



DOVER FLEXO ELECTRONICS, INC.
ISO 9001 CERTIFIED

INSTRUCTION MANUAL
MODEL NWI TRANSDUCER

DOC 801-0725 Rev 4

5 YEAR WARRANTY



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1.1 GENERAL DESCRIPTION

The Model NWI Narrow Web Tension Transducer is an electro-mechanical device that converts web tension into a D.C. 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, 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 Web Tension Transducer combines a bearing-mounted idler roll and two tension sensing elements in one package. Typically, it is used in tension control and display systems in label, tag, or tape printing or processing machines where the machine has only one side frame and the idler rolls are cantilevered.

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

1.2 CONSTRUCTION AND MECHANICAL OPERATION (see figure 1)

The Narrow Web roll is manufactured to industry standards for Total Indicated Runout (TIR), surface finish and taper. Optional surface finishes such as hard coat anodized, grooved, or plasma coat, are also available.

The shaft is one piece steel pressed into the stainless steel shaft housing for added rigidity. Perpendicularity to the base of the shaft housing is maintained to within 0.005 inches per foot of shaft length.

The bearings are the standard deep-groove ball type with a seal on the side toward the center of the roll to prevent grease from entering the roll. Shields are provided at the ends of the roll to discourage entrance of contamination. An extra-deep bearing bore on the connector end allows the roll to expand in length with rising temperature without causing any stress on the roll or bearings.

Inside the transducer are two dual cantilever beams, one at each end of the roll, with strain gages mounted on the top and bottom surfaces of each. The bearings are attached to the free end of each beam. When web tension is applied the beam deflects a small amount, causing an electrical output from the strain gages.

The shaft acts as a mechanical stop, preventing damage from accidental overloads. The stop is functional thru 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 damage.

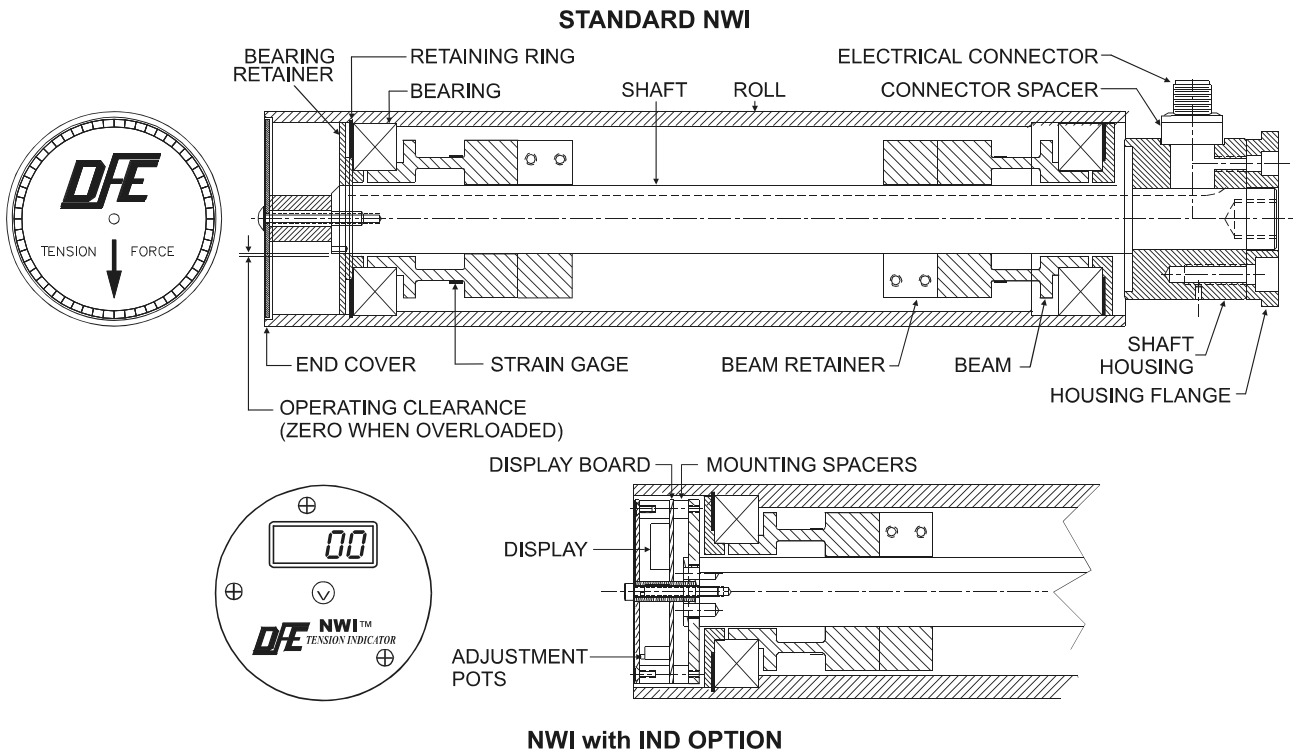


Figure 1 - CUT-AWAY VIEWS OF NWI TRANSDUCER

1.3 ELECTRICAL OPERATION (see figure 2)

The Model NWI Transducer has two tension sensors, one inside each end of the transducer roll. Web tension exerts a force on the roll which is transmitted to the cantilever beams by the bearings. 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 on both beams are electrically connected together in a Wheatstone bridge configuration. The bridge produces double the output of a single beam and averages the outputs so web position, width and loose or tight edges do not affect the accuracy of the tension signal.

THE TENSION (T) AND COMPRESSION (C) STRAIN GAGES ARE CONNECTED IN A BRIDGE CONFIGURATION. AS THE BEAMS BEND SLIGHTLY UNDER WEB TENSION, THE GAGE RESISTANCES CHANGE PRODUCING AN OUTPUT SIGNAL WHICH IS DIRECTLY PROPORTIONAL TO WEB TENSION.

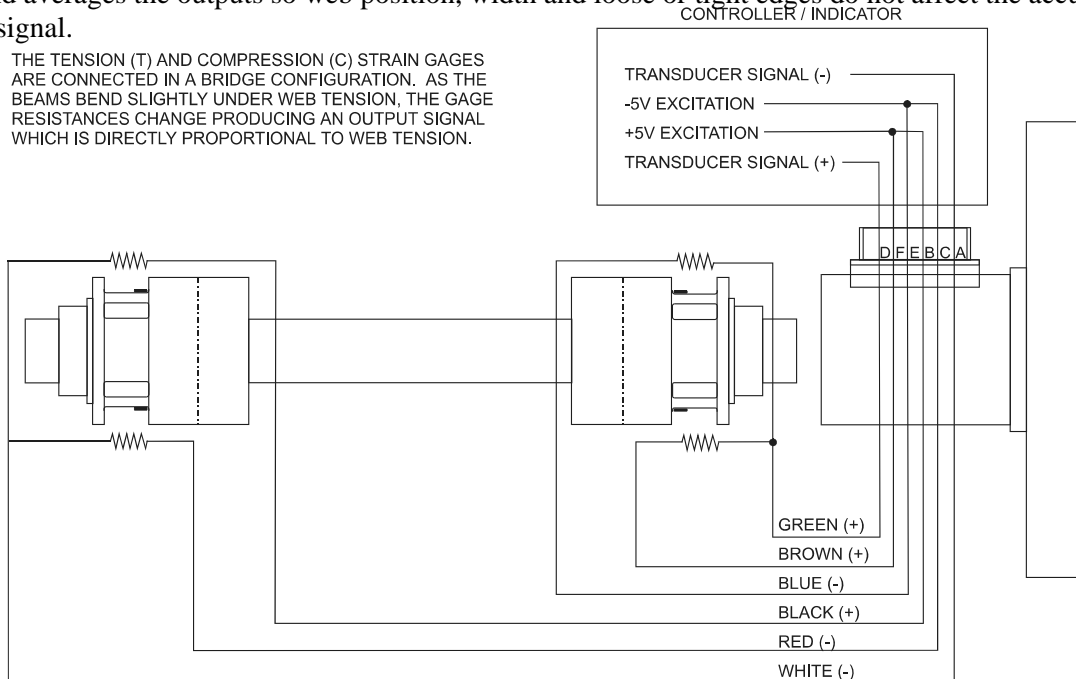


Figure 2 - STRAIN GAGE CONNECTIONS

The physical location of the strain gages, on opposite sides of the beam, ensures that each gage experiences the same temperature variations. This, and the Wheatstone bridge configuration, provide 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 NWI transducers is a very stable low-gain design. An added benefit of the high output is inherent immunity to electrical noise.

1.4 SPECIFICATIONS

ELECTRICAL

Excitation Voltage:	5 Vdc (10Vdc with XR option)
Output:	500mVdc, nominal (1 Vdc with XR option)
Input Voltage (IND option only):	115V/230V 50/60 Hz
Gage Resistance	Half bridge at each end of idler roll. 100 Ohms, nominal, each gage.
Non-Repeatability:	± 1/4% FS, typical
Combined Non-Linearity and Hysteresis:	± 1/2% FS
Temperature Range:	
Std NWI transducer	-10° F to 200° F (-23° C to 93° C)
NWI with IND Option	40° F to 104° F (4° C to 40° C)
Temperature Coefficient:	0.02% per ° F, typical (0.036% per ° C)
Mating Electrical Connector:	Amphenol MS3106A-14S-6S
Electrical Connector Position:	6 o'clock is standard, also 1:30, 3:00, 4:30, 7:30, 9:00, 10:30, 12:00
Connector Pin Assignments:	Pin A = (-) output, white, Pin B = +5V, black, Pin C = -5V, red, Pin D = (+) output, green, Pin E = -5V, blue, Pin F = +5V, brown
Output Ratio End-to-End:	99%

MECHANICAL

Deflection of Sensor Beam:	0.008 inch max (0.20 mm)
Load Ratings:	12, 25, 50, 100 lbs. (53, 111, 222, 445 N)
Overload Rating:	400 lbs. (1779 N) minimum, in load direction, without damage
Std. Roll Widths:	7, 10, 12, 14, 16, 18, 20 inches (178, 254, 305, 356, 406, 457, 508 mm)
No-Load Perpendicularity:	0.005 inches per foot of shaft length
Display (IND option only):	Red LED, 2 1/2 digits, 0.56" character height
Orientation:	The transducer may be installed in any position
Roll: Material	6061 Aluminum
TIR	0.001 inch for 3.5" diameter roll
Balance	quality grade G2.5 per ISO 1940/1-1986 & ANSI S2.19-1989
Finish	32 microinch
Weights	7" = 1.3 lbs. (0.59 kg.), 10" = 2.2 lbs. (1.0 kg.), 12" = 2.6 lbs. (1.18 kg.), 14" = 3.1 lbs. (1.41 kg.), 16" = 3.5 lbs. (1.59 kg.), 18" = 4 lbs. (1.81 kg.), 20" = 4.4 lbs. (2.0 kg.)
Basic Dynamic Load Rating of Bearings:	6910 lbs (30737 N)
Shaft and Shaft Housing:	Steel and Stainless Steel
Break-away Torque, greased bearing: ..	0.87 oz-in (62.6 gram-cm)
Optional Oiled bearing:	0.38 oz-in (27.36 gram-cm)

1.5 FEATURES

Features of Standard Transducer

- Wide operating Tension range.
- Four standard load ratings.
- Seven roll widths up to 20 inches. Special widths available.
- Standard NWI can be used with any standard Dover tension controller or indicator.
- Compact. Requires little space in the machine.

Features of Indicator Option

- 115 Vac Power Input.
- Zero, Cal, and Display Adjustments. Adjustment pots accessible with bezel removed.
- Display can be rotated +/- 170 degrees on end of transducer.
- 0-10V Output. Power supply module includes 0-10Vdc output with terminal block for external wiring.
- Full Scale Display. Displays scales from 5 lbs. to 175 lbs.

Features of Power Supply for Indicator Option

- Standoffs for surface mounting.
- Hardwired AC Power Connection terminal block.
- Hardwired terminal block or Amphenol connector for connection to transducer.

1.6 OPTIONS

- **Environmental Connector (EC)** Keeps liquid from entering transducer through the connector.
- **Extended Range (XR)**. Allows twice the excitation of the transducers being used. Transducers must also have extended range.
- **Hard Coat (HC)**. Black dye anodized hard coat.
- **Indicator Option (IND)**. Tension display in end of roll shell with separate power supply and 15 ft. cable. An optional 20 ft. cable (# 721-1611), or special length cable (721-0984) can be ordered.
 - 230 Vac power input. Switchable on Power Supply card.
 - Enclosure (ENCL). Optional enclosure for IND power supply.
 - Attached Power Cord (APC). A heavy duty 3 conductor power cord wired to the device by DFE.
- **Metric Mount Stud (MMS)**. Metric mounting screw for S type transducers.
- **Non-Lubricated Bearings (NLB)**. No lubrication for bearings. For lowest drag torque. Voids warranty.
- **Oiled Bearings (OB)**. Uses oil instead of grease for lubrication. For low drag torque. Voids warranty.
- **Short Connector Housing (SCH)**. Allows inner roll to be closer to machine frame.
- **Split Flange (SFL)**. Split mounting flange for transducers.
- **Steel Roll (SR)**. Roll is made of steel, or **Stainless Steel Roll (SSR)**. Roll is made of 304 stainless steel.

SECTION 2

INSTALLATION

2.1 DIMENSIONS

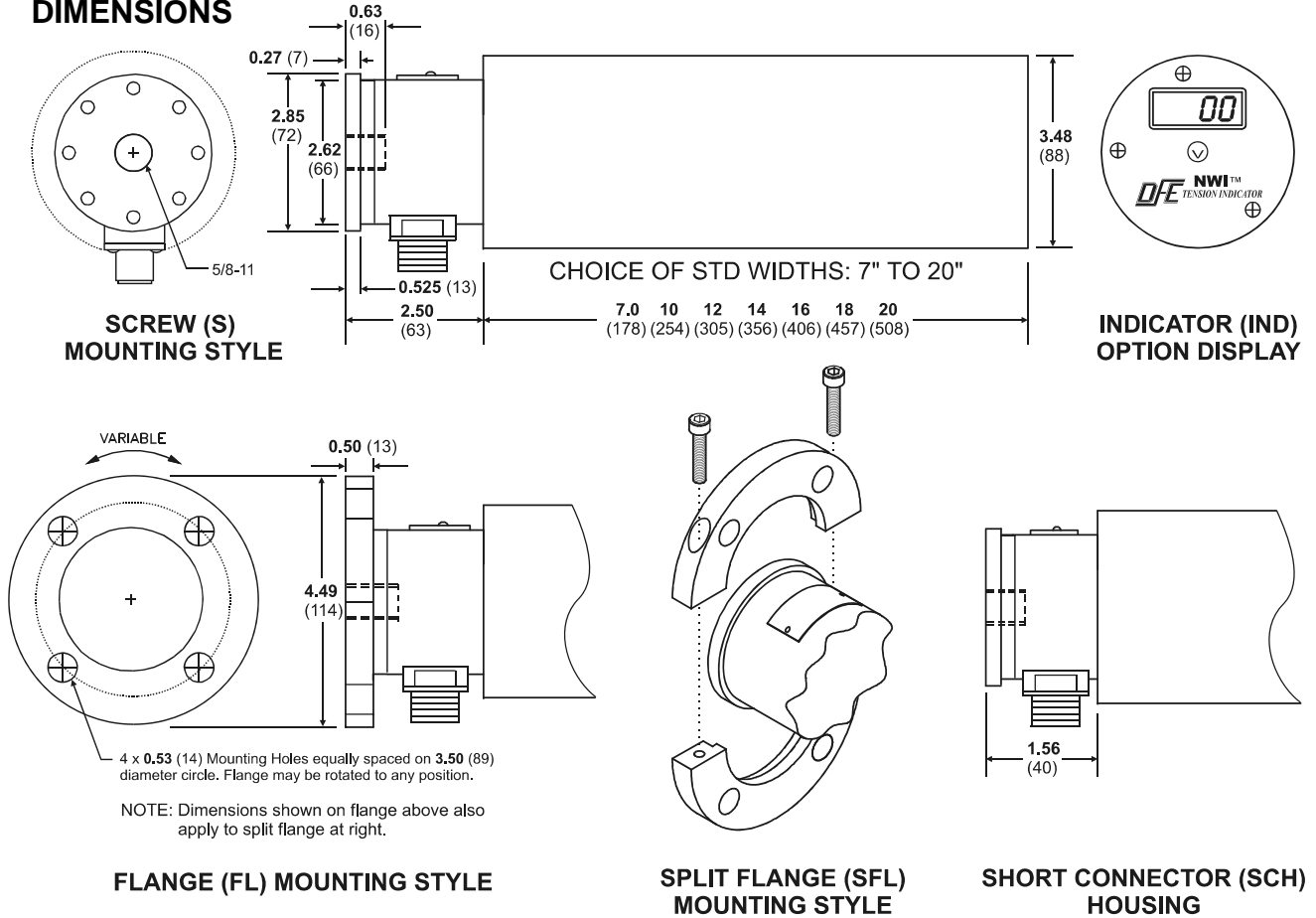


Figure 3 - NWI TRANSDUCER DIMENSIONS

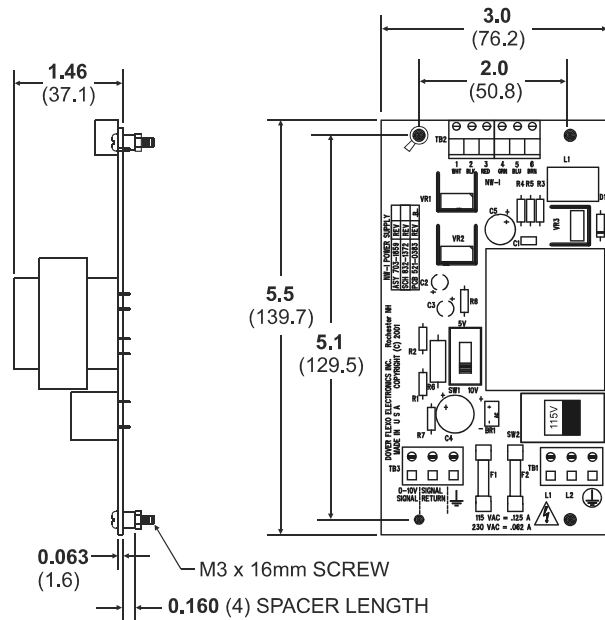
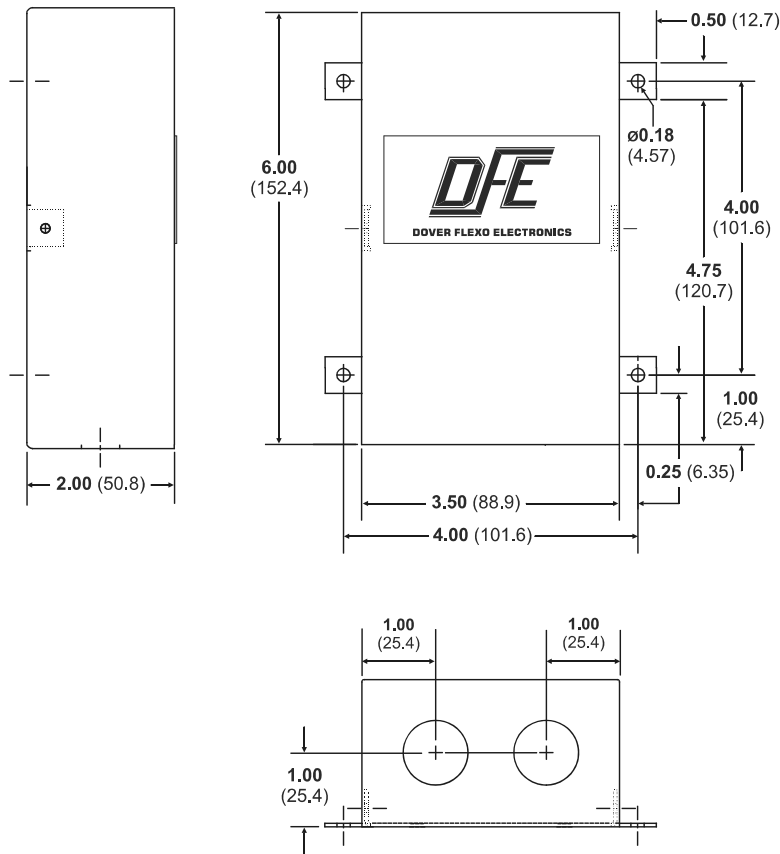


Figure 4 - DIMENSIONS OF POWER SUPPLY (INDICATOR OPTION ONLY)



**Figure 5 - DIMENSIONS OF OPTIONAL ENCLOSURE FOR POWER SUPPLY
(INDICATOR OPTION ONLY)**

2.2 SELECTION OF MOUNTING LOCATION

The following factors must be considered when installing your Narrow Web Transducer. Special references will be noted for the Indicator Option where applicable.

Please Note! There must be no brakes, clutches, belts, chains or gears attached to the transducer roll. It should not be used as a nip roll or be in contact with a nip roll. Nothing must contact the roll except the web.

1. TENSION ZONE.

The transducer 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.

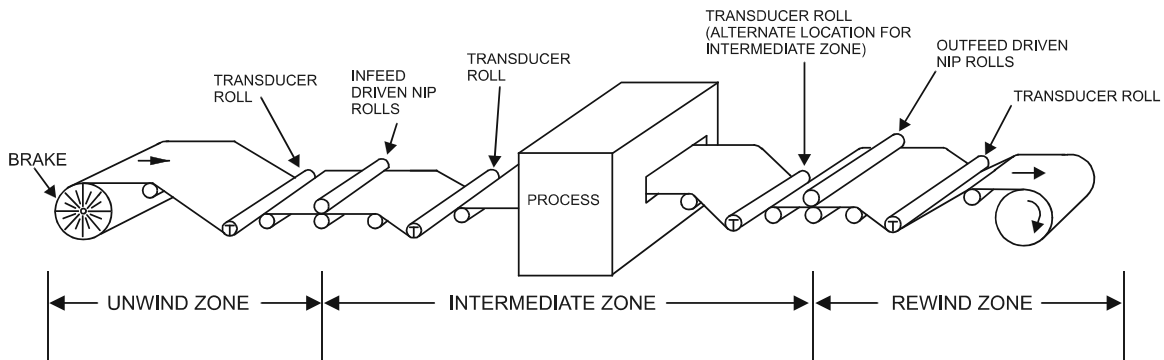


Figure 6 - TENSION ZONES

2. 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 and the unwind or rewind shaft. If the machine has more than one webbing path, be sure to choose a location that is wrapped the same for each. Otherwise it will be necessary to install an additional transducer, 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.

3. MOUNTING SURFACE.

For Standard NWI Transducer: The structure on which the transducer is mounted **MUST** be strong. Any movement of the structure may cause the transducer to become mis-aligned. This probably will not affect the transducer's performance but it could cause the web to shift toward one side when it goes over the roll.

For NWI Indicator Option Power Supply Card: The power supply card is designed for surface mounting within a control panel which protects the operator from coming into contact with high voltages. The location should be dry, clean and free from vibration. Since the Power PCB requires either 115Vac or 230Vac for operation, these should be available within the customer's enclosure.

If the power supply card is to be mounted on an outside surface of a machine, the optional enclosure must be used. This enclosure prevents access to hazardous voltage. The standard cable length is 15 feet. A 20 foot cable is also available as well as a custom length (Refer to Replacement Parts). This location should also be dry, clean and free from vibration. Regardless of the mounting style, please allow ample clearance beside or around the Power Supply card for wiring.

4. **ROLL WIDTH.** The face width of the roll is normally similar to the other rolls in the machine. Standard widths are specified in Section 1.4. If other widths are needed, consult Dover Flexo Electronics.

2.3 INSTALLATION INSTRUCTIONS FOR THE TRANSDUCER (including safety notes)

Warning! If this equipment is not installed or operated in the manner specified, the operating safety of the unit or of connected equipment cannot be guaranteed.

1. Mounting the standard transducer

The transducer is mounted on the machine frame by one of two methods; an S-mount which provides a tapped 5/8"-11 hole in the base of the shaft housing or by the use of the optional FL flange mount which provides a 4-hole pattern for bolting to the side frame.

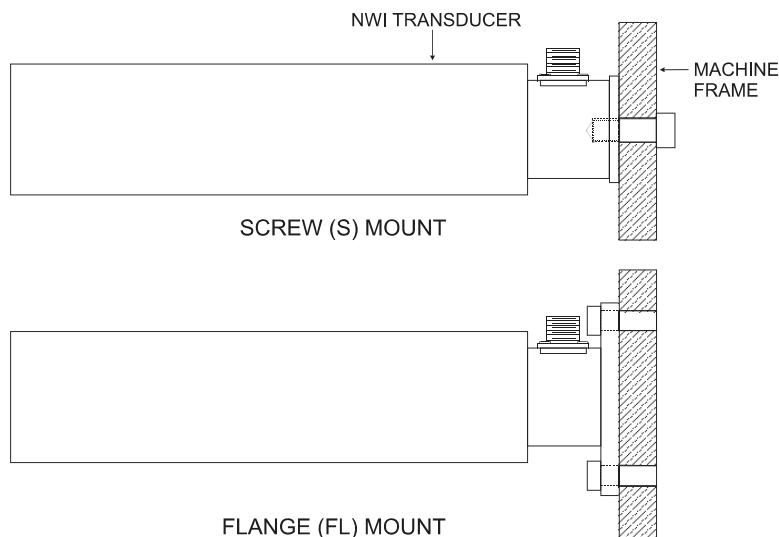


Figure 7 - NARROW WEB TRANSDUCER MOUNTING STYLES

The transducer must be turned so the Tension Force arrow points in the same direction as the Tension Force. Tighten the mounting bolt(s) so it cannot turn. See Figure 8 below.

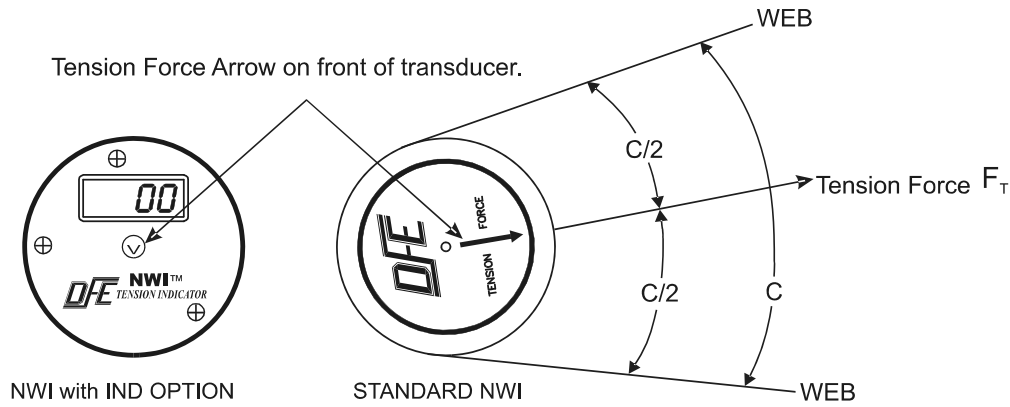


Figure 8 - ORIENT THE TRANSDUCER

2. Connect Transducer to Electronics

Make your connections to your electronics by plugging in the cables, being careful to align the connectors properly - never force them together. Tighten the connectors to properly seat the pins.

If you have just the standard NWI Transducer you may go to Section 3 for calibration.

2.4 INSTALLATION INSTRUCTIONS FOR THE INDICATOR OPTION POWER SUPPLY

1. Mounting the Power Card

The power card may be supplied by itself or in a metal enclosure. Regardless of the mounting type, be sure to allow ample clearance beside or around the card for wiring.

A. Standard Configuration

The standard power card comes with four sets of M3 screws, nuts and mounting spacers. To mount the power card, you will need to drill four holes as shown in Fig. 4. You can either tap them M3 x 0.5mm, or if you have access to the rear of the panel, you can drill four Ø0.14" holes through the panel and use the nuts provided on the rear of the power card.

Note that one of the four mounting screws has a ring terminal attached to it. This ring terminal is to be installed onto the shield of the cable which connects to the transducer, for grounding. When you install the card make sure you will be able to attach the ring terminal to the card in the same position.

B. Mounting the power card in the optional enclosure

The optional power card enclosure is designed for surface mounting on your machine or panel using four #10 screws. Drill the four holes and mount the enclosure as shown in Fig. 5.

2. Setting up the Power Card

A. Power Voltage selection

The NWI with IND option is designed to operate on either 115V 50/60 Hz OR 230V 50/60 Hz power. Verify that your unit is set up for the correct line voltage. See below for the location of switch SW2 which is used to make this selection. Also verify that the correct value fuses are installed based upon your line voltage selection.

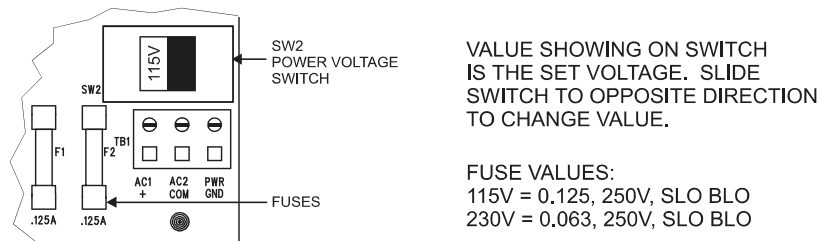


Figure 9 - POWER VOLTAGE SWITCH

B. Transducer Excitation Voltage selection

The tension transducer is excited by either the standard 5V, or by 10V with the Extended Range option. The selection is made using SW1. **CAUTION!** Do NOT use the 10V excitation unless the transducer has the Extended Range option! The transducer **WILL BE DAMAGED!**

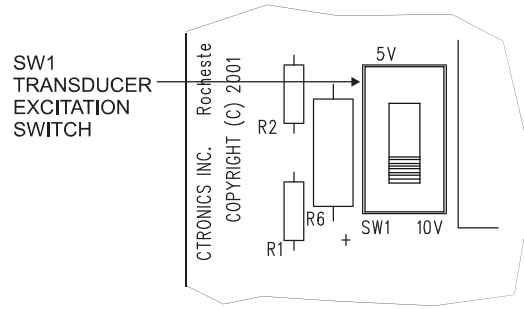


Figure 10 - TRANSDUCER EXCITATION SWITCH

3. **Electrical Connections between Transducer and Power Supply Card.**

Refer to Appendix A for location of terminal blocks for connecting power and signals.

A. Power and Ground

Warning! The card requires a reliable earth ground connection. Grounding is required for electrical safety! It is also required for good noise immunity.

Make your power connections to TB1, with AC Hot or L1 connected to TB1-1 (AC1+) and AC Neutral or L2 connected to TB1-2 (AC2 COM). Make your Ground or PE connection to TB1-3 (PWR GND). All connections to line voltage must be made with wire which has a minimum wire gauge of 18 AWG (or a cross-sectional area of at least 1mm²) rated 1250 watts/10A-125V.

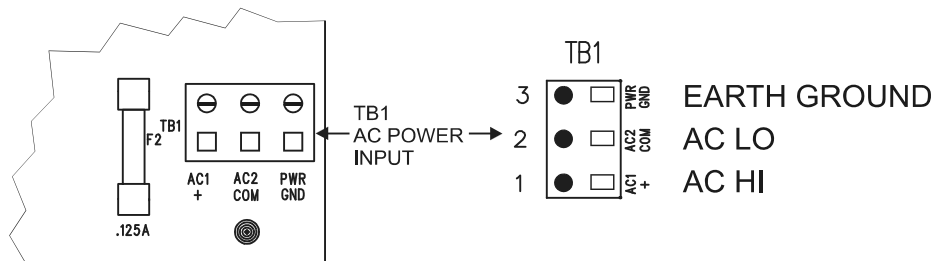


Figure 11 - AC ELECTRICAL CONNECTIONS

B. Transducer Connections

To connect the Transducer/Indicator to the power card, you may use a cable supplied by DFE or you may make your own. Measure the length of cable you will need between the transducer and the power card. Cables are available from DFE in any length.

If you make your own cable you will need to use 6-conductor 24 AWG cable with shield, and install an Amphenol (6 pin female, size 14SL) connector (DFE # 106-0081) at one end. Form the braided shield into a conductor at least 6" longer than the other wires (do not make a connection between the shield and the connector). Wire your cable as follows:

<u>Connector</u>	<u>Wire color</u>	<u>Connector</u>	<u>Wire color</u>
A	White	D	Green
B	Black	E	Blue
C	Red	F	Brown

Connect the 6-pin connector to the transducer at one end, and connect the color-coded wires at the other end to the terminal block as shown below:

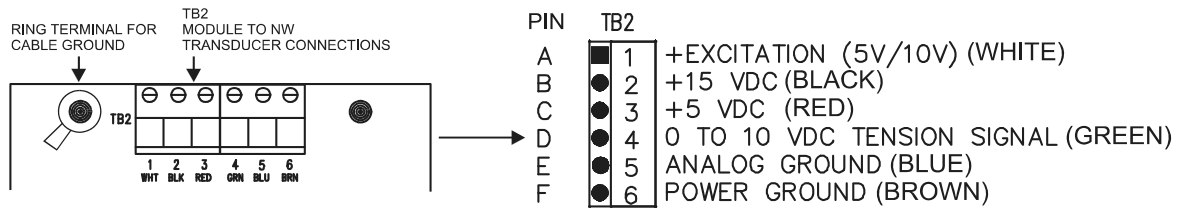


Figure 12 - TRANSDUCER CONNECTIONS

The power card is supplied with a ring terminal attached to one corner of it. Attach the ring terminal to the cable's shield. Then reinstall the eye terminal to the power card's mounting hole at the same position.

C. Connections for 0-10V Output (optional)

The Narrow Web Indicator can produce a 0-10V output for connection to a PLC or tension indicating meter if needed. To use this output, make your connection to TB3-1 (0-10V output) and TB3-2 (Analog GND).

D. Finishing Your Installation

When your connections are complete, dress all of the wiring you have installed (paying special attention to those carrying AC power to the unit) so they will not come into contact with either the NWI components, or with other components located in the cabinet.

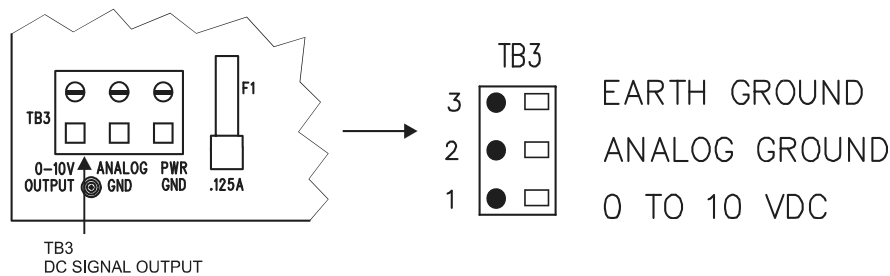


Figure 13 - 0-10V OUTPUT CONNECTIONS

4. Electrical Connections between Transducer and Power Supply Card in Enclosure

Warning! The card requires a reliable earth ground connection. Grounding is required for electrical safety! It is also required for good noise immunity.

You will make your wiring connections to the power card and to the enclosure before attaching the enclosure to your machine or control panel. Remove the two screws holding the cover and lift cover off. The enclosure is supplied with strain reliefs at all cable entry points. Remove the strain reliefs and slide them onto the power cord and the other wiring/cable you will use. Make proper connections to the power board, then, while ensuring inside wiring is neither too loose nor pulled too tight, snap strain reliefs into holes.

A. Power and Ground

Make connections the same as specified in Section 2.4.3.A. Refer to Figure #14 for the locations of the terminal block and the entry point for the AC wiring. Refer to Appendix A for larger view of connections.

B. Transducer Connections

Make connections the same as specified in Section 2.4.3.B. Refer to Figure #14 for the locations of the terminal block and the entry point for the transducer connections. Refer to Appendix A for larger view of connections.

C. Connections for 0-10V Output (optional)

Make connections the same as specified in Section 2.4.3.C. Refer to Figure #14 for the locations of the terminal block and the entry point for the optional 0-10V output wiring. Refer to Appendix A for larger view of connections.

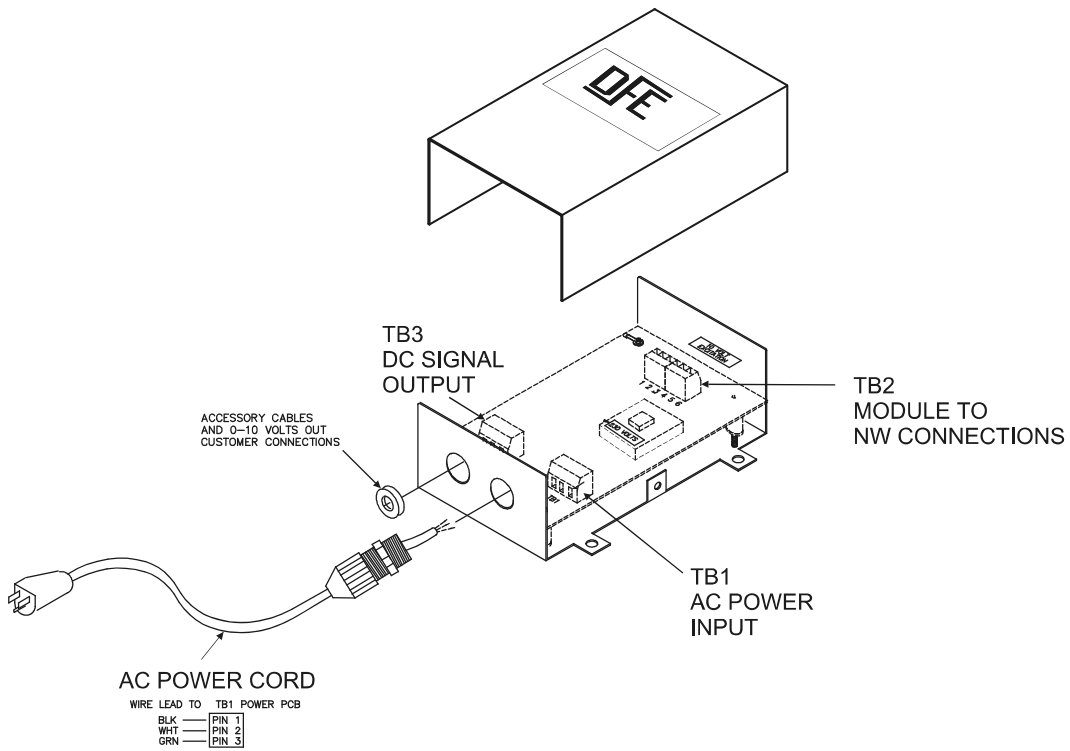


Figure 14 - ELECTRICAL CONNECTIONS TO POWER CARD IN ENCLOSURE

D. Finishing Your Installation

When your connections are complete, dress all of the wiring you have installed (paying special attention to those carrying AC power to the unit) so they will not come into contact with either the NWI components, or with other components located in the cabinet. Replace the cover and the two screws that hold it in place. Attach the enclosure to your machine or control panel using the enclosure tabs.

3.1 INTRODUCTION

Unless you have purchased the NWI with Indicator Option, there are no calibration adjustments on the Model NWI Transducer itself. The instructions below are for the electronic device which the transducer is connected to. All of the following terminology and procedures assume that the transducer is connected to a **Dover Flexo Electronics** tension controller, tension indicator, or has its own indicator option. If some other device is being used, you should follow the instructions furnished with it.

These are general instructions which are correct for most **Dover** 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 transducer must be properly installed and oriented as directed in **SECTION 2**.

3.2 ADJUSTING THE DISPLAY ORIENTATION (NWI with IND option only)

You may first need to adjust the orientation of your display assembly. Using a 2mm allen wrench, remove the three screws holding the display bezel to the display assembly. This will reveal the display card which is mounted to a clamp ring. The clamp ring has a screw (see Fig. 15) which must be loosened to allow the entire assembly to rotate. The display assembly may be rotated up to + or - 170 degrees on the shaft. Using a 1.5mm allen wrench, loosen this screw slightly and rotate the entire assembly until it has the correct orientation. Then tighten the screw.

3.3 ZERO THE TENSION METER (or the DISPLAY for the IND OPTION)

You will need to know the maximum tension this system was designed to measure. This information should be available from the people who ordered the system. If you cannot locate the information, call Dover Flexo Electronics at (603) 332-6150 to obtain it.

1. **For Standard NWI:** Turn the POWER OFF. If the meter does not read zero, turn the mechanical adjustment screw on the meter face so the needle indicates zero tension.

For NWI with IND Option: Apply power to the power card. The display on the transducer should read some value between 0 and 199. You should be able to push up or down on the transducer roll shell and watch the numbers on the display change. Connect a volt meter to the power card's output terminal block, TB3 positions 1 (+) and 2 (common).

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) and preferably as close to 100% as you can find. A spring scale can also be used. Get a length of rope, wire, or cable about 15 feet (3 meters) long.
3. Verify that there is no web contacting the transducer roll.

For Standard NWI: Turn the POWER ON. Wait a few seconds 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.

For NWI with IND Option: Refer to Fig. 15 for the location of the ZERO, CAL, and DSP adjustment potentiometers on the front of the transducer or on the display card. Turn the CAL potentiometer clockwise at least 10 turns (this makes the ZERO potentiometer more accurate). Then turn the ZERO potentiometer up or down until you measure 0 volts at TB3 positions 1 and 2.

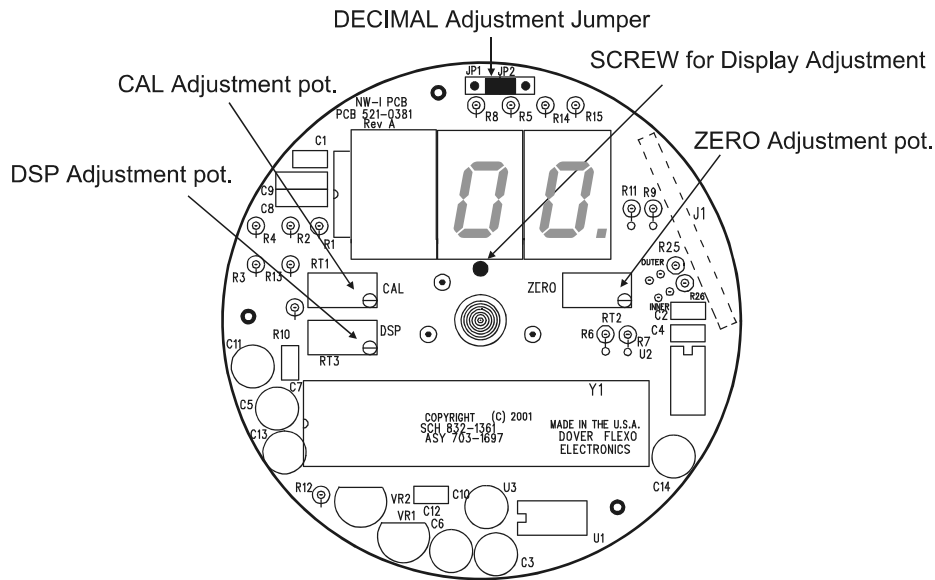


Figure 15 - DISPLAY BOARD WITH ADJUSTMENT POTS.

3.4 CALIBRATION

For Standard NWI: Fasten one end of the rope in the machine and thread the other end around the transducer roll in exactly the same path as the web will take. Be sure it does not pass around any driven rolls, drag bars, or anything else that can affect tension. Refer to Figure 16 below. Be sure the rope does not pass over any driven rolls, braked rolls or dead bars. (This will cause inaccurate 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 as the weight. Remove the weight and rope. This concludes the calibration procedure.

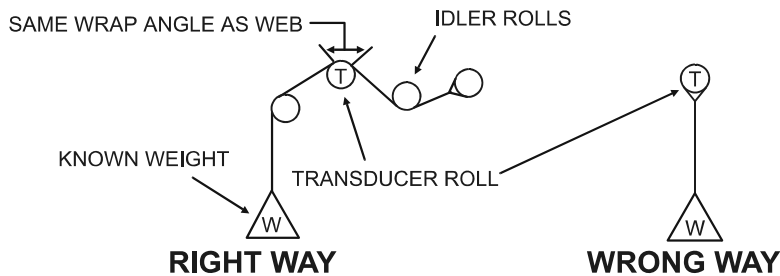


Figure 16 - WEB PATH

For NWI with IND Option:

1. Attach the weight to the free end of the rope as shown above. The weight should not touch anything. Adjust the CAL potentiometer as required such that:

$$\text{Voltage across TB3 positions 1 and 2} = (\text{calibration weight}) \times 10 / (\text{maximum tension})$$
2. Remove the weight and observe the volt meter reading. If it is not zero, adjust the ZERO pot as needed.
3. Repeat steps 1 and 2 as needed.
4. Again attach the weight to the free end of the rope. Verify that the display reads out the actual calibration weight. If not, adjust the DSP pot so that it does. (Note: if the middle and last digits are blank, the calibration setting is too high. Make sure the output voltage does not exceed 10V, then adjust the DSP pot counterclockwise until the two digits come back on). Remove the weight. The display should read "0". If it does not, adjust the zero potentiometer slightly counterclockwise, just enough to cause the display to read "0". (If you go too far, the under range indicator, a minus sign, will light up).

When calibration is complete, reattach the display bezel using the three screws you removed earlier. If you have the optional enclosure, refer to Section 2.4.4 to complete your installation.

3.5 CHANGING THE FULL SCALE TENSION RANGE (NWI with IND Option only)

The Digital Meter should have been adjusted at the factory to accommodate the expected maximum tension. THEREFORE, NO CHANGES SHOULD BE NEEDED. Use the following procedure only if you need to change the full-scale tension from its factory setting.

1. Determine the maximum tension to be used. If you are not sure, call DFE Technical Support to discuss your application.
2. Determine the number of decimal places for the display. It is usually best to use the maximum number of decimal places, to produce a stable display. Using a pair of needle-nose pliers, set the jumper on JP1 and/or JP2 as follows:

FULL SCALE TENSION:	JUMPER ON:
0.00 to 1.99	JP1 only
00.0 to 19.9	JP2 only
000 to 199 (most applications)	Across both JP1 and JP2

3. Adjust the ZERO pot clockwise so that the voltage at TB3 positions 1 and 2 is 10V.
4. Adjust the DSP pot so that the display reads the maximum tension to be used.

You will now need to repeat the Zero and Calibration procedures.

Your Dover Flexo Narrow Web Tension Transducer has been manufactured of quality materials. With proper application and installation your transducer will be maintenance free for years 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 roll change. Contact Dover for specific information and engineering approval.

The NWI Transducer with Indicator option will indicate tension in your system without any further operator intervention as well. It is not necessary to perform any type of maintenance on the indicator. However, you may find it worthwhile to observe whether there is a buildup of dust, debris, or moisture on or near the unit after a period of time.

Check fuses on power supply board. If they need to be replaced, use the correct values listed below:

115V Operation

0.125 Amp, 250V Slo-Blo

230V Operation

0.063 Amp, 250V, Slo-Blo

WARNING! Equipment must be disconnected from the **HAZARDOUS LIVE** voltage before changing the fuses.

4.1 BEARING LIFE

The bearings in the Model NWI Transducer will turn continuously in normal operation. They have been selected to give a long service life under typical operating conditions. Use the formula below, or the nomogram on the next page, to find the L_{10} life, in hours, for your application.

To find the radial load (P) for your application, use the appropriate sizing formula in Figure 21 on page 23, substituting 2 for the 4 in the numerator to eliminate the oversizing factor.

$$\text{RPM} = 3.82 \times \text{web speed in feet per minute} / \text{diameter of transducer roll in inches.}$$

$$(\text{RPM} = 318.3 \times \text{web speed in meters per minute} / \text{diameter of transducer roll in millimeters}).$$

BEARING SPECIFICATIONS		
BEARING TYPE	RATED LOAD (C)	MAXIMUM SPEED (RPM)
ball	6910 lbs (30737 N)	7500

LIFE CALCULATION FORMULAS (where P is radial load as described above)

$$L_{10} = (16667 / \text{RPM}) \times (C / P)^3$$

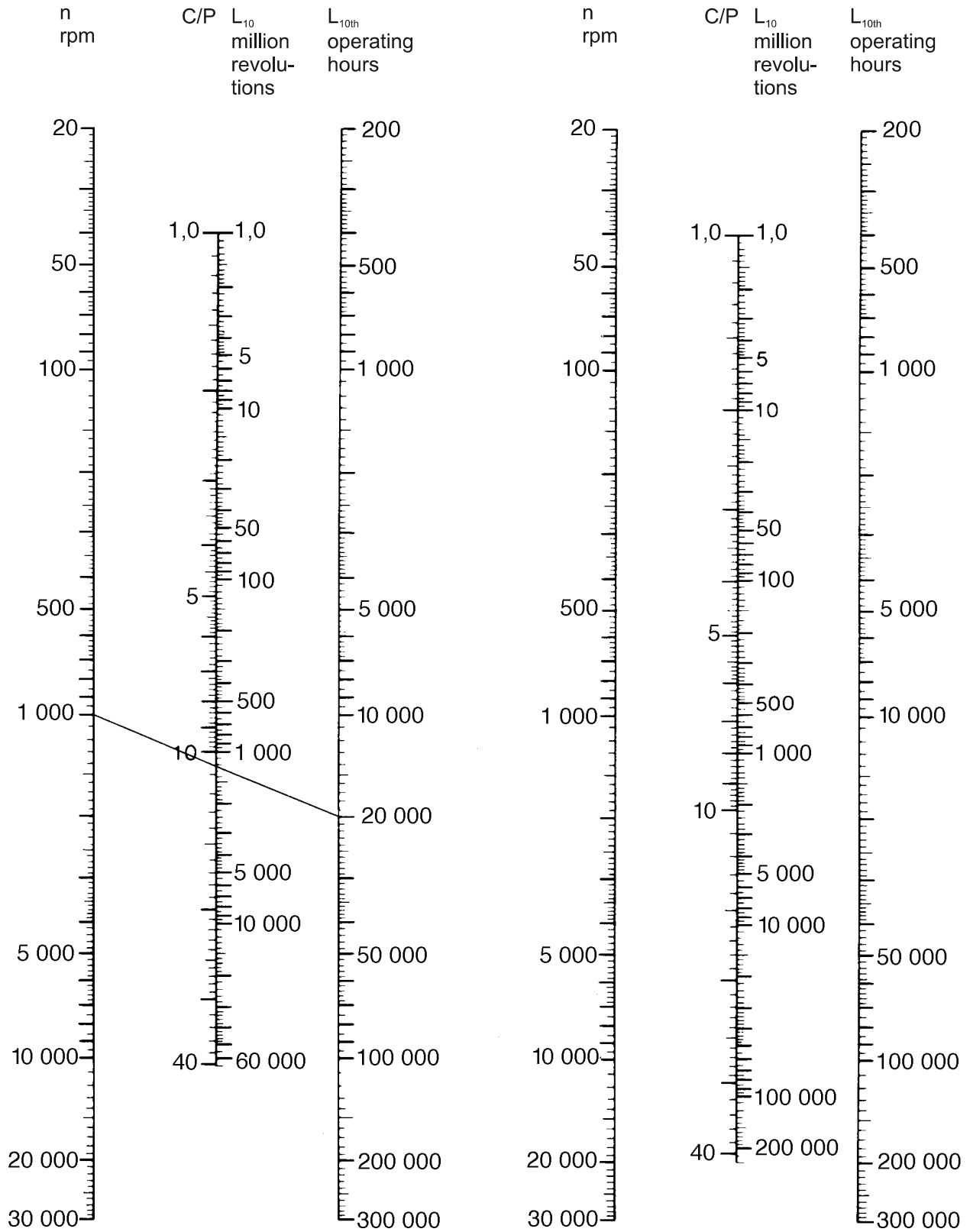
An L_{10} life of 20,000 to 30,000 hours is usually considered satisfactory for web process machinery such as printing presses, coaters, etc.

If preferred, the bearing life nomogram (Figure 13) on the next page can be used instead of the formulas. The result will be the same.

TO USE THE NOMOGRAM:

1. Use the left set of three scales for ball bearings.
2. Compute the speed of the bearing, in RPM.
3. Compute the ratio C/P.
4. Find the speed on the left scale. Mark it.
5. Find the value of C/P on the middle scale. Mark it.
6. Connect the two marks with a straight line extending to the right scale. Read the L_{10} life on the right scale where the line intersects it.

BEARING LIFE NOMOGRAM



This life is expected to be exceeded by 90% of the bearings. The median life is approximately five times as long.

Figure 17 - BEARING LIFE NOMOGRAM

4.2 DISASSEMBLY AND RE-ASSEMBLY (Ref. Fig. 18)

Following are the tools needed to disassemble your NWI Transducer and instructions for various procedures.

1. TOOLS REQUIRED

- a. Socket head screw hex keys

SCREW SIZE	KEY SIZE (inch)	LOCATION OF USE
M3 x 0.5	2.5 mm	electrical connector
4-40	0.0937 (3/32)	bearing retainer
10-32	0.1562 (5/32)	beam retainer
1/4-20 SHCS	0.1875 (3/16)	beam retainer
M4 x 0.7	3 mm	end cover
M3 x 8 Socket Set Dog Point	1.5mm	display adjustment screw
M3 x 8 SFHC	2 mm	display bezel screws

- b. A small flat blade screwdriver.
c. 20 watt soldering iron with small tip.
d. Diagonal wire cutters.
e. Wire stripper for 30 AWG wire.

2. ELECTRICAL CONNECTOR REPLACEMENT

1. Remove the four screws holding the connector in place.
2. Unsolder the wires. Set the electrical connector aside.
3. Take a new electrical connector in hand. Look closely at the end where the wires will be soldered. Notice that each pin is identified by a letter.
4. Refer to Page 3 of this Manual and solder the wires to the pins as described under "Connector Pin Assignments".
5. Carefully stuff the wires into the connector block and position the connector so the small key tab in the threaded end of the connector faces the roll. Replace all four screws and tighten.
6. Due to special spacing requirements at reassembly, the inner bearing or any beam replacement, can only be performed by Dover personnel.

3. ROLL, BEARING OR BEAM REPLACEMENT

1. Place the NW in an upright position on its shaft housing.
2. Remove the end cover using a M3 allen wrench.
3. Remove the bearing retainer 4-40 screws (4) using a 3/32 allen wrench.
4. With hands firmly grasping the roll, carefully lift it up until it clears the shaft assembly.

4. OUTER BEARING REMOVAL:

1. Using a small screw driver, remove the bearing retaining ring from the roll bore.
2. Grasp the ID of the bearing & slide it out of the roll.
3. Do procedures in step 2 in reverse to install bearing in new replacement roll.
4. Install replacement roll by performing step 1-4 in reverse from section 4.2.3 above.

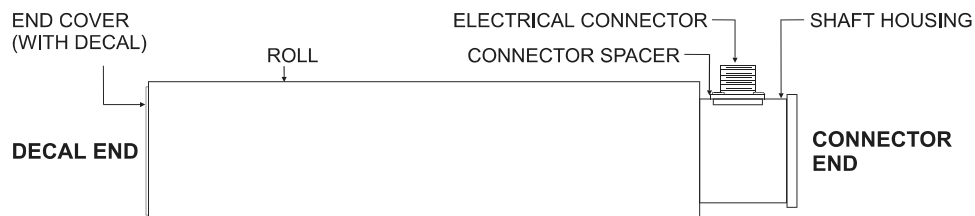


Figure 18 - NWI TRANSDUCER PARTS

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. Call our **TECHNICAL SERVICE DEPARTMENT** for analysis of operating conditions and solution to problem.

1. TRANSDUCER ROLL SHAKES, VIBRATES, or BOUNCES

- a. Roll is not balanced.
- b. Transducer mounting bolts are not tight.
- c. Roll is turning at its natural frequency.

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

- a. Failure in the tension indicator circuit
- b. Strain gage failure

3. TENSION METER READS BACKWARDS

- a. Transducers are installed backwards with force arrow pointing in opposite direction.
- 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.
- b. Transducer cable has broken wire, poor connection or short circuit.
- c. 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.
- d. 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.
- b. Transducer cable has a broken wire, poor connection or short circuit.
- c. A strain gage is cracked. Perform the test in 4c above.

6. TENSION METER DOES NOT READ THE SAME EACH TIME THE SAME FORCE IS APPLIED (poor repeatability)

- a. Extreme build-up of dirt, ink, adhesive, grease or other foreign material inside end of roll causing interference with beam movement.
- b. Transducer cable has a broken wire, poor connection or short circuit.
- c. A strain gage is cracked. Perform the test in 4c above.

7. TENSION METER READING DOES NOT CHANGE WHEN FORCE IS APPLIED TO ROLL. METER READS ZERO.

- a. Meter is not calibrated.
- b. Extreme build-up of dirt, ink, adhesive, grease or other foreign material inside end of roll causing interference with beam movement.
- c. Transducer cable has a broken wire, poor connection or short circuit.
- d. Transducer cables connected incorrectly, or to wrong transducers.
- e. 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. Transducer mounting bolts are loose.
- c. Tension controller is not adjusted properly. See controller Instruction Manual for procedure.

SECTION 6

REPLACEMENT PARTS

(DFE P/N)

NWI Transducer Parts:

Amphenol Electrical Connector, MS3102A-14S-6P	106-0074
Amphenol Connector Screws:	
4-40 x 5/8 Button Head Socket Cap	123-0086 OR
M3 x 0.5 x 16mm Black Oxide	123-0093
Bearings, SKF 6208-ZZ	133-0022
Retainer Ring for Outer Bearing, VH-312	135-0002
End Cover Screw, M4 x 0.7 x 50mm Black Oxide	123-0437
Screws securing removable end:	
(1) M4 x 50 Button Head Socket Screw	123-0437 AND
Bearing Retainer Screws,	
(4) 4-40 x 1/2 Socket Head Cap Screws, Stainless Steel	123-0083

NWI Indicator Option Parts:

Interconnect cable, 15 ft. (Std.)	721-1610
Interconnect Cable, 20 ft. (Accessory)	721-1611
Interconnect Cable, Special Length request	721-0984
AC Power Cable	131-0039
Fuse, 0.125A, 250V, Slo Blo for use with 115V line voltage	108-0045
Fuse, 0.063A, 250V, Slo Blo for use with 230V line voltage	108-0054

Call **Customer Service** for prices and for part numbers of items not listed. For help with service or repairs, call **Technical Service**. We can be reached by the following:

Phone: 603-332-6150
Fax: 603-332-3758
E-mail: Customer Service: customerservice@dfc.com
Technical Service: techsupport@dfc.com

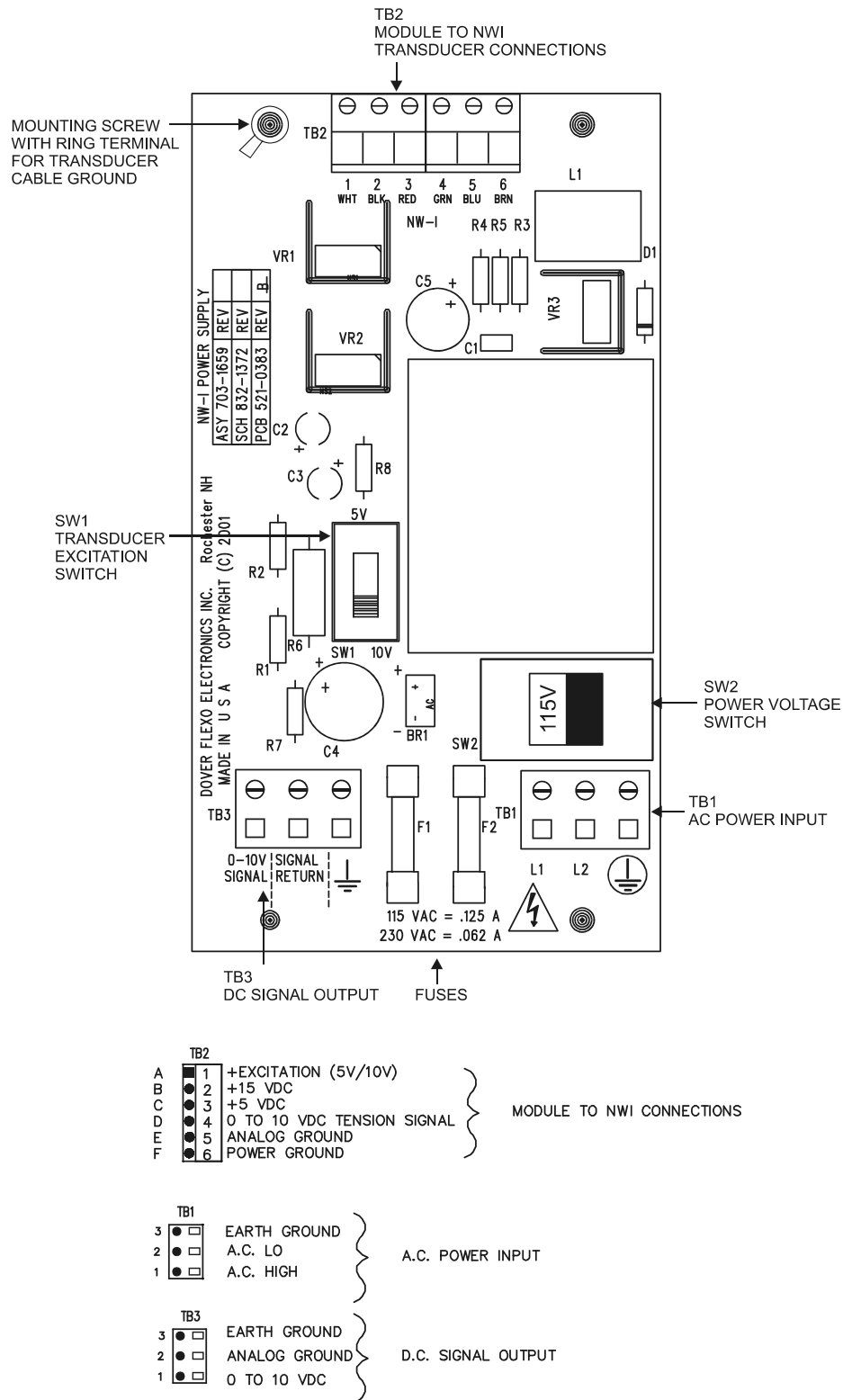


Figure 19 - OPTIONAL POWER CARD & CONNECTIONS

TENSION ROLL (TR) AND NARROW WEB (NWI) TRANSDUCERS

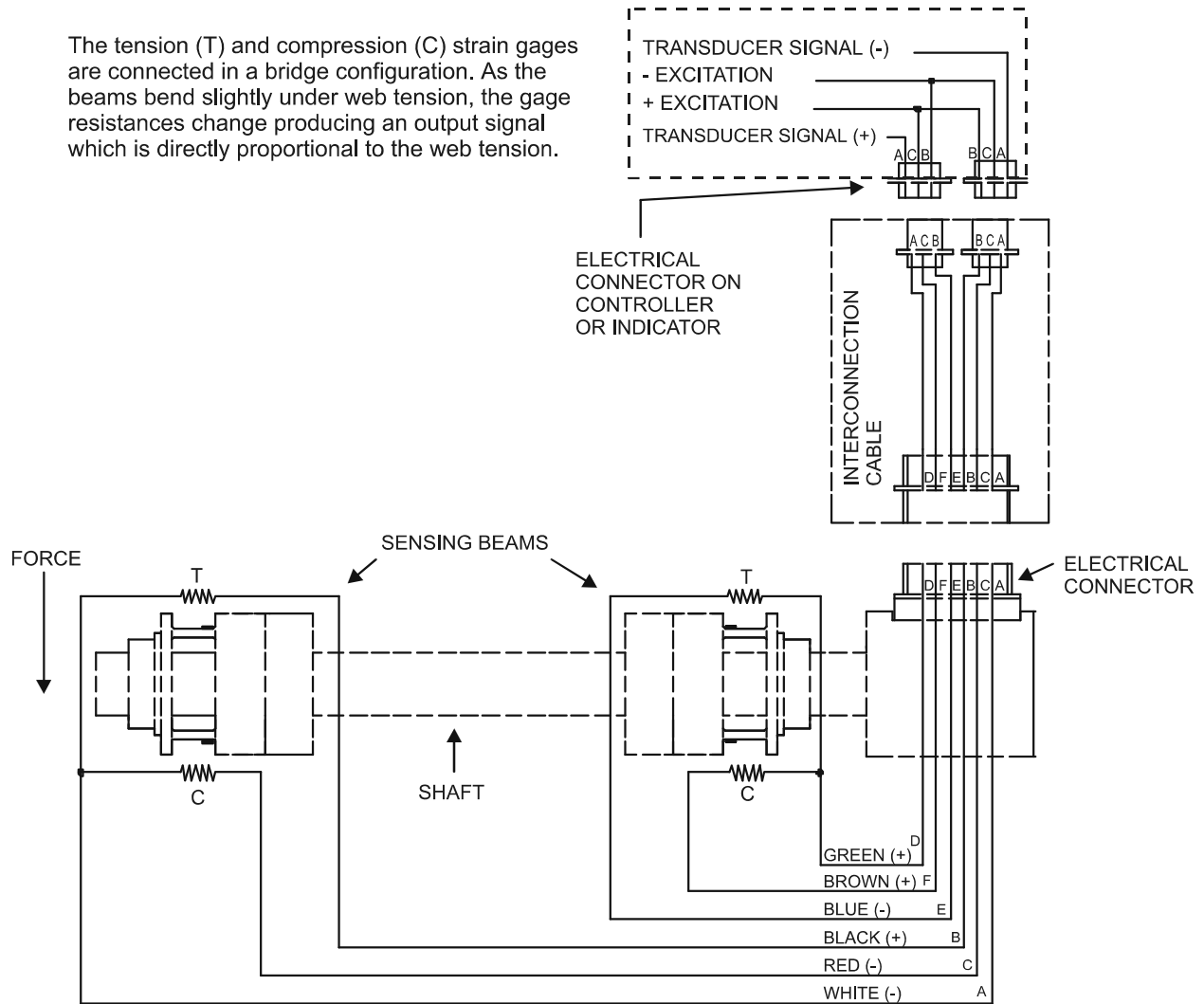


Figure 20 - MODELS NWI & TR TRANSDUCER WIRING

Following is the procedure used to calculate the load rating for the transducer(s) for your application. The correct transducer load rating was determined by maximum web tension, wrap angle, and roll weight. If you change any part of your application or plan to move your transducers to another application, please follow the steps below to reconfigure. As always please feel free to contact one of our Applications Engineers for assistance .

1. LOAD RATINGS

The Model NWI Transducer is available with four standard load ratings ranging 12 lbs. to 100 lbs. (53 to 445 N). Load ratings are generally selected for the application prior to purchase of the equipment. If more equipment is needed for a different application or a change to the present one, use the steps following to select the load ratings.

The correct transducer load rating for your application is determined by maximum web tension, wrap angle, and roll weight. Choose the appropriate wrap configuration from the diagrams below. Then compute the Net Force using the formula below the diagram.

2. SELECTION PROCEDURE

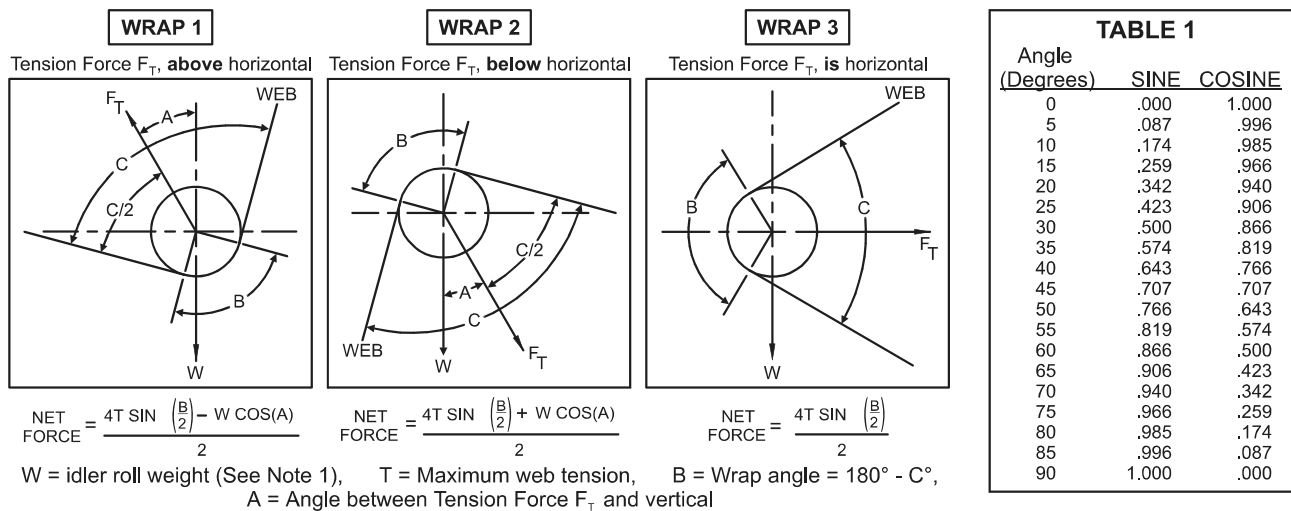
The correct load rating is found in four simple steps:

Step 1. OBTAIN DATA TO PLUG INTO THE SELECTION FORMULA

- Estimate the maximum web tension. Use the Typical Tensions table in Appendix D as a guide if necessary.
- Determine the wrap angle.
- Determine the angle of tension force F_T , relative to the vertical. (Note: F_T bisects wrap angle B)

Step 2. COMPUTE NET FORCE USING THE SELECTION FORMULA

Compute the Net Force, using the formula below the correct wrap diagram in Figure 21 below.



Note 1: Roll weight equals weight of roll shell plus weight of bearing assemblies.

Roll Shell Weights
 7 in. (178mm) is 1.3 lbs. (0.59 kg)
 10 in (254mm) is 2.2 lbs (1.0 kg.)
 12 (305mm) is 2.6 lbs (1.18 kg.)
 14 (356mm) is 3.1 lbs (1.41 kg)
 16 (406mm) is 3.5 lbs (1.59 kg)
 18 (457mm) is 4 lbs (1.81 kg)
 20 (508mm) is 4.4 lbs (2.0 kg)

Weight of bearing assemblies is 1.7 lbs. (0.77 kg) total

Figure 21 - LOAD RATING SELECTION FORMULA

Step 3. SELECT THE LOAD RATING

Use the chart below 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. Therefore the actual force exerted on the transducer will not exceed its rating,

LOAD RATING CHART	
NET FORCE -lbs. (N)	LOAD RATING - lbs. (N)
up to 15 (66)	12 (55)
16 - 32 (71-142)	25 (110)
33 - 63 (146-280)	50 (225)
64 - 125 (284-556)	100 (450)

Step 4: COMPARE LOAD RATING WITH EFFECTIVE TRANSDUCER ROLL WEIGHT

The following applies only to steel rolls and rolls in excess of 14 inches (356mm) in width:

Sometimes a roll is so heavy that its weight uses up most of the operating range of the transducer. 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: The effective roll weight 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),
3. Use the next higher load rating (this is the least desirable choice because it reduces transducer signal output).

Appendix D:

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	<u>GAUGE</u>	<u>AT 25% STRETCH</u>	<u>AT 50% STRETCH</u>
	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	<u>GAUGE - INS</u>	<u>UNWIND-PSI</u>	<u>REWIND-PSI</u>
	.001 -.005	1000	4000
	.006 -.025	850	3500
	.026 -.040	750	3000
	.041 -.055	650	2600
	.058 -.070	550	2200
	.071 -.090	450	1800
	.091 -.120	450	1400
	.121 -.140	400	1200
	.141 -.165	400	1000
	.166 -.200	400	900
	.201 -.275	400	800
	.276 -.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 warranted. 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 canceled 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.

DECLARATION OF CONFORMITY

We,

Dover Flexo Electronics
217 Pickering Road
Rochester, NH 03867 USA
Tel: (603) 332-6150
Fax: (603) 332-3758

declare under our sole responsibility that the product:

Model NWI Web Tension Transducer, except with IND Option

manufactured after the date 1 May 1997, and to which this declaration relates, is in conformity with the following standards or other normative documents:

EN 55011: Radiated and Conducted Emissions
EN 50082-2: Electromagnetic compatibility - Generic immunity standard,
Part 2. Industrial Environment, to include:
ENV 50140: Radio Frequency Immunity - AM
ENV 50141: Conducted Radio Frequency Interference
ENV 50204: Radio Frequency Immunity - Pulse Modulated
ENV 61000-4-2: Electrostatic Discharge
EN 61000-4-4: Electrical Fast Transient Bursts

following the provisions of Council Directive 89/336/EEC of 3 May 1989 on the approximation of the laws of the member states relating to electromagnetic compatibility (the "EMC Directive").

The Technical Construction File is maintained at:

Dover Flexo Electronics
217 Pickering Road
Rochester, NH 03867 USA

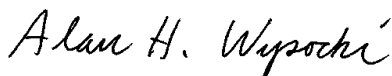
Per Annex II R of the Machinery Directive (89/392/EEC):

The machinery, product, assembly, or sub-assembly covered by this Declaration of Conformity must not be put into service until the machinery into which it is to be incorporated has been declared in conformity with the provisions of the applicable Directive(s).

Date of issue: 5 May, 1997

Place of issue: Rochester, NH USA

Signed: _____



Alan H. Wysocki, Engineering Manager

NOTES

NOTES

NOTES

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