DOVER FLEXO ELECTRONICS, INC.
ISO 9001 CERTIFIED

INSTRUCTION MANUAL
Low Tension Transducer
MODEL LT

5 YEAR WARRANTY

DOVER FLEXO ELECTRONICS, INC.

217 Pickering Road

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

For assistance, please call:

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

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

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FIGURES

LOW TENSION TRANSDUCER

PART NUMBER DERIVATION

S	-	LT	-	1000	-	F
STYLE		MODEL		LOAD RATING		WHEEL

(S) Stackable	50 gram	(F)ilament Wheel
(T) Threaded	100	(N)one*
	200	(R)ibbon Wheel
	500	(P)in
	1000	
	2000	

* M5 x 0.8 threaded hole for mounting other hardware, subject to DFE Engineering approval.

SECTION 1 DESCRIPTION AND OPERATION

1.1 GENERAL DESCRIPTION

The Model "LT" Low Tension Transducer is an electro-mechanical device that converts filament tension into a D.C. voltage 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 Low Tension Transducer is typically used in tension control and display systems in filament winding machines 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 Low Tension Transducer, how it works, and how it is used.

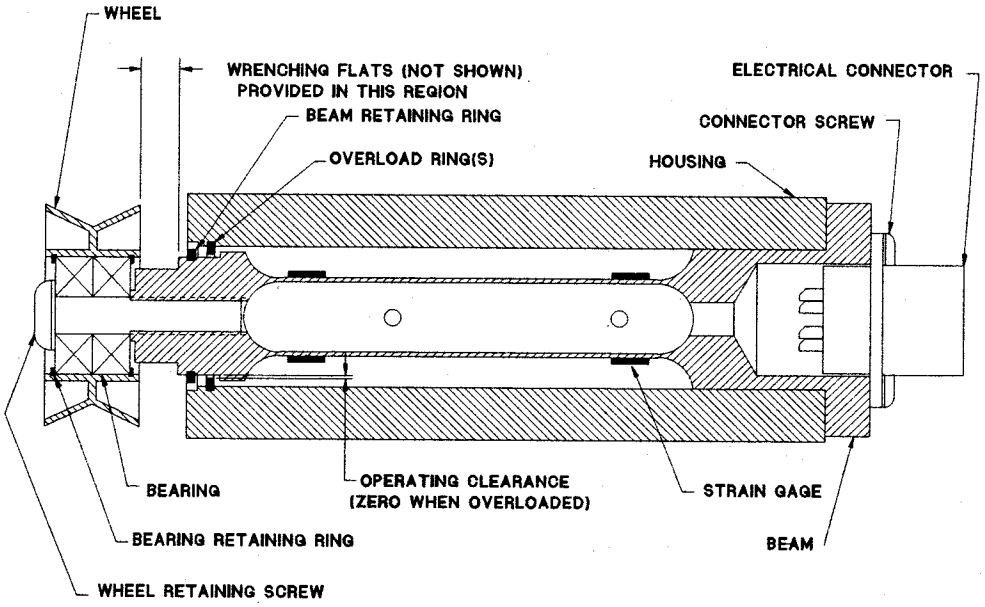


Figure 1 - CUT-AWAY VIEW OF MODEL LT TRANSDUCER

1.2 CONSTRUCTION & MECHANICAL OPERATION (see figure 1)

The standard Low Tension Transducer wheels are manufactured of aluminum to be lightweight and of low inertia, and given a hard coat anodized surface finish to be durable. The bearings are standard deep-groove ball type with shields to discourage entry of contaminants. Custom wheel geometries and/or finishes are available or the transducer may even be purchased without a wheel so that special hardware may be mounted at the drilled and tapped hole in the end of the transducer, subject to specific DFE engineering approval.

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 transducer may be mounted by 1 of 3 methods; using either of 2 pair of mounting holes in the stackable housing as shown in Figures 2A & 2B, or using jam nuts to position the threaded housing in a hole through the machine frame as shown in Figure 2C.

CAUTION: Never use the wrenching flats on the beam for any purpose other than removal of the wheel from the beam. Using these flats to turn the threaded housing into a tapped hole will almost certainly damage the beam.

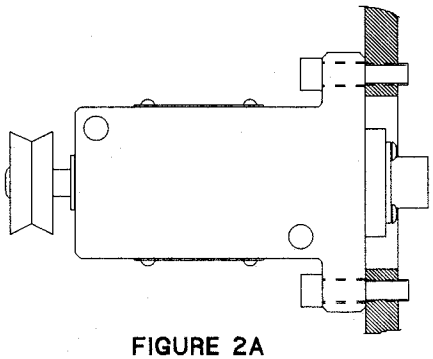


FIGURE 2A

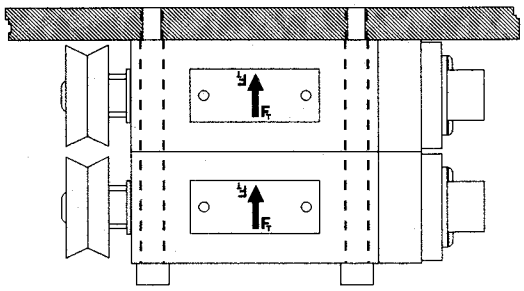


FIGURE 2B

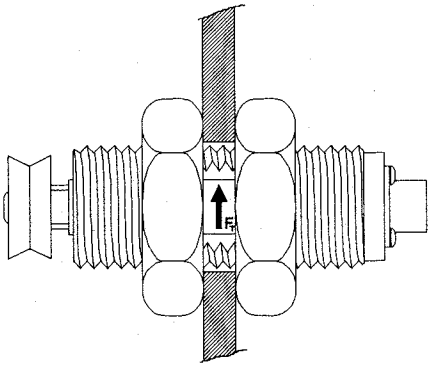


FIGURE 2C

Figure 2 - MOUNTING STYLES

1.3 ELECTRICAL OPERATION

The Low Tension Transducer has two strain gages on each web of the dual cantilevered beam; two in compressive regions and the other two in tensile regions. The four total strain gages are electrically connected in a wheatstone bridge configuration to provide automatic temperature compensation and stable output.

The strain gages are high output semiconductor devices which typically put out 16 times the signal of inexpensive foil gages used in some transducers. Therefore, the signal amplifier used with this transducer may be of a very stable low-gain design. An added benefit of the high output from the strain gages is inherent immunity to electrical noise.

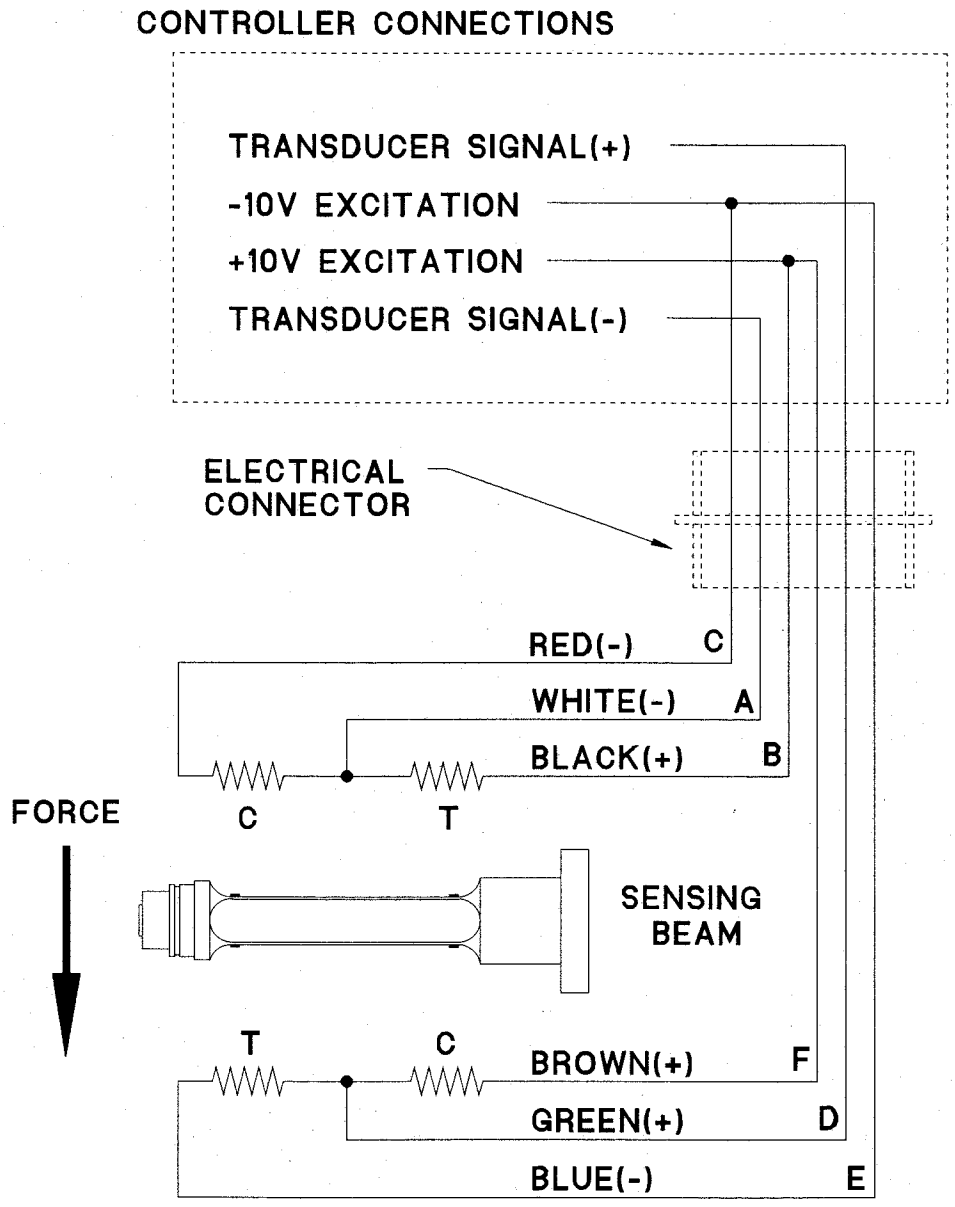


Figure 3 - STRAIN GAUGE CONNECTIONS

TYPICAL TENSIONS FOR RIBBON MATERIALS

ACETATE		.5 lb. per mil per inch of width
FOIL	Aluminum	.5 lb. per mil per inch of width
	Copper	.5 lb. "
CELLOPHANE		.75 lb. per mil per inch of width
NYLON		.25 lb. per mil per inch of width
PAPER	15 lb *	.4 lb. per inch of width
	20 lb	.5 lb. "
	30 lb	.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		.12 lb. per mil per inch of width
POLYESTER (Mylar)		.75 lb. per mil per inch of width
POLYPROPYLENE		.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		.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		.05 lb.per mil per inch of width	

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

Figure 4 - TYPICAL TENSIONS

SECTION 2

SELECTION OF TRANSDUCER LOCATION

2.1 PRECAUTIONS

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 FILAMENT!**

2.2 LOCATION OF TRANSDUCER (see figure 5)

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.

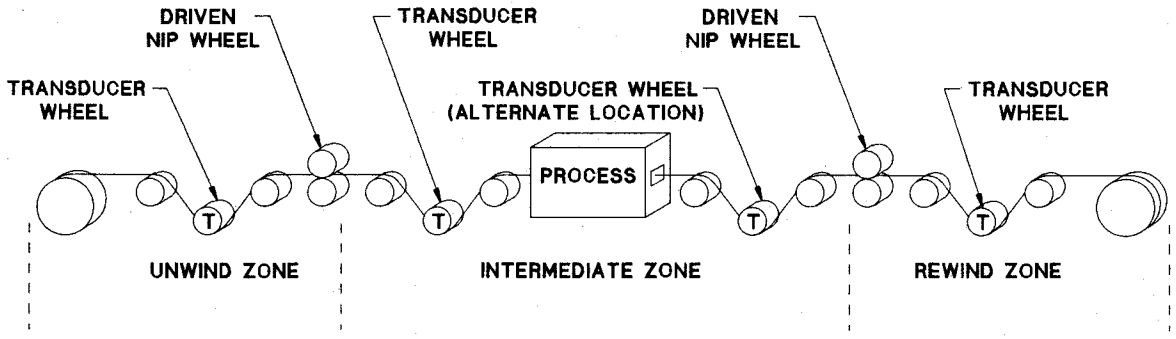


Figure 5 - TENSION ZONES

WRAP ANGLE. The 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 filament 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 as well as tension in the web, and accuracy will be reduced.

MOUNTING SURFACE. The structure on which the transducer is mounted should be strong. Vibration of the machine frame could cause sympathethic vibration of the transducer, resulting in fluctuating output.

SECTION 3

SELECTION OF LOAD RATING

3.1 LOAD RATINGS

The Low Tension Transducer is available with six standard load ratings ranging from 50 grams to 2000 grams (0.11 lbs TO 4.40 lbs). The correct transducer load rating for your application is determined by maximum filament tension, wrap angle, direction of force, and wheel weight. Choose the appropriate wrap configuration from the diagrams below. Then compute the Net Force using the formula below the diagram.

3.2 SELECTION PROCEDURE

The correct load rating is found in four simple steps:

Step 1: OBTAIN DATA TO PLUG INTO THE SELECTION FORMULA

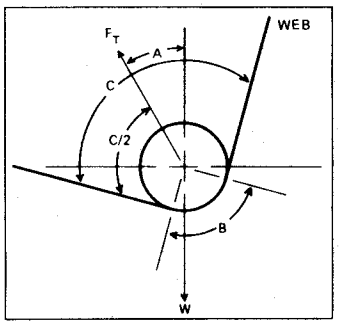
a. Estimate the maximum filament tension. Use Figure 4, page 4, as a guide if necessary.
b. Determine the wrap angle and tension force direction.

Step 2: COMPUTE NET FORCE USING THE SELECTION FORMULA

Refer to Figure 6. Compute the Net Force, using the formula below the wrap diagram.

WRAP 1

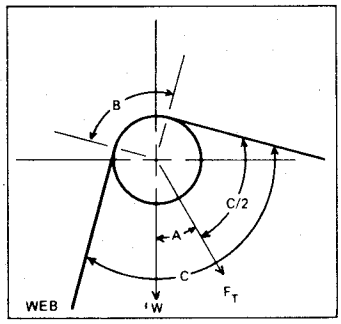
Tension Force, F_T, **above** horizontal.



$$NET\ FORCE = 4TSIN(\frac{B}{2}) - WCOS(A)$$

WRAP 2

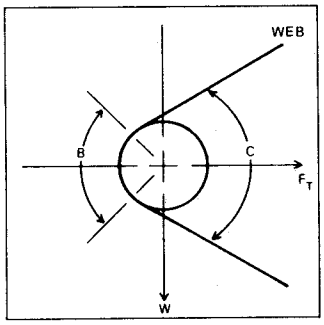
Tension Force, F_T, **below** horizontal.



$$NET\ FORCE = 4TSIN(\frac{B}{2}) + WCOS(A)$$

WRAP 3

Tension Force, F_T, **is** horizontal



$$NET\ FORCE = 4TSIN(\frac{B}{2})$$

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

W = Wheel Weight (See Note 1)
B = Wrap angle = 180° - C
T = Maximum filament tension,
A = Angle between tension force, F_t and vertical

NOTE 1: Weight of standard filament wheel is 25 grams (0.055 lbs.) including bearings, fasteners and free end of beam.
Weight of standard ribbon wheel is 28 grams (0.062 lbs.) including bearings, fasteners and free end of beam.
Weight of free end of beam = 5 grams (.011 lbs.) without wheel, bearings and fasteners.
Weight of customer supplied wheel must be provided and is subject to DFE engineering approval.

Figure 6 - LOAD RATING SELECTION FORMULAE

Step 3: SELECT THE LOAD RATING FROM FIGURE 7

Use Figure 7 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 chart below.

LOAD RATING CHART	
NET FORCE - grams (lbs.)	LOAD RATING - grams (lbs.)
up to 60 (up to 0.13)	50 (0.11)
60 - 120 (0.13 - 0.26)	100 (0.22)
120 - 240 (0.26 - 0.52)	200 (0.44)
240 - 600 (0.52 - 1.32)	500 (1.10)
600 - 1200 (1.32 - 2.64)	1000 (2.20)
1200 - 2400 (2.64 - 5.29)	2000 (4.40)

Figure 7 - LOAD RATING CHART

Step 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 standard wheels:

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).

SECTION 4 INSTALLATION

4.1 ORIENT THE TRANSDUCER (see figure 8)

The transducer must be oriented so the Tension Force arrow points in the same direction as the Tension Force. Tighten the mounting fasteners so it cannot move.

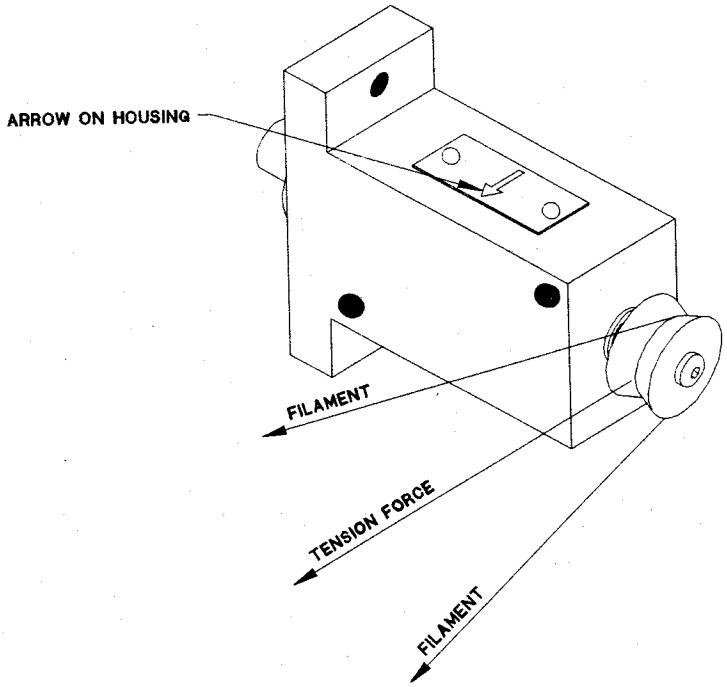


Figure 8 - TENSION FORCE DIRECTION

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

SECTION 5

CALIBRATION

5.1 INTRODUCTION

There are no calibration adjustments on the Low 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 in the Manual for the indicator or controller.

The transducer must be properly installed and oriented as directed in **SECTION FOUR**, page 8.

5.2 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 2. above.
4. Verify that there is no line contacting the transducer wheel. Turn the "POWER" switch on. Wait a few minutes for the tension meter to settle. Turn the "CALIBRATE" pot. to approximately 75%. Then, turn the "ZERO" pot. so the tension meter reads zero tension.

5.3 CALIBRATE THE TENSION METER

See Figure 9. Pass the line over the Transducer Wheel in exactly the same path as the filament follows. Tie the end in the machine running over 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 meter still reads zero with no load. Repeat as needed.

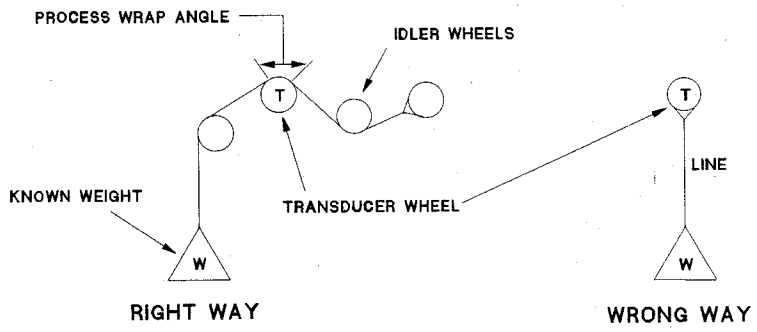


Figure 9 - FILAMENT PATH

SECTION 6

SPECIFICATIONS AND OPTIONS

6.1 SPECIFICATIONS

EXCITATION VOLTAGE	10VDC
OUTPUT	500 mVDC, nominal
STRAIN GAGES	semiconductor type, 800 ohms nominal bonded resistance
NON-REPEATABILITY	± 1/4% full span (FS)
NON-LINEARITY AND HYSTERESIS COMBINED	± 1/2% FS
TEMPERATURE RANGE	-10° to 200°F (-23° to 93°C)
TEMPERATURE COEFFICIENT	0.02% per F degree typical (0,01% per C degree typical)
MATING ELECTRICAL CONNECTOR	Bendix PT06E10-6S
ELECTRICAL CONNECTOR POSITION	Rear Only
CONNECTOR PIN ASSIGNMENTS	
pin A (WHITE)	negative output
pin B (BLACK)	10V+
pin C (RED)	10V-
pin D (GREEN)	positive output
pin E (BLUE)	10V-
pin F (BROWN)	10V+
WHEEL: MATERIAL	6061 Aluminum
FINISH	32 microinch Hard coat & anodized
MINIMUM OVERLOAD CAPACITY	11 lbs. (49 N)
DEFLECTION OF SENSOR BEAM	0.020 inch typical (0,50mm typical)
LOAD RATINGS	50, 100, 200, 500, 1000, 2000 grams (0.11, 0.22, 0.44, 1.10, 2.20, 4.40 lbs.)
BREAK-AWAY TORQUE, TYPICAL	0.02 oz-in (1,5 gram-cm)
BASIC DYNAMIC LOAD RATING OF BEARINGS	299 lbs (1340 N)

6.2 OPTIONS

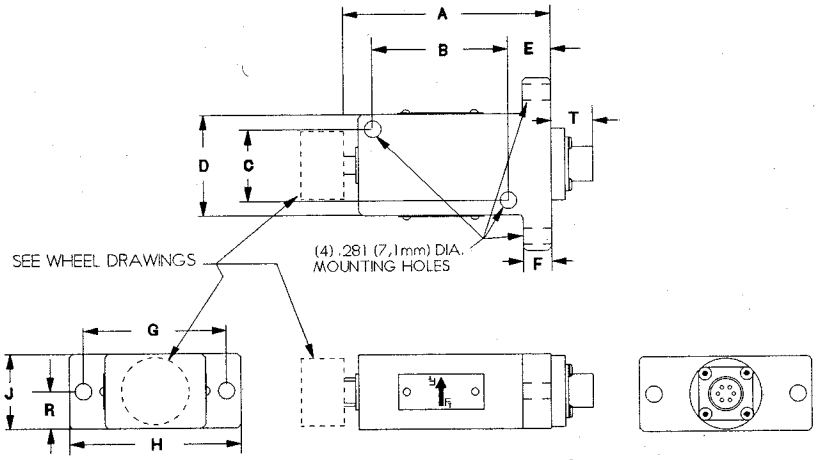
A. Non-standard wheels
B. Non-standard roll finishes

SECTION 7

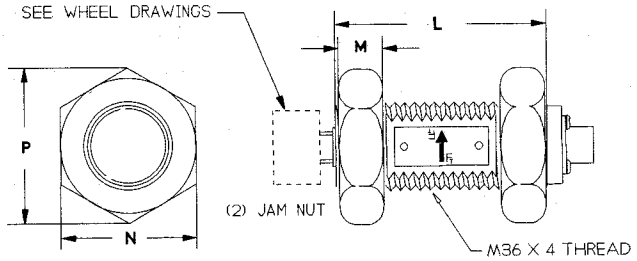
DIMENSIONS

DIMENSIONS:

UNITS	A	B	C	D	E	F	G	H	J	L	M	N	P	R	T
inch	3.63	2.38	1.25	1.75	0.75	0.50	2.50	3.00	1.31	3.38	0.71	2.17	2.39	0.66	0.73
mm	92,2	60,5	31,8	44,5	19,1	12,7	63,5	76,2	33,3	85,9	18,0	55,0	60,8	16,8	18,5



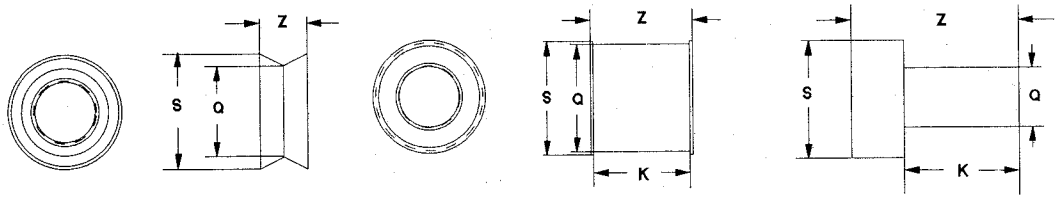
STACKABLE HOUSING



THREADED HOUSING

WHEEL DIMENSIONS:

WHEEL	UNITS	K	Q	S	Z
FILAMENT	inch	--	.96	1.19	.50
	mm	--	24,38	30,2	12,7
RIBBON	inch	1.02	1.13	1.19	1.09
	mm	26,0	28,70	30,2	27,6
PIN	inch	.63	.24	.39	.83
	mm	16,0	6,0	10,0	21,0



FILAMENT WHEEL RIBBON WHEEL PIN

Figure 10 - DIMENSIONS

SECTION 8

BEARING LIFE

The bearings in the Low Tension 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 6 on page 6, substituting 2 for the 4 to eliminate the oversizing factor.

RPM = 318.3 x line speed in meters per minute/diameter of transducer wheel in millimeters
(RPM = 3.82 x line speed in feet per minute/diameter of transducer wheel in inches).

BEARING SPECIFICATIONS		
BEARING TYPE	RATED LOAD (C)	MAXIMUM SPEED (RPM)
ball	299 LBS. (1340 N)	36000

Figure 11 - BEARING SPECIFICATIONS

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

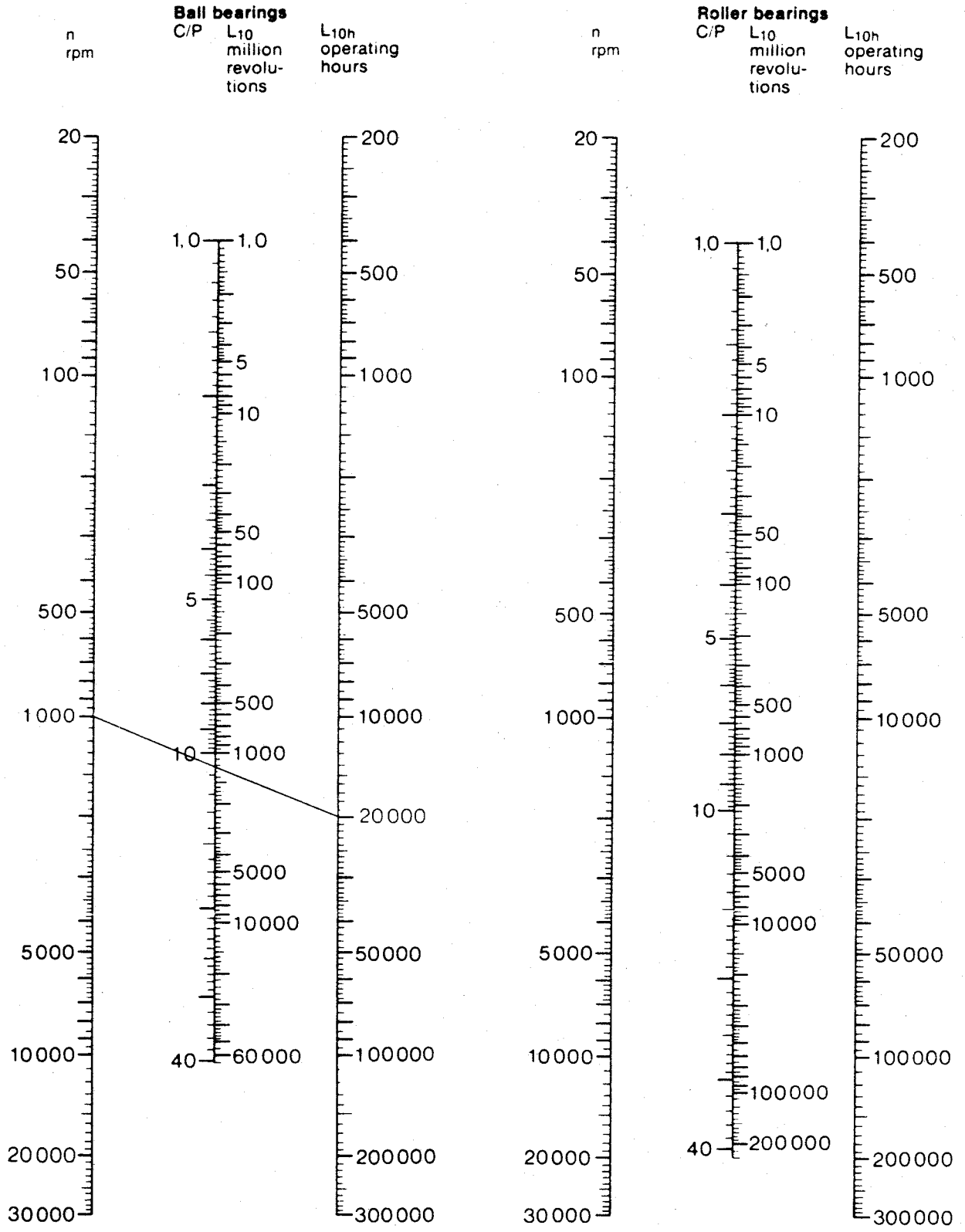
$$L_{10} = (16667 / RPM) \times (C / P)^3$$

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

If preferred, the bearing life nomogram (Figure 12) 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.



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

Figure 12 - BEARING LIFE NOMOGRAM

SECTION 9

REPLACEMENT PARTS LIST
(Low Tension Transducer)

PART DESCRIPTION	COMMERCIAL DESIGNATION	DFE PART NUMBER
Electrical Connector	Bendix PTO2E 10-6P	106-0049
Connector Screws	M3 x 0.5 x 16mm Button Head Socket Cap	123-0093
Wheel Retaining Screw	M5 x 0.8 x 20mm Button Head Socket Cap	123-0284
Bearings	SKF 625-2Z	133-0024
Bearing Retaining Rings	Smalley VH-62	135-0020
Beam Retaining Ring	Smalley DNS-16	135-0019

Figure 13 - REPLACEMENT PARTS

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-Mail: dfe@ttlc.net Internet: www.dfe.com

SECTION 10

TROUBLESHOOTING GUIDE

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

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

a. Failure in the tension indicator circuit. Refer to tension indicator manual.
b. Strain gage failure. Perform test in 4.c. 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 4.1 page 8.
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 5.2 page 9.
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 800 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. Refer to controller/indicator manual.

5. TENSION METER READING DRIFTS WITH TIME.

a. Meter is not calibrated. See Section 5.3 page 9.
b. Transducer cable has a broken wire, poor connection, ground or short circuit.
c. A strain gage is cracked. Perform the test in 4.c. 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 4.c. 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 5.3 page 9.
   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. Filament 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.

SECTION 11 DISASSEMBLY AND REASSEMBLY

11.1 TOOLS REQUIRED

a. Right angle allen wrenches

SCREW SIZE	HEX SOCKET SIZE	LOCATION OF USE
M3 - 0,5 button	2mm	electrical connector
M5-0,8 button	3mm	wheel retaining screw

b. 8 mm open end wrench.
c. A small flat blade screwdriver.
d. 20 watt soldering iron with small tip.
e. Diagonal wire cutters.
f. Wire stripper for 30 AWG wire.

11.2 ELECTRICAL CONNECTOR REPLACEMENT

1. Remove the four screws holding the connector and beam in place.
2. Unsolder the wires. (You need not remember where the wires came from because the correct connections are listed in Figure 3, page 3, and in the "Specifications" on page 10 of this Manual.) 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. Turn to Page 10 of this Manual and solder the wires to the pins as described under "Connector Pin Assignments".
5. Carefully stuff the wires into the back of the beam and position the connector and beam so that the notch in the base of the beam is oriented in the net force direction. Replace all four screws and tighten.

11.3 WHEEL OR BEARING REMOVAL/REPLACEMENT

It is essential that the following procedure be followed exactly to prevent damage to the sensing beam of the Low Tension Transducer.

1. Remove the transducer from its mounting surface as it must not be fixed to anything when the wheel retaining screw is being loosened or tightened.

2. Grasp the wheel between the thumb and forefinger of one hand and hang the transducer vertically as shown in Figure 14. Put an 8 mm open-end wrench on the wrenching flats of the beam between the housing and wheel and put a right angle allen wrench in the socket of the wheel retaining screw. With the other hand, pull the two wrench handles together, also as shown in Figure 14. **DO NOT** grip the housing when tightening or loosening this screw as damage to the beam may result. Remove the screw and the wheel.

3. Using a small flat blade screwdriver, carefully remove the retaining rings from the wheel and then press the bearings out.

4. Replace the wheel or the bearings as needed and perform steps 1,2 & 3 in reverse.

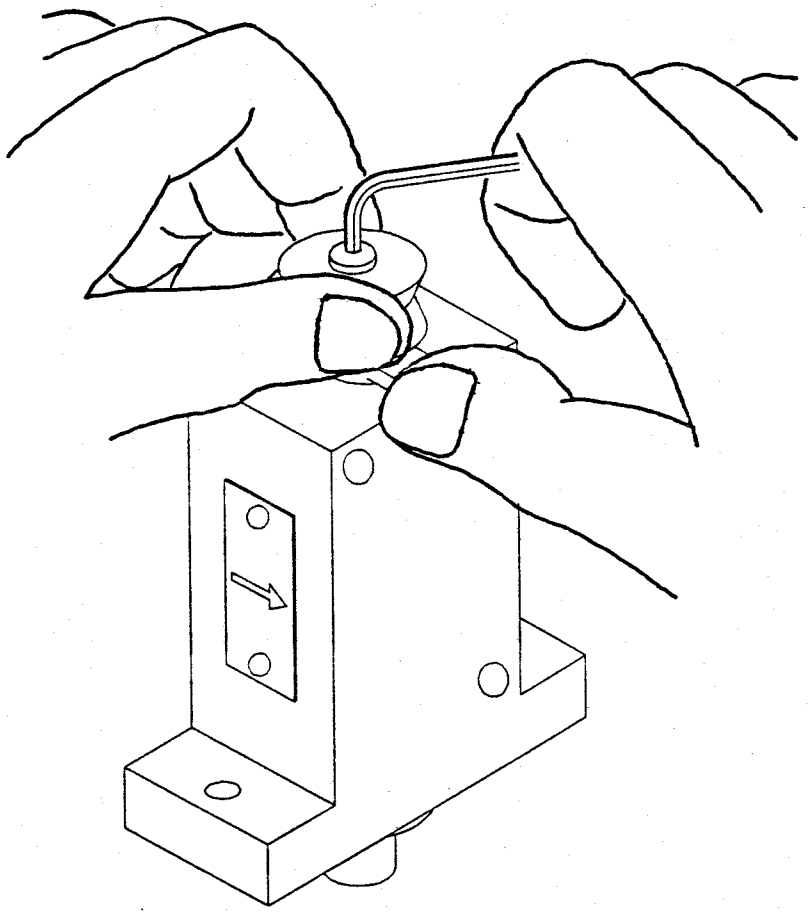


Figure 14 - BEARING REMOVAL/REPLACEMENT

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 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 canceled 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.

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