DOVER FLEXO ELECTRONICS, INC.
ISO 9001 CERTIFIED

INSTRUCTION MANUAL

VERY NARROW WEB TRANSDUCERS
MODEL VNW

DOVER FLEXO ELECTRONICS, INC.

217 Pickering Road

Rochester, NH 03867-4630 U.S.A.

For assistance, please call:

TECHNICAL SERVICE - Installations, Start-Up, Troubleshooting, Repairs, Field Service, Returns. **techsupport@dfe.com**

CUSTOMER SERVICE - Replacement Parts, Individual Products, Questions about Orders, Manuals. **customerservice@dfe.com**

SALES - Product Information, Systems Application Questions, and placing orders for standard products and special systems.
sales@dfe.com

Telephone: (603) 332-6150 Fax: (603) 332-3758

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

TABLE OF CONTENTS

LIST OF ILLUSTRATIONS

SECTION 1

PRODUCT DESCRIPTION

1.1 GENERAL DESCRIPTION

The Model VNW "Very Narrow Web" Tension Transducer is an electro-mechanical device that converts web or filament 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 filament 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 VNW Tension Transducer is typically used in tension control and display systems in ribbon or filament and narrow web winding, unwinding, and intermediate applications where the machine has only one side frame and the idler wheels are cantilevered. The information in this Section will help give a clear understanding of the VNW Tension Transducer, how it works, and how it is used.

1.2 CONSTRUCTION AND MECHANICAL OPERATION (see Figure 1)

Inside the transducer is a single beam having two parallel cantilevered webs with strain gages mounted on each. When tension is applied, the beam deflects a small amount, causing an electrical output from the strain gages which is directly proportional to the filament tension.

The bore of the housing acts as a mechanical stop, preventing damage to the beam and gages 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.

The standard VNW Transducer accessory wheels are manufactured of aluminum to be lightweight and of low inertia, and the ribbon and filament wheels are given a hard coat anodized surface finish for durability. The bearings are standard deep-groove ball type with shields to discourage entry of contaminants. Custom wheel geometries and/or finishes are available including those made by the customer to be mounted on the adapter wheel, subject to specific DFE engineering approval.

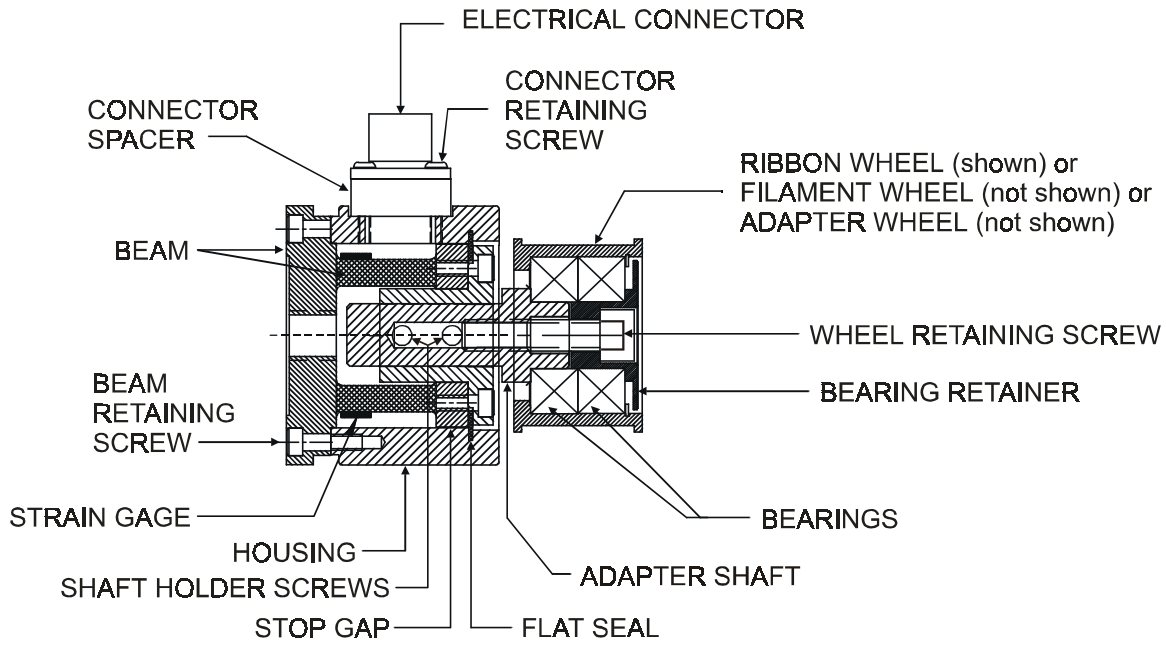


Figure 1 **- CUT-AWAY VIEW OF VNW TRANSDUCER**

1.3 SPECIFICATIONS

Excitation Voltage:	5 Vdc (10 Vdc w/XR Option)
Output:	500 mVdc, nominal, at rated load (1000 mVdc w/XR Option)
Strain Gages:	Semiconductor, 100 ohms nominal resistance
Non-Repeatability:	+/- 1/4% full span (FS)
Non-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 (0.036% per degree C, typical)
Material:	Transducer = Stainless Steel & Aluminum
	Optional Wheel = Aluminum, Hard coat anodized (except adapter)
Maximum Overload Capacity	1200 lbs. (5338 N)
Deflection:	0.005" typical (0,127 mm typical)
Electrical Connector:	Bendix PT02E10-6P
Mating Electrical Connector	Bendix PT06E10-6S
Standard Connector Position	S, PB, and FL styles - 6 o'clock with reference to force direction
Electrical Connections	pin A = negative output (WHT) pin B = (+) Excitation (BLK)
	pin C = (-) Excitation (RED) pin D = positive output (GRN)
	pin E = (-) Excitation (BLU) pin F = (+) Excitation (BRN)
Load Ratings:	10, 25, 50, 100, 200, 400 lbs (45, 111, 222, 445, 890, 1779 N)

NOTE: Information below only applicable if DFE Wheel or shaft assembly are used

Break-Away Torque:	0.25 in-oz (18 gram-cm) typical
Basic Dynamic Load Rating of Bearings:	4300 lbs. (19120 N)
Wheel Weights:	**Filament**: 0.49 lbs (222 g), **Ribbon**: 0.45 lbs. (204 g), **Adapter**: 0.65 lbs. (295 g)

1.4 STANDARD FEATURES

- Compact size for easy mounting--even in small spaces
- Choice of 5 mounting styles: standard, flange, pillow block, pilot flange, and through frame.
- Choice of 3 standard wheel types: ribbon, filament and adapter wheel
- Load ratings from 10 to 400 lbs (45 to 1779)
- Ribbon wheel widths up to 6.13 inches (15.57 cm)

1.5 CONFIGURATION CHOICES

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

- **Mounting Style**. Screw or Bolt mount (S) uses a single bolt to mount to machine frame. Pillow Block bracket (PB) uses a right-angle bracket to mount onto the machine frame. Flange mount (FL) uses a four bolt flange mounted onto the machine frame which can be rotated to any position for precise orientation. Through-Frame (TF) style inserts a collar into the wall of the machine frame and is clamped with a flange outside the frame wall. Piloted Flange (PFL) fits directly in place of industry standard RFC style 3.0" piloted flange bearings.
- **Load Ratings.** 10, 25, 50, 100, 200, 400 lbs (45, 111, 222, 445, 890, 1779 N)
- **Wheel** Choices are as follows: **No wheel**. **Ribbon (R1-6):** Specify width of 1 to 6 inches. **Filament (F)**, or **Adapter (A)** for custom applications. **Shaft assembly with bearings:** Special wheels are available as **Non-standard (N)**, or specify none and use your own wheel.
- **Connector Position**. Choices are as follows:

  S, FL , PB ,PFL TF,: 6:00 (std.), 12 o'clock. Rear for PB, PFL, TF (note Through frame is rear only).

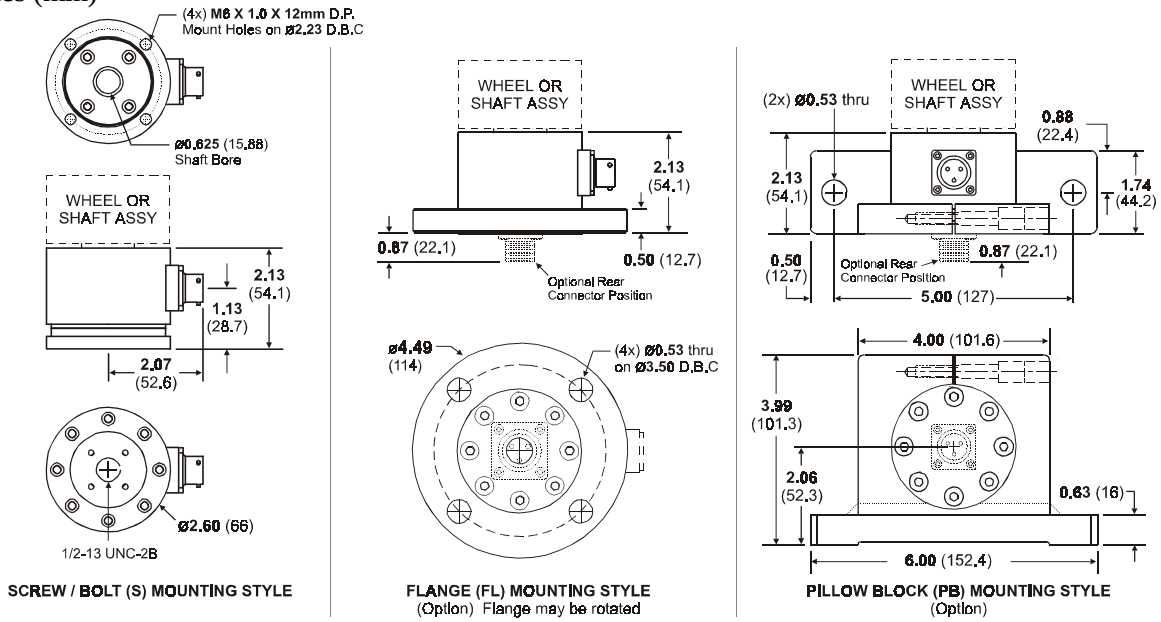
1.6 OPTIONS

- **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 extended range also.
- **Metric Mounting Stud. (MMS)** Metric mounting screw for S type transducers.

SECTION 2 INSTALLATION

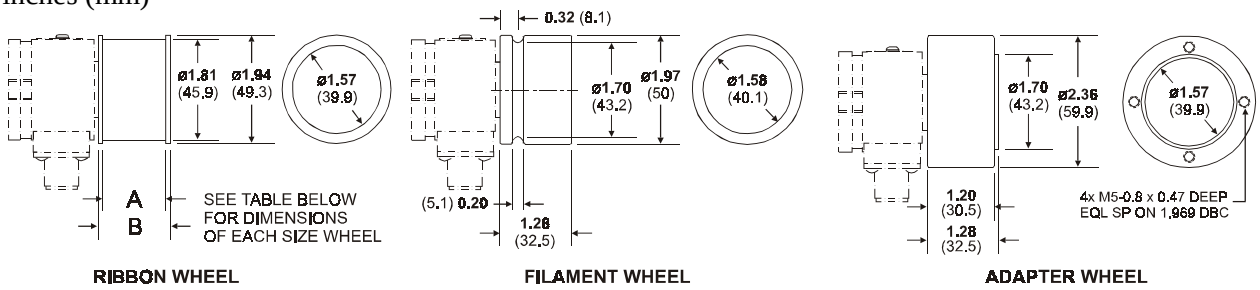
2.1 DIMENSIONS

inches (mm)



WHEEL DIMENSIONS

inches (mm)



		RIBBON WHEEL SIZES					
		1	2	3	4	5	6
A	in.	**1.13**	**2.13**	**3.13**	**4.13**	**5.13**	**6.13**
	mm	28.7	54.1	79.5	104.9	130.3	155.7
B	in.	**1.28**	**2.28**	**3.28**	**4.28**	**5.28**	**6.28**
	mm	32.5	57.9	83.3	108.7	134.1	159.5

Figure 2 **- DIMENSIONS**

2.2 PRE-INSTALLATION REQUIREMENTS

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

A. 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 filament path that can change tension is at one end of a tension zone.

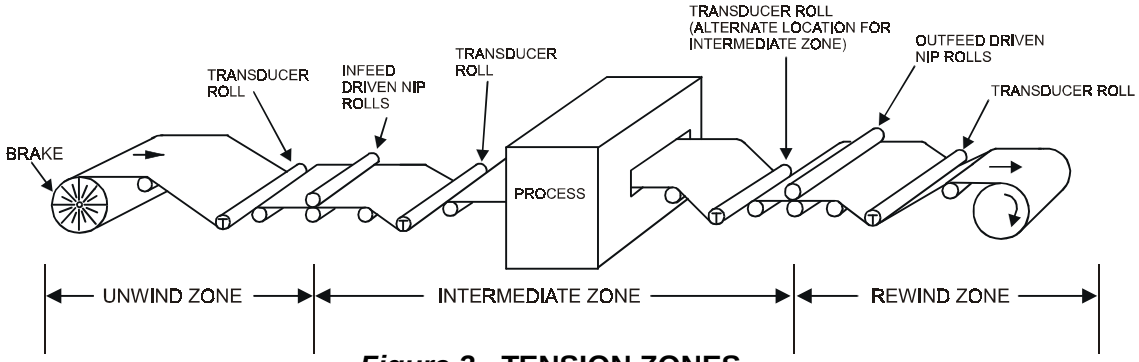


Figure 3 **- TENSION ZONES**

B. WRAP ANGLE

The web or filament must always contact the transducer wheel in exactly the same way. The wrap angle must not change as the unwind or rewind reel diameter changes. Therefore there must be at least one idler wheel between the transducer and the unwind or rewind shaft. If the machine has more than one web path, be sure to choose a location that is wrapped the same for each. Otherwise it will be necessary to install an additional idler roll or transducer, or dual calibration circuitry, or all three. If the wrap angle is allowed to change, the transducer output will change with angle as well as tension, and accuracy will be reduced.

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 crooked when they are installed.

The VNW transducer is sold in five mounting styles with an alternative to face-mount the transducer on the outside of the machine frame using a four bolt pattern on the front of the transducer.

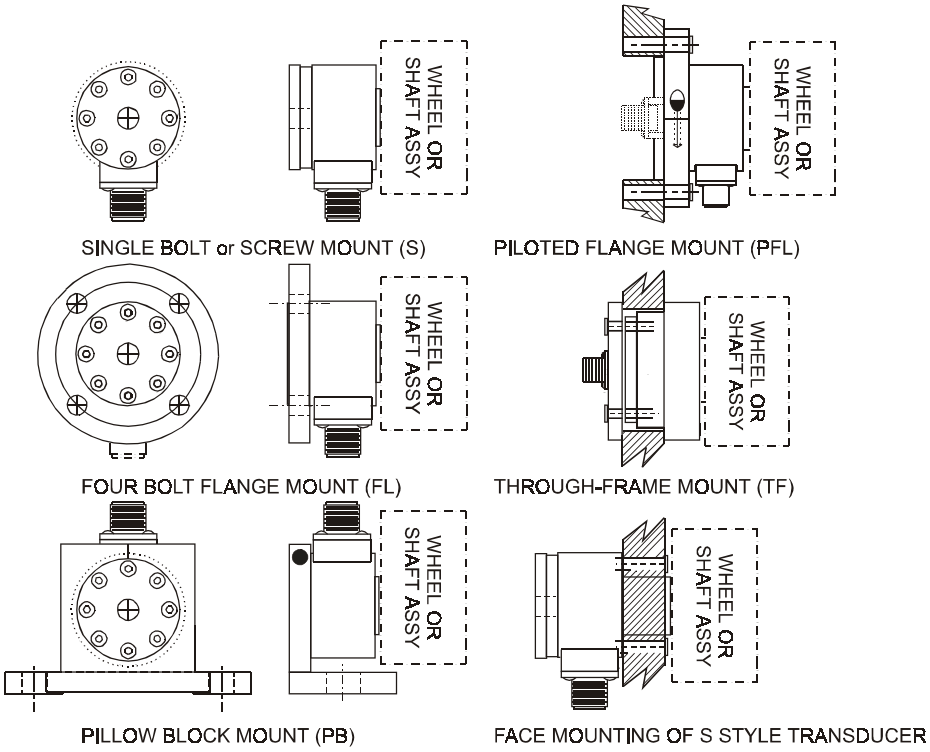


Figure 4 **- VNW MOUNTING STYLES**

2.3 INSTALLATION

Model VNW Tension Transducers are very easy to install. Follow the simple steps below.

1. ORIENT THE TRANSDUCER (see Figure 5)

The transducer must be turned so the Tension Force arrow (or the notch on the rear edge of the beam) points in the same direction as the Tension Force.

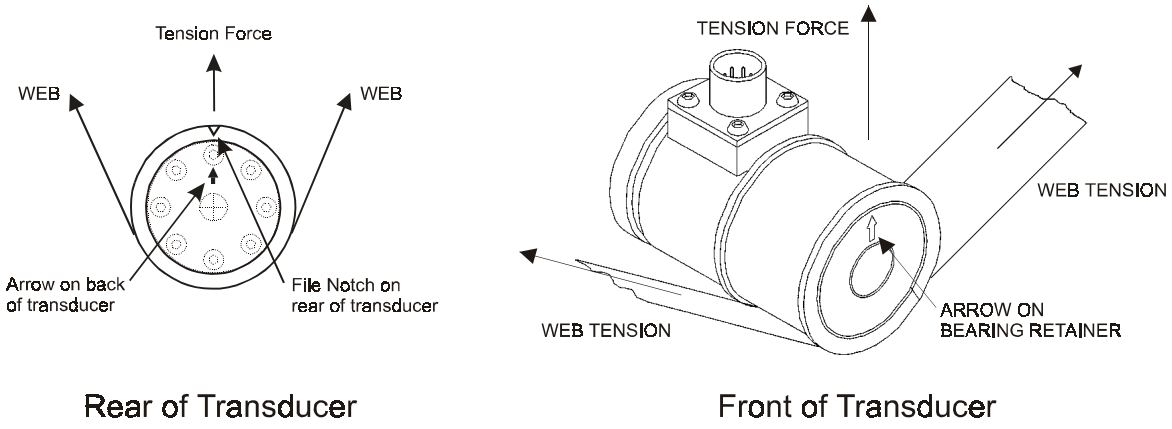


Figure 5 **- TENSION FORCE DIRECTION**

If you are installing an "S", "FL", "PFL" or "TF" mounting style transducer, adjust the transducer on the machine frame by hand (do NOT use a wrench) so the arrow (or notch) will bisect the wrap angle.

If you are installing a "PB" bracket style transducer, the transducer is already assembled with the force direction orientation specified when purchased. It can be aligned more accurately by loosening the clamp bolt on top of the bracket and turning the transducer by hand. (Pry the top of the bracket open with a screwdriver if necessary) Re-tighten the clamp bolt.

2. INSTALL AND TIGHTEN MOUNTING FASTENERS

With the transducer properly oriented with respect to its tension force, install mounting fasteners and tighten to secure the transducer in place. On S-style mounting, screw should insert no more than 0.45 inch (11.4 mm) deep into transducer.

NOTE: During installation and handling, be careful not to drop the transducer. Damage could result.

3. 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.

4. INSTALL SHAFT OR WHEEL ASSEMBLY

Remove the two M5 socket head set screws on the side of the transducer housing using a 4mm hex wrench**.** Loosen the inner two M4 socket head set screws using a 3mm hex wrench and slide the shaft assembly into place. Tighten the inner set screws and replace the outer. There is 0.25" of adjustment in the standard wheel assemblies to allow for alignment of web. (NOTE: If a non-standard DFE wheel or shaft assembly is used make certain that it does not bottom out on the transducer, as this will interfere with the proper function of the transducer and possibly cause damage to the unit.)

SECTION 3

CALIBRATION AND SETUP

3.1 INTRODUCTION

There are no calibration adjustments on the VNW Tension 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 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 **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 provided in the Manual for the indicator or controller.

The transducer must be properly installed and oriented as directed in **Section 2.4.1.**

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 between 25% and 100% of the maximum value on the tension meter scale. (Be sure you know the exact weight).
3. Find a lightweight line that will support the weight in step 2 above.
4. Verify that there is no line contacting the transducer wheel. Turn the **POWER** switch **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.

3.3 CALIBRATE THE TENSION METER

See Figure 6. Pass the line over the Transducer Wheel in exactly the same path as the web or filament will follow. Tie the end in the machine at least one idler beyond the Transducer. Pass the other end by at least one idler before the Transducer. Be sure the line does not pass over any driven wheels, braked wheels or dead bars. (This will cause inaccurate calibration). Attach the weight to the free end of the line 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 line. Verify that the tension meter still reads zero. If not, re-adjust the **ZERO** pot. so that it does.

This concludes the calibration procedure.

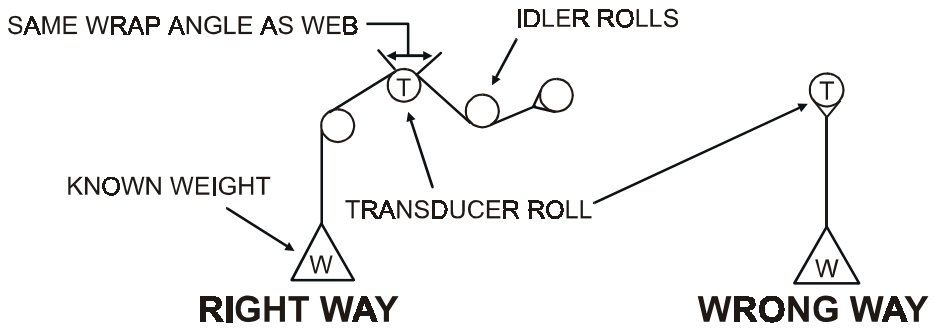


Figure 6 **- WEB PATH**

SECTION 4 CARE AND MAINTENANCE

Your Dover Flexo VNW Tension Transducer has been manufactured of quality materials. With proper application and installation your transducer should be relatively 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 wheel change. Contact Dover for specific information and engineering assistance. Please note the following information is for the units sold with DFE wheel or shaft assemblies.

4.1 BEARING LIFE

The bearings in the VNW 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 Appendix B, substituting 2 for the 4 to eliminate the oversizing factor.

RPM = 3.82 x line speed in feet per minute/diameter of transducer wheel in inches

(RPM = 318.3 x line speed in meters per minute/diameter of transducer wheel in millimeters)

BEARING SPECIFICATIONS		
Bearing Type	**Rated Load (C)**	**Maximum Speed (RPM)**
ball	4300 lbs (19120 N)	20,000

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

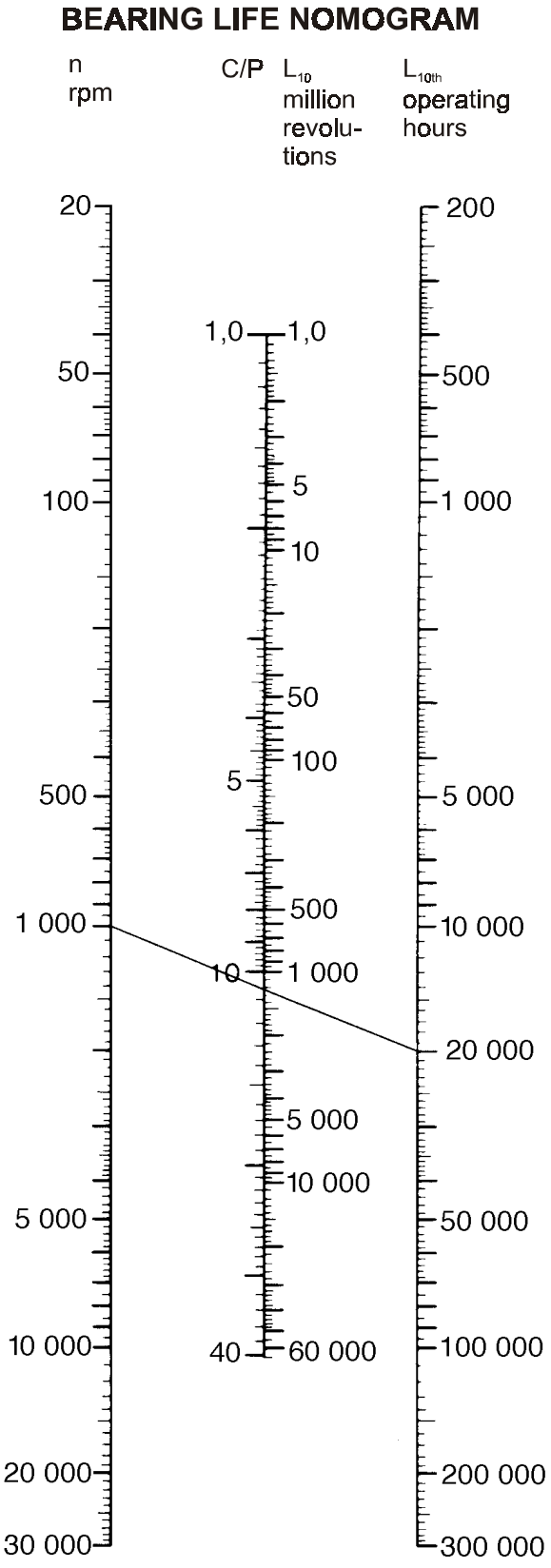
$L_{10} = (16667 / RPM) \times (C) / P)^3$, for ball bearings

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 7) on the next page can be used instead of the formulas. The result will be the same.

2. TO USE THE NOMOGRAM:

1. Use the left set of three scales for ball bearings, the right set for roller 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 on the left side of the middle scale.
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.



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

Figure 7 **- BEARING LIFE NOMOGRAM**

4.2 DISASSEMBLY AND REASSEMBLY - TOOLS REQUIRED

1. Right angle allen wrenches

SCREW SIZE	HEX SOCKET SIZE (inch)	LOCATION OF USE
M3 - 0.5 button	2mm	electrical connector
M4 - 0.7	3mm	beam
M8 - 1.25	6mm	bearing retainer

2. A small flat blade screwdriver.
3. 20 watt soldering iron with small tip.
4. Diagonal wire cutters.
5. Wire stripper for 30 AWG wire.

4.3 ELECTRICAL CONNECTOR REPLACEMENT

1. Remove the four screws holding the connector and spacer in place.
2. Unsolder the wires (You need not remember where the wires came from because the correct connections are listed in Appendix A (Figure 8, page 13) and in the Specifications on Page 2 of this manual. Discard the old connector.
3. Looking at the end of the new connector where the wires will be soldered, take notice of the pin letter designations.
4. Turn to either page mentioned above and solder the wires to the pins as described under connector pin assignments.
5. Carefully stuff the wires back into the housing, position the connector and spacer on the housing and reinstall and tighten the four screws.

4.4 CHANGING THE BEARING(S) AND/OR OPTIONAL WHEEL OR SHAFT ASSEMBLY

1. Remove the two M5 set screws in the side of the housing. Loosen the two M4 set screws and remove the shaft or wheel assembly.
2. Hold the end of the wheel shaft in a vise and remove the single M8 cap screw holding the wheel, bearings, retainer, and spacer (if any) onto the shaft adapter.
3. Remove the wheel, bearings, and bearing retainer from the shaft adapter. If the hardware does not separate easily, it may be carefully pried apart by putting flat blade screwdrivers between the wheel and the shaft adapter and prying equally on opposite sides of the assembly.
4. Remove the bearing retainer, retaining ring and bearings from the wheel.
5. Reassemble the unit with new bearings, new wheel, or both by following the preceding steps in reverse order.

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 WHEEL SHAKES, VIBRATES, or BOUNCES

a. Wheel is not balanced.
b. Transducer is not securely mounted.
c. Wheel is turning at its natural frequency. Call **DOVER** for analysis of operating conditions and solution to problem.
d. Transducer beam is vibrating sympathetically with a vibrating machine frame.

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

a. Failure in the tension indicator circuit. Refer to tension indicator manual.
b. Strain gage failure. Perform test in 4c below.
c. Wheel greater than 95% load rating (W COS(A)).

3. TENSION METER READS BACKWARDS

a. Transducer is installed backwards with force arrow pointing in opposite direction. See Section 2.3.1 page 5.
b. Transducer cable is 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 6.
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. Also measure between pins D,E and D,F. In each case the resistance should be about 100 ohms. Measure the resistance between any pin and the housing of the transducer. The meter should read infinite resistance. Apply an appropriate force to the wheel by hand or by using a line and a weight, in the direction of the tension force and maintain it while again measuring between pins A,B and A,C. Repeat while measuring between pins D,E and D,F. 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. See Section 3.3 page 6.
b. Transducer cable has a broken wire, poor connection, ground 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 transducer causing interference with beam movement.
b. Transducer cable has a broken wire, poor connection, ground or short circuit.
c. Strain gage failure. See 4c. above for test.

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

a. Meter is not calibrated. See Section 3.3 page 6.
b. Extreme build-up of dirt, ink, adhesive, grease or other foreign material inside end of transducer causing interference with beam movement.
c. Transducer cable has broken wire, poor connection, ground 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, worn bearings, chattering unwind brake, flat spot in unwind or rewind roll, machine vibration, etc.
b. Transducer is not securely mounted.
c. Tension controller is not adjusted properly. See controller Instruction Manual for procedure.
e. Failure in the tension amplifier circuit of the controller/indicator.

SECTION 6

REPLACEMENT PARTS

(DFE P/N)

PART DESCRIPTION	COMMERCIAL DESIGNATION	DFE PART NUMBER
Electrical Connector	Bendix PTO2E 10-6P	106-0049
Mating Electrical Connector	Bendix PT06E 10-6S	106-0127
Connector Screws	M3 x 0.5 x 16mm Button Head Socket Cap	123-0093
Beam Screws	M4 X 0.7 X 12mm Socket Head Cap	123-0232
Flat Seal	NONE	503-0001
Bearings	SKF 6203ZZ	133-0028
Bearing Retaining Rings	Smalley VH-156	135-0022
Beam Retaining Screws	M8-1.25 x 35mm Socket Head Cap	123-0301
Shaft Holder Plug Set Screws	M5 x 0.8 x 5mm Socket Set Screw	123-0448
Shaft Holder Set Screw (Short)	M4 x 0.7 x 4mm Socket Set Screw	123-0161
Shaft Holder Set Screw (Long)	M4 x 0.7 x 16mm Socket Set Screw	123-0449
Instruction Manual	NONE	DOC 801-1561

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
E-Mails: customerservice@dfe.com, techsupport@dfe.com
Internet: www.dfe.com

VERY NARROW WEB (VNW) TRANSDUCERS

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 THE WEB TENSION.

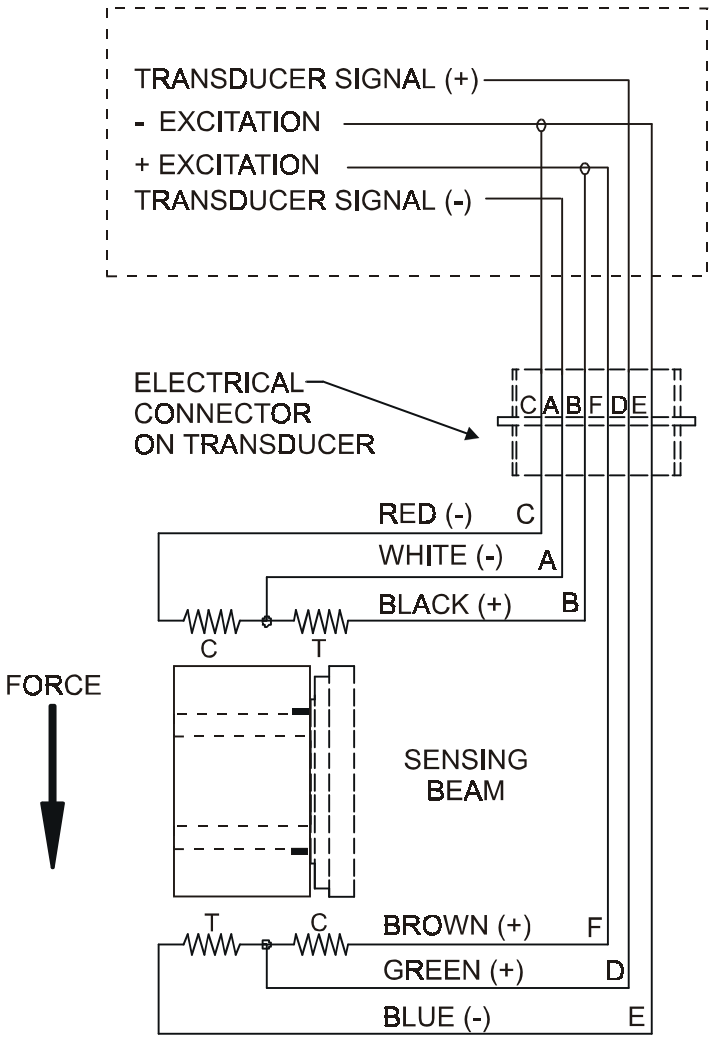


Figure 8 **- MODEL VNW TRANSDUCER WIRING**

Appendix B: Selection of Load Rating

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 ribbon (or filament) tension, wrap angle, and wheel 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 .

The VNW Tension Transducer is available with five standard load ratings ranging from 10 pounds to 150 pounds (45N to 665N). Choose the appropriate wrap configuration from the following diagrams. Then compute the Net Force using the formula below the diagram.

SELECTION PROCEDURE:

The correct load rating is found in four simple steps:

1. OBTAIN DATA TO PLUG INTO THE SELECTION FORMULA

a. Estimate the maximum web (or filament) tension. Use the Typical Tensions table in Appendix B as a guide if necessary.

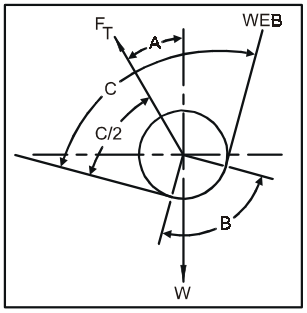
b. Determine the wrap angle and tension force direction.

2. COMPUTE NET FORCE USING THE SELECTION FORMULA

Refer to the formulas above. Compute the Net Force, using the formula below the correct wrap diagram.

WRAP 1

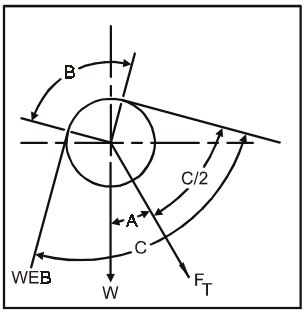
Tension Force F_T **above** horizontal



$$\text{NET FORCE} = 4T \sin\left(\frac{B}{2}\right) - W\cos(A)$$

WRAP 2

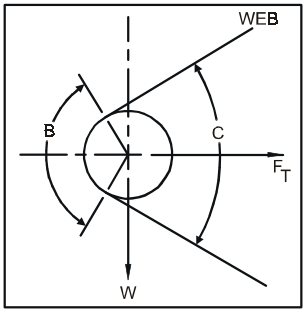
Tension Force F_T **below** horizontal



$$\text{NET FORCE} = 4T \sin\left(\frac{B}{2}\right) + W\cos(A)$$

WRAP 3

Tension Force F_T **is** horizontal



$$\text{NET FORCE} = 4T \sin\left(\frac{B}{2}\right)$$

W = Wheel weight (See Note below)
B = Wrap angle = 180° - C°

T = Maximum web tension
A = Angle between Tension Force F_T and vertical

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

NOTE: Weight of standard filament wheel is 0.49 lbs. (222 grams) including bearings and fasteners
Weight of standard ribbon wheel is 0.45 lbs. (204 grams) including bearings and fasteners
Weight of standard adapter wheel is 0.65 lbs. (295 grams) including bearings and fasteners.
Weight of customer supplied wheel must be provided and is subject to DFE engineering approval.

3. SELECT THE LOAD RATING

Use the table 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, if the transducer is chosen according to the following chart.

LOAD RATING CHART	
NET FORCE - lbs. (N)	LOAD RATING - lbs. (N)
up to 13 (up to 58)	10 (45)
14 - 32 (62 - 142)	25 (111)
33 - 63 (147 - 280)	50 (222)
63 - 125 (285 - 556)	100 (445)
126 - 240 (561 - 1068)	200 (890)
241-480 (1072-2135)	400 (1779)

4. COMPARE LOAD RATING WITH EFFECTIVE TRANSDUCER WHEEL WEIGHT

The following applies only to non-standard wheels or other hardware used in place of the wheel:

Sometimes a wheel 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 wheel is too heavy, compare the load rating with the effective weight of the wheel as follows: The effective wheel 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 wheel 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 C: 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
	.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 warranteed. 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.

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 C2, VNW Web Tension Transducers,

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

Alan H. Wysocki, Engineering Manager

8010715b.doc

INDEX

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

INDIA

CHILE

F & C 4/02 DOC 801-1561
PRINTED IN USA