 800 lbs. The correct rating for any particular application depends on web tension, transducer roll weight, wrap angle, and the direction of the tension force on the transducer roll. Figure 5 below contains mathematical formulas which use these factors to determine the correct load rating.

B. SELECTION PROCEDURE

The correct load rating is found in four simple steps:

1. OBTAIN DATA TO PLUG INTO THE SELECTION FORMULA

a. Weigh the transducer roll.

b. Estimate the maximum web tension. Use the Typical Tensions table in Appendix B as a guide if necessary.

c. Determine the wrap angle.

d. Determine the angle of the tension force, F_T, relative to the vertical. (**NOTE:** F_T bisects the wrap angle B)

2. COMPUTE NET FORCE USING THE SELECTION FORMULA

Refer to Figure 5. Select the appropriate wrap configuration as determined by the direction of the tension force (above, below or on horizontal). Compute the Net Force, using the formula below the wrap diagram.

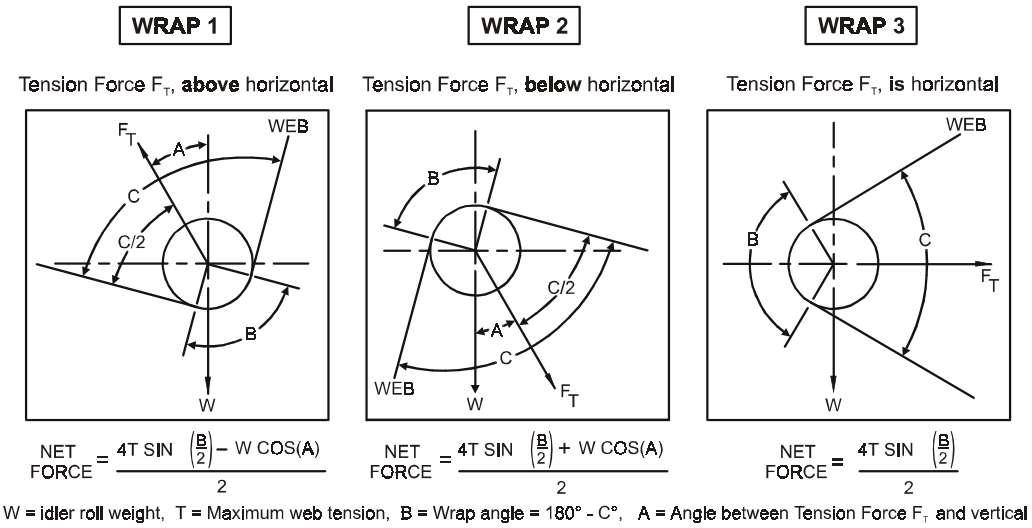


TABLE 1

Angle (Degrees)	SINE	COSINE
0	.000	1.000
5	.087	.996
10	.174	.985
15	.259	.966
20	.342	.940
25	.423	.906
30	.500	.866
35	.574	.819
40	.643	.766
45	.707	.707
50	.766	.643
55	.819	.574
60	.866	.500
65	.906	.423
70	.940	.342
75	.966	.259
80	.985	.174
85	.996	.087
90	1.000	.000

***Figure 5* - LOAD RATING SELECTION FORMULAS**

Use Figure 6 to select the correct load rating. In some cases, the load rating may be **LESS** than the computed Net Force. This is acceptable because the Net Force formula contains an oversizing factor of 2 for tension surges, which means that the actual force exerted on the transducer will not exceed its rating if the transducer is chosen according to the chart below. The actual force on the transducer will reach 125% of the load rating before hitting the beam deflection stop.

3. SELECT THE LOAD RATING

LOAD RATING CHART	
NET FORCE (lb)	LOAD RATING (lb)
up to 32	25
33 - 63	50
64 - 125	100
126 - 187	150
126 - 250	200
251 - 500	400
501 - 1000	800

***Figure 6* - LOAD RATING CHART**

4. COMPARE LOAD RATING WITH EFFECTIVE TRANSDUCER ROLL WEIGHT

Sometimes, a transducer roll is so heavy that its weight uses up most of the operating range of the transducers. When this happens, it may not be possible to adjust the tension indicating meter to read zero when tension is zero because the adjustment range of the electronic circuit has been exceeded. To find out if the roll is too heavy, compare the load rating with the effective weight of the roll as follows:

Refer back to the Net Force formula used in Section 2.3.B.2. The effective roll weight on the pair of transducers is the "W Cos(A)" term in the formula. If W Cos(A) is more than 95% of the load rating chosen, the tension meter will probably not be adjustable to zero. If this is the case, one or more of the following changes must be made to reduce W Cos(A) to less than 95% of the load rating:

1. Reduce the transducer roll weight.
2. Increase angle (A). (See Figure 5).
3. Use the next higher load rating. (This is the least desirable choice because it reduces the output signal).

2.4 INSTALLATION INSTRUCTIONS

Model THN Transducers are very easy to install. For both the Dead Shaft (D) version and Live Shaft (L) version, both transducers are mounted on the machine and the roll is then installed in them.

A. DETERMINE SHAFT LENGTH

Measure the distance between the machine frames (D) where the transducers will be mounted. Use the appropriate formula below to determine the correct shaft length. The formulas allow approximately 1/16 inch (1.5mm) clearance at both shaft ends. This clearance is necessary for proper operation and for ease of installation and removal. **DO NOT ALLOW THE SHAFT TO CONTACT THE BOTTOM OF THE BORE.** This may cause pre-loading! (see Figure 8).

SHAFT LENGTH CALCULATION		
SIZE	**FLUSH MOUNT**	**PILOT MOUNT**
2	L = D - 2.04 in (52 mm)	L = D - 1.92 in (49mm)
L = Shaft length in inches D = Distance between mounting surfaces in inches		

***Figure 7* - SHAFT LENGTH CALCULATION FORMULA**

B. BALANCE THE ROLL

The roll must be dynamically balanced if web speed is 300 FPM or more. Balance the roll to Quality Grade G-2.5 as described in ISO 1940 and ANSI S2.19-75 standards. If these standards are not available, please contact Dover Flexo Electronics and we will provide the appropriate data.

C. INSTALL THE ROLL AND TRANSDUCERS ON THE MACHINE

This part of the installation is slightly different for the (D) and (L) versions. Use the procedure under **1.** below for the (D) version. Use the procedure under **2.** for the (L) version. However, refer to Figures 8 and 9 for each version for illustration of the shaft end clearance. **CAUTION!** To avoid injury, be sure to follow your approved lockdown/lockout procedure before removing or installing rolls.

1. Installation Procedure for the D (dead shaft) Version:

a. Ensure that your shaft ends for the bushing size for your transducers. Refer to Figure 8.

b. Remove the clamp from the transducer by removing the two cap screws. Mount the transducers on the machine using the mounting bolt provided. Bring the bolt through the transducer front, through the piloted mounting flange and into the tapped inside wall of the machine frame. Orient the transducer so the force direction arrow bisects the wrap angle. The arrow must point away from the web contact area on the roll. Refer to Figure 10. Tighten the mounting bolt.

c. Lift and set the roll in place and hold it there.

d. Install the clamps and screws on both transducers. Leave the screws slightly loose.

e. Adjust the shaft depth to allow approximately 1/16 inch (1.5mm) end clearance in ONE transducer ONLY (see Figure 8). Tighten the clamp screws to fasten the shaft into the transducer.

DO NOT TIGHTEN the clamp screws on the other transducer yet! This must be done later, in Step D.

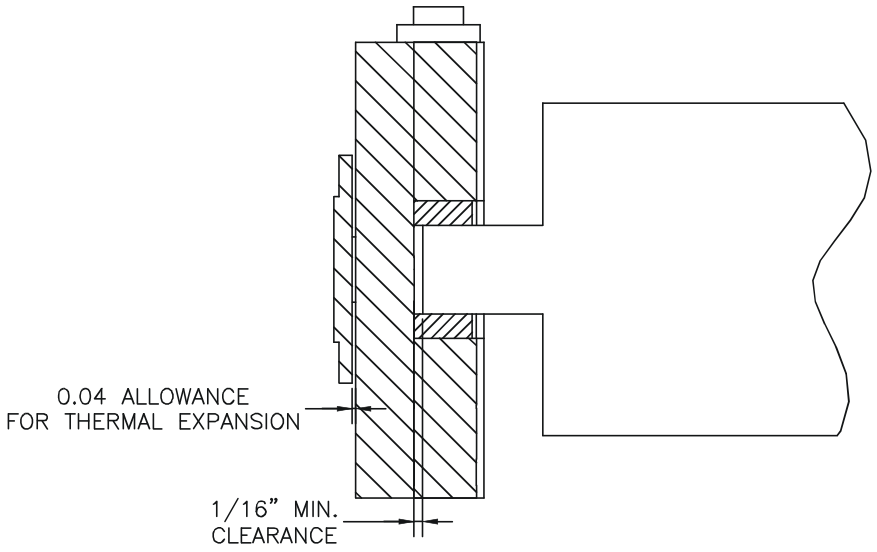


***Figure 8* - DEAD SHAFT END CLEARANCE**

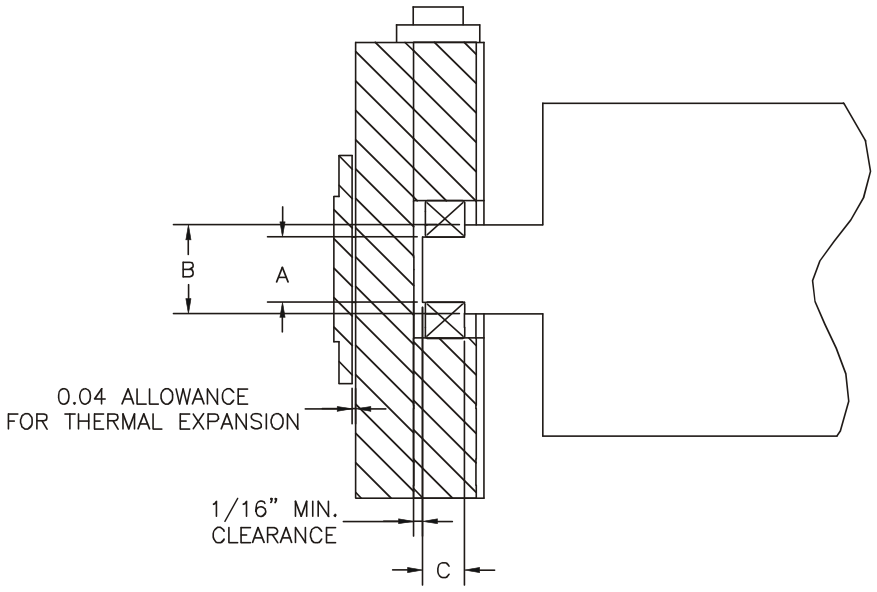
2. Installation Procedure for the L (Live shaft) version:

a. Ensure that roll ends are stepped or include snap ring to match dimensions(show below in Figure 9) for the correct bearing inner diameter and depth.

b. Install the bearings on the ends of the idler roll shaft.

c. Follow steps b thru e in 2.4.C.1. above.

d. Tighten clamp bolts to **not more than 5 lb-ft** torque.



	DESIGNATOR	ØA	ØB	C
20MM BORE BEARING	INCH	0.7880 0.7875	1.062	0.512
	mm	20.015 20.002	27	13
25MM BORE BEARING	INCH	0.9848 0.9843	1.062	0.394
	mm	25.015 25.002	27	10

***Figure 9* - DEAD SHAFT END CLEARANCE**

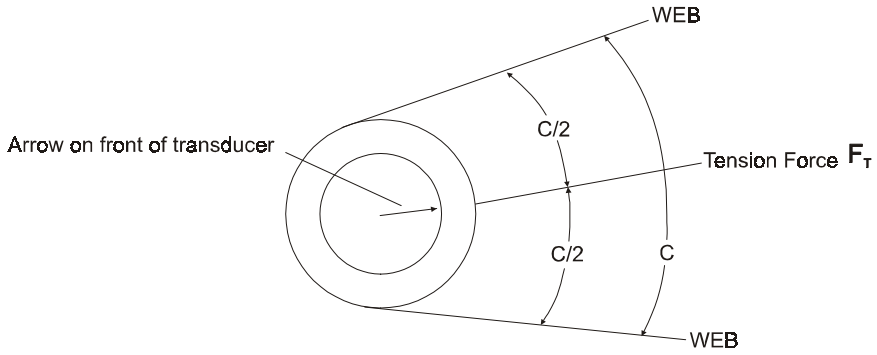


***Figure 10* - TENSION FORCE DIRECTION**

D. TIGHTEN THE LOOSE TRANSDUCER CLAMP (follow the instructions below very carefully)

For any tension transducer to operate properly, there must be some axial (along the idler shaft) movement capability to allow for shaft deflection and length variations caused by temperature fluctuations. The Model THN transducer is designed with approximately 0.040 inches (1.0mm) of axial movement per transducer with a maximum of 0.080" (1.5mm) per pair. To preserve this capability, follow the instructions below. A normal installation will have about 0.040" (1.0 mm) of axial movement. The D version coupling should also have a small amount of rotational free play. See Figure 12.

1. **Procedure** Refer to Figure 11. Remember, the left end transducer is tightly clamped to the shaft and the right end transducer clamp is loose.
   a. Pull the roll toward the loose clamp on the right end while pushing this transducer away from the roll.

b. Rotate the shaft and the loose transducer a small amount by hand in the same direction until they both stop.

c. Tighten the clamp cap screws alternately and progressively ½ turn at time to clamp the shaft into the transducer. **NOTE: <u>Do not exceed 5 lb-ft torque for L</u>** (live shaft version). Higher torque creates drag.

d. If shaft length is correct and installation has been done correctly, you will be able to move the idler roll shaft axially at least 0.040 inch (1.0mm). **THE AXIAL MOVEMENT IS ESSENTIAL TO THE PROPER OPERATION OF THE TRANSDUCERS!** If no movement can be detected, loosen one shaft coupling and repeat the installation procedures, Section 2.4.C, 1 or 2.

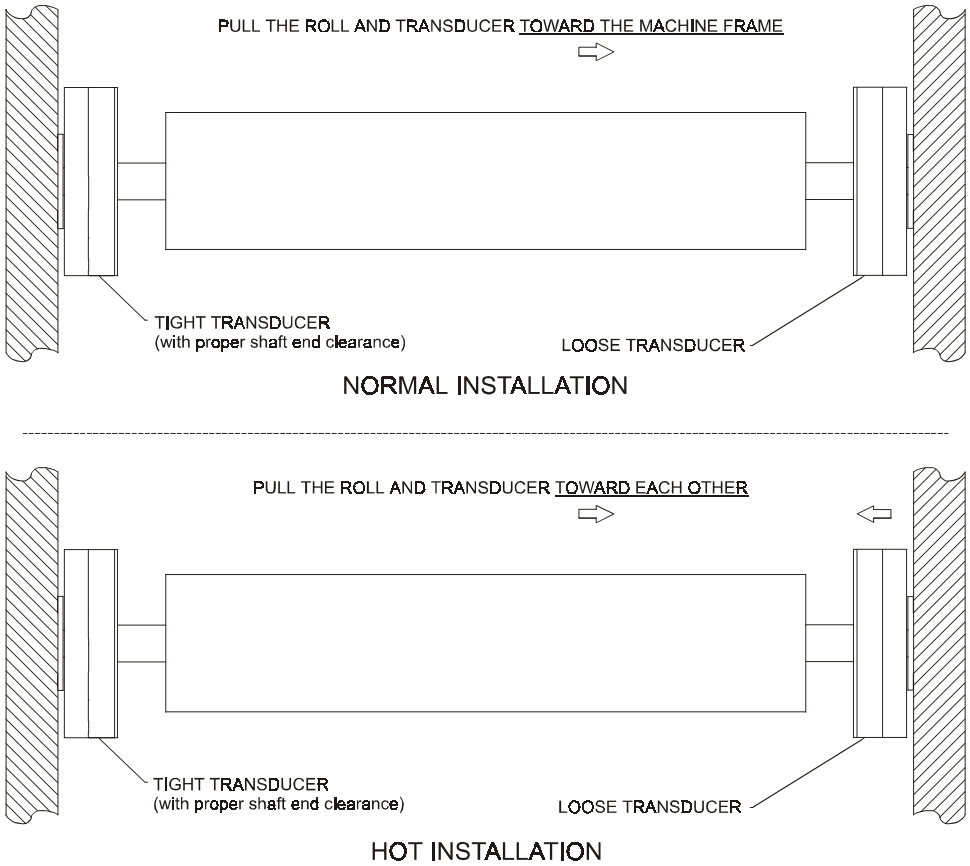


Figure 11 - **ADJUSTING FOR AXIAL PLAY**

2. **<u>Special procedure for Hot Installations</u>**: If the idler roll is exposed to high temperatures (from a hot web, for example), it may be advisable to maximize the axial movement to allow the shaft length to expand more without danger of preloading the transducers. To increase axial movement to the maximum; follow the procedures in 2.4.D, BUT push the loose transducer <u>toward</u> the roll instead of away from it. Refer to Figure 10. This will double the available axial expansion capability as compared to the normal installation procedures.

VERIFY THE AXIAL MOVEMENT NOW. NOTE: If you used the special procedure for hot installations you will not be able to measure any axial movement until the idler roll gets hot.

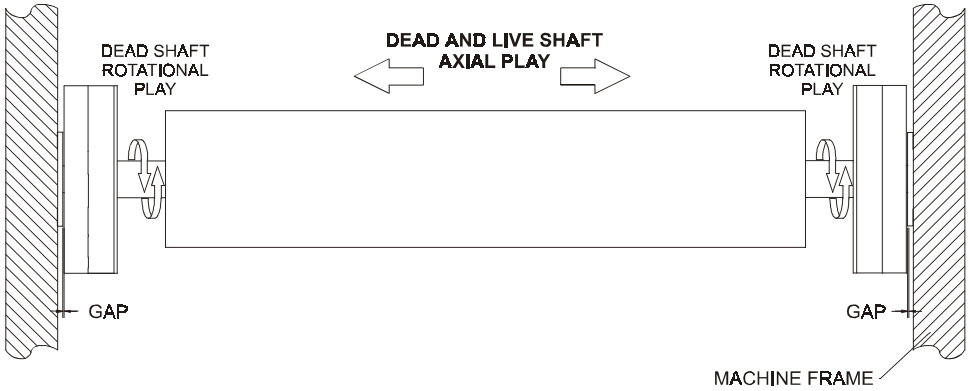


Figure 12 - **AXIAL AND ROTATIONAL PLAY**

VERIFY THE ROTATIONAL FREE PLAY (D version, only) at this time, see Figure 11. Not much is needed, only enough to be able to feel. If none is detected, loosen one shaft clamp and turn both the idler shaft and the loose coupling in the SAME direction. Then re-tighten the clamp.

The rotational and axial movements eliminate the possibility of mechanically pre-loading the transducers. Pre-loading causes non-linearity, zero-drift, and loss of calibration.

NOTE: It is important for accuracy and safety that the shaft clamp screws be tightened firmly.

E. CHECK THE GAP FOR CORRECT ALIGNMENT (see Figure 12)

Up to 2° of transducer misalignment is possible. However, misalignment during installation may cause mechanical preloading and loss of accuracy. It is best to minimize misalignment as much as possible.

Measure the gap between the transducer and machine frame in at least four places equally spaced around the circumference of each transducer. A mis-alignment of 2° will measure 0.096" (2.4mm) difference in clearance between the transducer and the machine frame from the minimum gap to the maximum gap. Shim or reposition the transducers at the mount surface as necessary. If shims are installed, check the axial movement again. Refer to 2.4D.1 or 2 for the procedure. Be sure the correct axial movement is present.

2.5 REMOVAL OF ROLL AND/OR TRANSDUCERS

To remove the transducers, first support the idler roll so it won't fall. Then, follow the procedure below to remove the roll shaft from the transducers. **CAUTION!** To avoid injury, be sure to follow your approved lockdown/lockout procedure before removing or installing rolls.

A. <u>Procedure for both D and L versions:</u>

1. Remove the two screws from the shaft clamp on each transducer and lift off the clamp.
2. Take the roll out of the transducers.
3. Remove transducers, if needed.

2.6 ELECTRICAL OPERATION

The Model THN Transducer is used in pairs, one on each end of an idler roll shaft. Web tension exerts a force on the roll which is transmitted to the cantilever beam by the idler roll shaft. Two semiconductor strain gages are mounted on the beam, one on the top and one on the bottom. As force is applied and the beam deflects, the top gage is stretched and the bottom gage is compressed. This increases the electrical resistance of the top gage and decreases the resistance of the bottom gage. The gages in both transducers are electrically connected together in a Wheatstone bridge configuration. The output from the bridge is the sum of the output from the two transducers. Therefore, web position, width and loose or tight edges do not affect the accuracy of the tension signal.

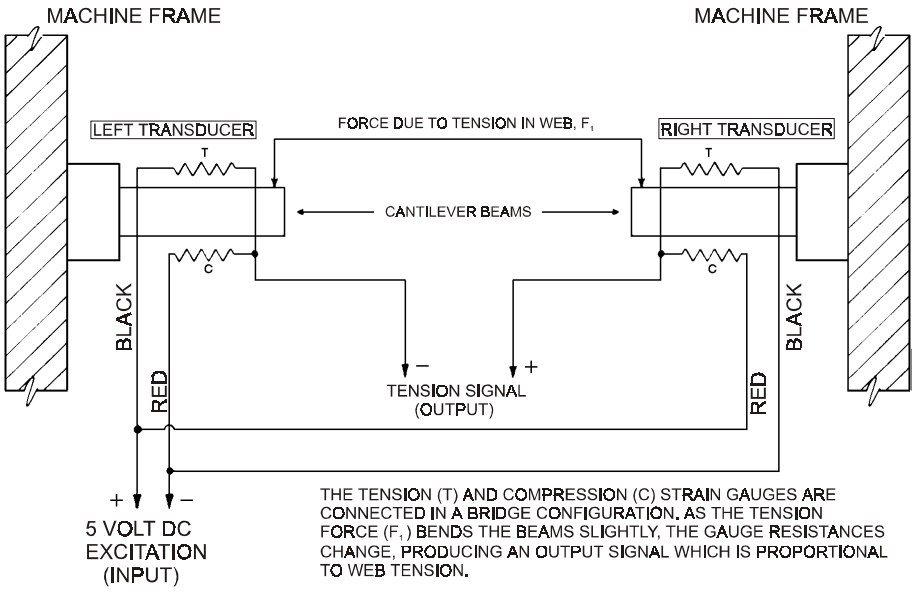


***Figure 13* - STRAIN GAGE CONNECTIONS**

The physical location of the strain gages, on opposite ends of the beam, ensures that each gage experiences the same temperature variations. This, and the Wheatstone bridge configuration, provides automatic temperature compensation and a stable output.

The strain gages are high output semiconductor devices which typically have an output sixteen times greater than the inexpensive foil gages used in some transducers. Therefore, the signal amplifier used with these Model THN transducers is a very stable low-gain design. An added benefit of the high output is inherently high immunity to electrical noise.

SECTION 3

CALIBRATION AND SETUP

3.1 INTRODUCTION

There are no calibration adjustments on the Model THN transducer itself. The instructions below are for the electronic device which the transducers are connected to. All of the terminology and procedures, following, assume that the transducers are connected to a **DOVER FLEXO ELECTRONICS** tension controller or tension indicator. If some other device is being used, you should follow the instructions furnished with it.

These are general instructions which are correct for most **DFE** controllers and indicators, and are placed here for your convenience. If you have any difficulty calibrating or if there is any discrepancy between these instructions and those in the Instruction Manual for the indicator or controller, you should disregard these instructions and follow the instructions in the Manual for the indicator or controller.

*The transducers must be properly installed and oriented as directed in **SECTION 2.4**, pages 7-10.*

3.2 ZERO THE TENSION METER

1. Turn the "POWER" switch off. If the meter does not read zero, turn the mechanical adjustment screw on the meter face so the needle indicates zero tension.
2. Find an object of some kind that weighs at least 25% of the maximum value on the tension meter scale. (Be sure you know the exact weight). Calculate the exact ratio of this calibration weight and the expected web tension.
3. Find a rope, tape, or wire that will support the weight in 2. above.
4. Verify that there is no web contacting the Transducer Roll. Turn the "POWER" switch on. Wait for about five minutes for the tension meter to settle. Turn the "CALIBRATE" pot. to approximately 75%. Then, turn the "ZERO" pot. so the tension meter reads zero tension.

3.3 CALIBRATE THE TENSION METER

See Figure 13. Pass the rope over the Transducer Roll in exactly the same path as the web follows. Tie the end in the machine at least one idler roll beyond the Transducer Roll. Pass the other end by at least one idler roll before the Transducer Roll. Be sure the rope does not pass over any driven rolls, braked rolls, or dead bars. (This will cause in-accurate calibration). Attach the weight to the free end of the rope and let it hang without touching anything. Turn the "CALIBRATE" pot. so the tension meter reads the same ratio of scale as the ratio of the calibration weight and maximum tension calculated in Section 3.2. Remove the weight and rope. This concludes the calibration procedure.

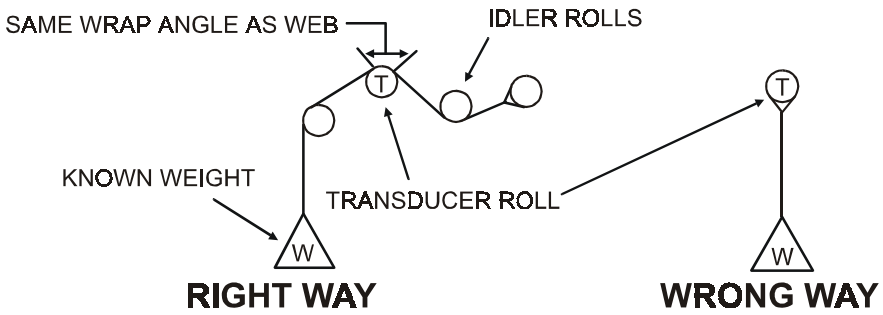


***Figure 14* - WEB PATH**

SECTION 4

CARE AND MAINTENANCE

Your Dover Flexo Model THN Tension Transducers have been manufactured of quality materials. With proper application and installation your transducers will be maintenance free and long lasting. Any changes in your application which affect the dynamics of your equipment such as web speed, net force, material, etc. could possibly require upgrading of load rating or a roll change. Contact Dover for specific information and engineering assistance.

4.1 BEARING LIFE (L version, only)

The shaft bearing in the L (live or rotating shaft) version of the Model THN transducer will turn continuously in normal operation. It has been selected to give a long service life under typical operating conditions and is lubricated for life. Be sure the bearing clamp screws have been tightened to **no more than 5 lb-ft torque**. Higher torque will deform the bearing and shorten its life. It will also cause the idler roll to resist turning, creating drag.

SECTION 5

TROUBLESHOOTING

This is a list of problems which could occur during initial start-up or afterwards. The probable causes are listed with the most likely one first and the least likely one last.

1. TRANSDUCER ROLL SHAKES, VIBRATES, or BOUNCES

a. Roll is not balanced. See Section 2.4.B page 8 and Section 2.2 page 4.

b. Shaft is not clamped tightly in transducers. Coupling screws are loose or shaft diameter is undersize.

c. Transducer mounting bolts are not tight.

d. Shaft is too weak or there is too much shaft extension between the ends of the roll and the transducers.

e. Shaft is bent or too weak.

f. Roll is turning at its natural frequency. Call our **TECHNICAL SERVICE DEPARTMENT** for analysis of operating conditions and solution to problem.

2. CAN NOT ADJUST TENSION METER TO READ ZERO WHEN WEB IS SLACK

a. Transducer roll is too heavy. See Section 2.3.B.4 on page 7.

b. Transducers are pre-loaded. See Section 2.4.A page 7 and 2.4.D page 9.

3. TENSION METER READS BACKWARDS

a. Transducers are installed backwards with force arrow pointing in opposite direction. See Section 2.4.C page 8.

b. Transducer cables are connected wrong at controller/indicator terminal strip. Signal wires are reversed.

4. TENSION METER NEEDLE PEGS HIGH OR LOW

a. Meter is not electrically adjusted to zero. See Section 3.2 page 12.

b. Transducers are pre-loaded. See Section 2.4.A page 7 and 2.4.D page 9.

c. Transducer cable has broken wire, poor connection or short circuit.

d. A strain gage has failed. To verify: Unplug the transducer cable and use an ohm-meter to measure the resistance of the gages at the connector on the transducer. Measure between pins A,B, and A,C. In each case, the resistance should be about 100 ohms. Measure the resistance between any pin and the outside of the transducer. The meter should read infinite resistance. Apply a force to the roll by hand or by using a rope and a weight, in the direction of the tension force and maintain it while again measuring between pins A,B and A,C. The resistance should be only a few ohms different from before.

e. Failure in the tension amplifier circuit of the controller/indicator.

5. TENSION METER DOES NOT READ ZERO WHEN WEB IS SLACK AND READING DRIFTS WITH TIME.

a. Meter is not calibrated. See Section 3.3 page 12

b. Transducers are pre-loaded. See Section 2.4.A page 7 and 2.4.D page 9.

c. The structure the transducers are mounted on is weak. See Section 2.2.C page 5.

d. Transducer cable has a broken wire, poor connection or short circuit.

e. A strain gage is cracked. Perform the test in 4d above.

6. **TENSION METER DOES NOT READ THE SAME EACH TIME THE SAME FORCE IS APPLIED** (poor repeatability)
   a. Transducers are pre-loaded. See Section 2.4.A page 7 and 2.4.D page 9.
   b. The structure the transducers are mounted on is weak. See Section 2.2.C page 5.
   c. The shaft coupling cap screws are loose.

7. **TENSION METER READING DOES NOT CHANGE WHEN FORCE IS APPLIED TO ROLL. METER READS ZERO.**
   a. Meter is not calibrated. See Section 3.3 page 12.
   b. Gap between shaft coupling and beam housing is not even. See Section 2.4.E page 10.
   c. Transducer roll is too heavy. See Section 2.3.B.4, page 7.
   d. Transducer cable has broken wire, poor connection or short circuit.
   e. Transducer cables connected incorrectly, or to wrong transducers.
   f. Failure of tension amplifier circuit in controller/indicator. Unit not turned on.

8. **TENSION METER NEEDLE BOUNCES**
   a. Web tension is fluctuating because of machine speed fluctuations, bent roll shafts, worn idler roll bearings, chattering unwind brake, flat spot in unwind or rewind roll, etc.
   b. Shaft is loose in the transducers. Shaft coupling cap screws are loose or shaft diameter is under-size.
   c. Transducer mounting bolts are loose.
   d. Tension controller is not adjusted properly. See controller Instruction Manual for procedure.

9. **TRANSDUCER ROLL WON"T TURN FREELY** (Live shaft version, L, only)
   a. Clamp screws too tight. Loosen and retighten to no more than 5 lb-ft torque. The bearing on the idler roll shaft is squeezed too tightly.

SECTION 6

REPLACEMENT PARTS

PART	TRADE NUMBER	DOVER PART NUMBER
Electrical Connector	MS3102A - 10SL - 3P	106-0070
Connector Screws	M3 x 6 Socket Button Head	123-0032
Joint Bearing	1204	133-0058
Shaft Bearing (L type only) 20mm	6004 2Z	133-0061
Shaft Bearing (L type only) 25mm	61905	133-0062
Shaft Bushing (D Type)	None	866-1750 (Specify bore diameter)
Shaft Clamp Screws (D & L Type)	M8 x 20	123-0045
Mounting Bolt	3/8 - 16 Low Head socket cap screw M10 Low Head socket cap screw (option)	123-0464 123-0462

NOTE: All screws are steel socket head, metric, grade 8.8 or higher, coarse thread unless otherwise noted.

Call **Customer Service** for prices and for part numbers of items not listed. For help with service or repairs, call **Technical Service.**

DOVER FLEXO ELECTRONICS

Telephone: 603-332-6150

Fax: 603-332-3758

TOOLS NEEDED FOR DISASSEMBLY

The following metric socket screw keys are the only tools normally needed for assembly or disassembly of the Model THN transducer.

Screw Size	Key Size (mm)	Transducer Size
M3 button/flat heads	2.0	2
M3	2.5	2
M5	4.0	2
M6	5.0	2
M8	6.0	2

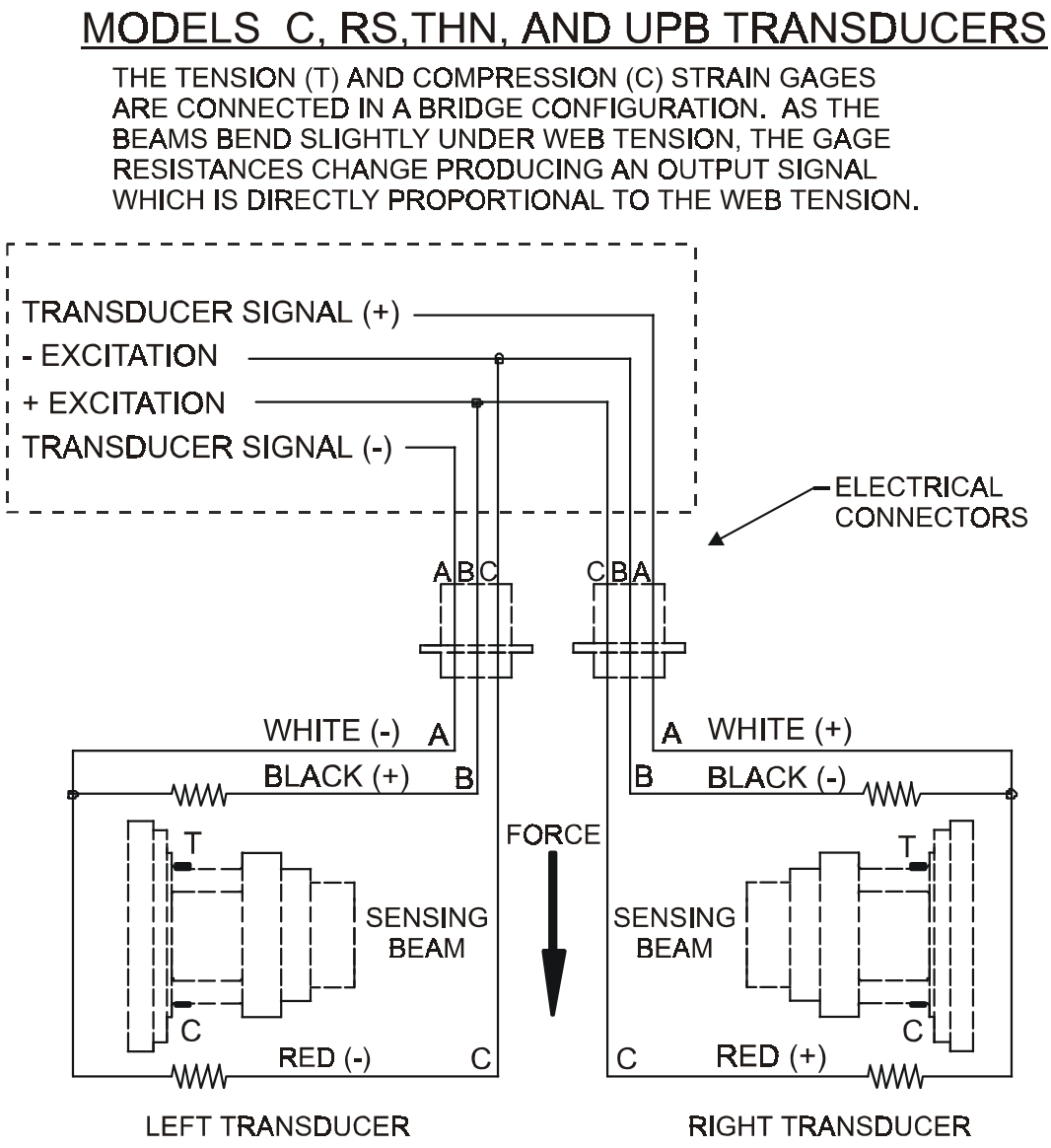


Figure 15 **- MODEL THN TRANSDUCER WIRING**

Appendix B: Typical Tensions for Various Materials

TYPICAL TENSIONS FOR WEB MATERIALS

ACETATE		0.5 lb. per mil per inch of width
FOIL	Aluminum	0.5 lb. per mil per inch of width
	Copper	0.5 lb. "
CELLOPHANE		0.75 lb. per mil per inch of width
NYLON		0.25 lb. per mil per inch of width
PAPER	15 lb *	0.4 lb. per inch of width
	20 lb	0.5 lb. "
	30 lb	0.75 lb. "
	40 lb	1.25 lb. "
	60 lb	2.0 lb. "
	80 lb	3.0 lb. "
	100 lb	4.0 lb. "
	* based on 3000 sq. ft. ream	
PAPERBOARD	8pt	3.0 lb. per inch of width
	12pt	4.0 lb. "
	15pt	4.5 lb. "
	20pt	5.5 lb. "
	25pt	6.5 lb. "
	30pt	8.0 lb. "
POLYETHYLENE		0.12 lb. per mil per inch of width
POLYESTER (Mylar)		0.75 lb. per mil per inch of width
POLYPROPYLENE		0.25 lb. per mil per inch of width
POLYSTYRENE		1.0 lb. per mil per inch of width

RUBBER	GAUGE	AT 25% STRETCH	AT 50% STRETCH
	10 mil	1.75	3.68
	12 mil	1.10	2.03
	16.5 mil	4.09	8.17
	26 mil	2.47	4.97

SARAN	0.15 lb per mil per inch of width	

STEEL	GAUGE - INS	UNWIND-PSI	REWIND-PSI
	0.001 - 0.005	1000	4000
	0.006 - 0.025	850	3500
	0.026 - 0.040	750	3000
	0.041 - 0.055	650	2600
	0.058 - 0.070	550	2200
	0.071 - 0.090	450	1800
	0.091 - 0.120	450	1400
	0.121 - 0.140	400	1200
	0.141 - 0.165	400	1000
	0.166 - 0.200	400	900
	0.201 - 0.275	400	800
	0.276 - 0.380	300	700

VINYL	0.05 lb. per mil per inch of width

*** For laminated webs, sum the tension for the individual webs and add 0.1 lb per inch of width.

TERMS AND CONDITIONS OF SALE AND SHIPMENT

1. THE COMPANY **5/1/00**

Dover Flexo Electronics, Inc. is hereinafter referred to as the Company.

2. CONFLICTING OR MODIFYING TERMS

No modification of, additions to or conflicting provisions to these terms and conditions of sale and shipment, whether oral or written, incorporated into Buyer's order or other communications are binding upon the Company unless specifically agreed to by the Company in writing and signed by an officer of the Company. Failure of the Company to object to such additions, conflicts or modifications shall not be construed as a waiver of these terms and conditions nor an acceptance of any such provisions.

3. GOVERNING LAW

This contract shall be governed by and construed according to the laws of the state of New Hampshire, U.S.A. The parties agree that any and all legal proceedings pursuant to this contract shall take place under the jurisdiction of the courts of the State of New Hampshire in the judicial district of Strafford County.

4. PENALTY CLAUSES

Penalty clauses of any kind contained in orders, agreements or any other type of communication are not binding on the Company unless agreed to by an officer of the Company in writing.

5. WARRANTY

Dover Flexo Electronics, Inc. warrants its' products to be free of defects in material and workmanship for five years from date of original shipment. Warranty is valid on products purchased on or after April 2, 1999. During the warranty period the Company will repair or replace defective products free of charge if such products are returned with all shipping charges prepaid and if, upon examination, the product is shown to be defective. This warranty shall not apply to products damaged by abuse, neglect, accident, modification, alteration or mis-use. Normal wear is not warrantied. All repairs and replacements under the provisions of this warranty shall be made at Dover Flexo Electronics or at an authorized repair facility. The Company shall not be liable for expenses incurred to repair or replace defective products at any other location or by unauthorized persons or agents. This warranty contains all of the obligations and warranties of the Company. There are no other warranties, either expressed or implied. No warranty is given regarding merchantability or suitability for any particular purpose. The Company shall not be liable in either equity or law for consequential damages, losses or expenses incurred by use of or inability to use its' products or for claims arising from same. No warranty is given for products of other manufacturers even though the Company may provide these products with its' own or by themselves. The provisions of this warranty can not be changed in any way by any agent or employee of the Company. Notice of defects must be received within the warranty period or the warranty is void.

6. PAYMENTS

Standard terms of credit are net 30 days from date of shipment, providing satisfactory credit is established with the Company. Amounts past due are subject to a service charge of 1.5% per month or portion thereof or 18% per annum. The Company reserves the right to submit any unpaid late invoices to a third party for collection and Buyer shall pay all reasonable costs of such collection in addition to the invoice amount. All quoted prices and payments shall be in U.S. Dollars.

If the Company judges that the financial condition or payment practices of the Buyer does not justify shipment under the standard terms or the terms originally specified, the Company may require full or partial payment in advance or upon delivery. The Company reserves the right to make collection on any terms approved in writing by the Company's Finance Department. Each shipment shall be considered a separate and independent transaction and payment therefore shall be made accordingly. If the work covered by the purchase order is delayed by the Buyer, upon demand by Company payments shall be made on the purchase price based upon percentage of completion.

7. TAXES

Any tax, duty, custom, fee or any other charge of any nature whatsoever imposed by any governmental authority on or measured by any transaction between the Company and the Buyer shall be paid by the Buyer in addition to the prices quoted or invoiced.

8. RETURNS

Written authorization must be obtained from the Company's factory before returning any material for which the Buyer expects credit, exchange, or repairs under the Warranty. Returned material (except exchanges or repairs under the Warranty) shall be subject to a minimum re-stocking charge of 15%. Non-standard material or other material provided specially to the Buyer's specification shall not be returnable for any reason. All material returned, for whatever reason, shall be sent with all freight charges prepaid by the Buyer.

9. SHIPPING METHOD AND CHARGES

All prices quoted are F.O.B. the Company's factory. The Company shall select the freight carrier, method and routing. Shipping charges are prepaid and added to the invoice of Buyers with approved credit, however the Company reserves the right to ship freight-collect if it prefers. Shipping charges will include a charge for packaging. Company will pay standard ground freight charges for items being returned to Buyer which are repaired or replaced under the Warranty.

10. CANCELLATION, CHANGES, RESCHEDULING

Buyer shall reimburse Company for costs incurred for any item on order with the Company which is cancelled by the Buyer. Costs shall be determined by common and accepted accounting practices.

A one-time hold on any item ordered from the Company shall be allowed for a maximum of 30 days. After 30 days, or upon notice of a second hold, Company shall have the right to cancel the order and issue the appropriate cancellation charges which shall be paid by Buyer. Items held for the Buyer shall be at the risk and expense of the Buyer unless otherwise agreed upon in writing. Company reserves the right to dispose of cancelled material as it sees fit without any obligation to Buyer.

If Buyer makes, or causes to make, any change to an order the Company reserves the right to change the price accordingly.

11. PRICES

Prices published in price lists, catalogs or elsewhere are subject to change without notice and without obligation. Written quoted prices are valid for thirty days only.

12. EXPORT SHIPMENTS

Payment for shipments to countries other than the U.S.A. and Canada or to authorized distributors shall be secured by cash in advance or an irrevocable credit instrument approved by an officer of the Company. An additional charge of 10% will apply to any letter of credit. There will be an extra charge for packaging and documentation.

13. CONDITION OF EQUIPMENT

Buyer shall keep products in good repair and shall be responsible for same until the full purchase price has been paid.

14. OWNERSHIP

Products sold are to remain the property of the Company until full payment of the purchase price is made.

NOTES

INDEX

Axial movement 3, 9, 10
  adjustment 9
  amount 9

Balance, dynamic 4, 8
Beam 1, 2, 3
Bearing 1, 2, 9, 16
  life 14
  options 3, 9
  part number 17

Calibration 13
Configuration Choices 1, 2, 3

Deflection 1, 2
Dimensions 4

Electrical connections..... 2, 11, 18
Electrical connector..... 2, 3, 17
  environmental 3
  mating connector part number 2
End clearance of shaft 7, 8, 9
Excitation voltage 2, 18
Extended Range 3

F_T (see Tension force)

Gage (see Strain gage)
Gap (Alignment) 10, 11

Hysteresis 2

Installation 4-11
L version 1, 3, 9
Linearity 2
Load rating 2, 3
  selection of 6-7

Mechanical Operation 1
Misalignment 1, 2, 10, 11
Material 2, 3
Mounting
  styles 3, 5
  surface 5

Net Force 6, 7

Options 3
Output 2, 18
Overload 1
  ratings 2
  stops 1, 6

Parts, replacement 17
Pre-installation Requirements 4
Pre-loading 1, 7, 10, 11, 15, 16

Removal of transducer roll 11
Repeatability 2
Replacement Parts 17
Rotational play 9-10, 11

Shaft, idler roll 1, 2, 7
  end clearance 8, 9
  length 7
  size 2, 3
  tolerance 2
Specifications 2
Standard Features 3

Strain gage 1, 2, 3,11, 15, 18
Stops (see Overload stops)
Temperature coefficient & range 2
Tension force 4, 6, 9, 11, 18
Tensions, typical 19
Tension zones 5
Terms and Conditions of Sale 20
Transducer roll 4, 6, 7
Troubleshooting 15-16

Vacuum Compensation 3

Warranty 20
Web path 13
Wheatstone bridge 3, 11, 18
Wrap angle 5, 6, 8, 9, 13

DOVER FLEXO ELECTRONICS, INC.

217 PICKERING ROAD
ROCHESTER, NEW HAMPSHIRE 03867-4630 U.S.A
TEL: 603-332-6150
FAX: 603-332-3758
E-mail: info@dfe.com Internet: www.dfe.com

CANADA

MEXICO

UNITED KINGDOM

EUROPE

TAIWAN

KOREA

AUSTRALIA

COLOMBIA

©2004 DOVER FLEXO ELECTRONICS, INC.
ALL RIGHTS RESERVED

DOC 801-1752
PRINTED IN USA