MODEL UPBV TENSION TRANSDUCER

The UPBV is a heavy-duty transducer designed to accurately measure web tension in machines having live-shaft idler rolls. One is placed under the pillow block bearing on each end of the roll shaft. The UPBV has no hinges so it is more reliable and stronger than comparable UPB transducers on the market. Though designed for live shafts, it can also be used with dead shaft idlers with equal accuracy.

BENEFITS/FEATURES

- Low maintenance design
- Sensitive to loads perpendicular to the top plate.
- Corrosion-resistant stainless steel and aluminum construction.
- Entire length of top plate is clear for pillow block installation.
- Can be installed in any orientation.
- Overload stop provides protection over 360 degrees.
- Splash resistant.
- Use with live or dead shaft idler rolls.

BEARING RECOMMENDATION

The UPBV transducer will perform best if the proper bearings are used. First, both of the bearings should have **self-aligning** capability. This will eliminate stresses on the top plate caused by roll deflection, misalignment and uneven mounting surfaces. Second, the shaft should be able to **"float"** (move axially a small amount) relative to one of the bearings to compensate for roll/shaft length expansion.

OPTIONS

- **Drill and Tap (DT) -** Drill and tap the top plate.
- **Environmental Connector (EC)** - Seals with mating cable environmental connector to protect against electrical contact oxidation; especially useful in corrosive environments.
- **Extended Range output (XR)** - Produces twice the output signal for a given load rating. Must be used with electronics having extended range option
- **Full Bridge (FB)** - Wheatstone bridge configuration. Needed when using only one transducer.
- **Permanently Attached Cable (PT)** - Permanently attached cable with tinned leads instead of amphenol connector on device.
- **Permanently Attached Cable with Connector (PTC)** - Permanently attached cable with connector instead of amphenol connector on device.
- **Right Angle Connector Block (RAB) -** Alows electrical connector to plug in at 90 degrees to normal.

FACTORS AFFECTING LOAD RATING SELECTION

The UPBV transducer is designed to measure forces which are mostly perpendicular to the top plate. It is available in three load ratings: 100, 200, and 400. The load rating appropriate for a particular web application depends on the transducer's mounting orientation, roll weight, web tension, wrap angle, and direction of tension force.

The transducer can be mounted in any angular orientation about the roll axis, as long as the tension force direction 'F_T' is within +\- 45° of the line 'V' which is perpendicular to the transducer top plate (see diagram 2). Outside of this angular range, DFE's model UPBH transducer should be used. The UPBH transducer is used to measure tension with the applied force directed mostly parallel to the top-plate.

When looking at the UPBV transducer orientation sketches on the next page, note that the side view of each transducer shows one end as the pivot end (stamped 'H'). This designation distinguishes one end of the transducer's internal pivot end from the other end, which is the sensing-beam end. Both transducers are supporting a shaft and must have the pivot end to the same side of the shaft. Because of its asymmetric internal design, the transducer is significantly more sensitive to non-perpendicular applied force directed through the sensing-beam end than through the pivot end.

As a result, calculating net force and selecting a load rating are not as straightforward as with other transducers. We strongly recommend that you ask your sales representative or one of DFE's applications engineers to select a load-rating for your application.

If you wish to calculate the correct total net force for an application yourself, follow the Load Rating Selection instructions on the next page. Note that total net force is the sum of two components: net force from roll weight and net force from web tension.

The correct load rating for a UPBV transducer pair can then be selected by matching your calculated total net force to the range of values from the corresponding Max. Net Force list.

Ordering Instructions

You may order by description or by indicating your feature choices in place of the X's in the product code shown below.
Example: UPBV2-200-S-XR, EC

UPBV2 - X - X - OPTIONS (Separated by commas)

LOAD RATING	CONNECTOR POSITION	OPTIONS
100 200 400	S = Standard O = Optional	D&T = Drill & Tap EC = Environmental Connector FB = Full Bridge PT = Permanently Attached Cable PTC = Permanently Attached Cable with connector RAB = Right Angle Connector Block XR = Extended Range Z = Special (SPR)

SELECTING THE LOAD RATING

To select the correct load rating for each model UPBV transducer (to be used in a pair), look at Diagrams 1 and 2. You will need to calculate Net Force from Roll Weight and Net Force from Tension. The sum of these net force components equals the Total Net Force used to select the correct load rating.

F_T = direction of force midway between two tensions

V = line 'V', perpendicular to mount surface and top plate

1. Enter values from your application for the equation variables below.

   T = max. tension in web __________

   W = weight of roll and support bearings __________

   A = angle between weight 'W' direction and line V______

   B = web wrap angle (=180° - C in diagram 2) ________

   D = angle between tension force direction 'F_T' and line 'V" _________.

   Dimensional Constants inches (mm)

   L = 2.4 (61)

   H = 1.8 (46) + "a"

   a = 1.0 (25.4) to 2.5 (63.5)

   Where "a" is the bearing block shaft-center height above the top-plate surface. (This depends on the pillow block you are using). If the tension force F_T is directed toward the pivot end (marked "H") at angle D = 45°, then when the pillow block height is more than 1.4 inches, the output signal polarity will be reversed.

2. Refer to the Diagram 1 formulas for Net Force from roll weight. Determine (as it applies to your situation) whether the roll weight will be pushing toward or pulling from the top plate, and whether the direction of the weight from the center of the roll is pointed in the 90° quadrant on the left or the right of line V. Again, whether the pivot end is to the left or right effects sensitivity.

   Plug the values for your variables (and the dimensional constants) into the associated equation that most closely matches your application. Calculate the Net Force from Weight. *Note:* It is critical to maintain the algebraic sign ("+" or "-") in the result.

3. Refer to the Diagram 2 formulas for Net Force from tension. Select the drawing that most closely matches your application in terms of F_T direction relative to line V (observe the pivot end marked "H"). Plug the values for your variables (and the dimensional constants) into the equation associated with the 45° sector that most closely matches your application. Calculate the Net Force from Tension. Again, it is critical to maintain the algebraic sign ("+" or "-") in the result.

   Note: When the calculated Net Force from Tension is negative (i.e. pulling away from the transducer) it is necessary to reverse the signal polarity in associated electronics (indicators or controllers) for positive control. This optional reverse polarity can be specified when purchasing DFE electronics.

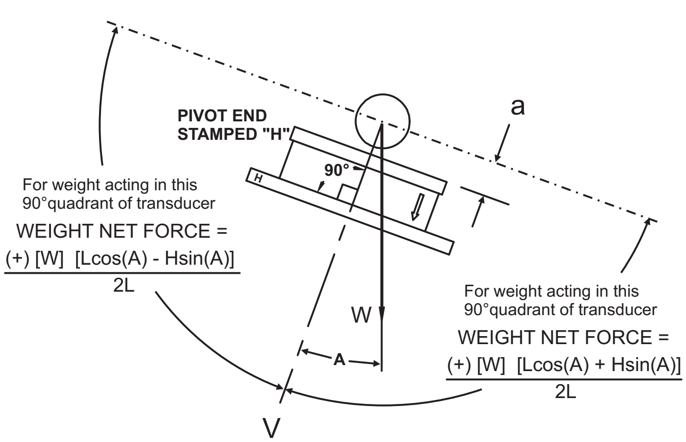
4. Add the Net Force from Weight and the Net Force from Tension paying close attention to the algebraic sign of each component. Use the absolute value of the total to select the appropriate load rating (lbs) from the list below.

Size	**Max. Net Force** lbs. (Newtons)	**Load Rating**
2	up to 120 (550 N)	100 lbs. (450 N)
	240 (1075 N)	200 lbs. (900 N)
	480 (2150 N)	400 lbs. (1800 N)

5. To get expected results, be sure the installers are given the details of mounting orientation, pivot end, and tension direction. If the Net Force has a negative (-) value, the output signal from associated electronics will need to be reversed. Application sketches are helpful.

DIAGRAM 1: FORMULAS FOR NET FORCE FROM ROLL WEIGHT

CASE A: Weight pushing <u>toward</u> top plate



CASE B: Weight pulling <u>away</u> from top plate

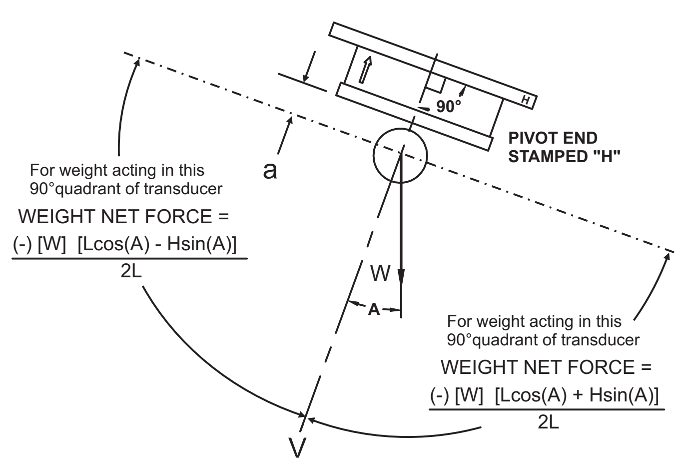


DIAGRAM 2: FORMULAS FOR NET FORCE FROM TENSION

Notes:

1. If F_T is perpendicular (Angle D = 0°) and toward the top plate, either of the two drawing/formulas on the left can be simplified to $+2T \sin(B/2)$.

   If F_T is perpendicular (Angle D = 0°) and pulling away for the top plate, either of the two drawing/formulas on the right can be simplified to $-2T \sin(B/2)$.

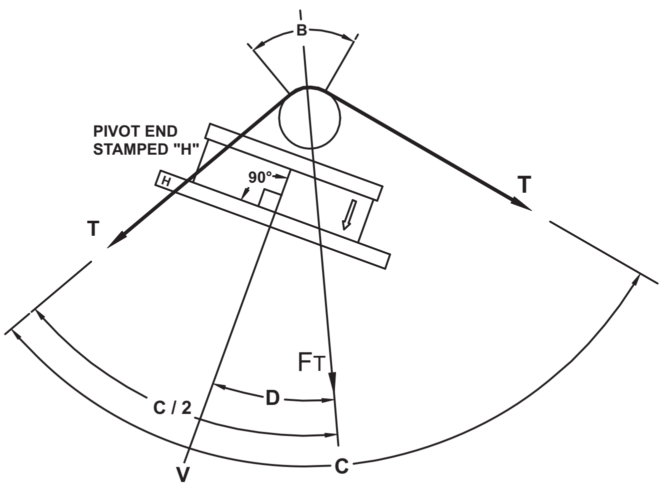
2. These tension force equations have an oversizing factor of two (2) for tension surges.

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

WRAP 1

F_T **pushes toward** top plate and away **from** pivot end

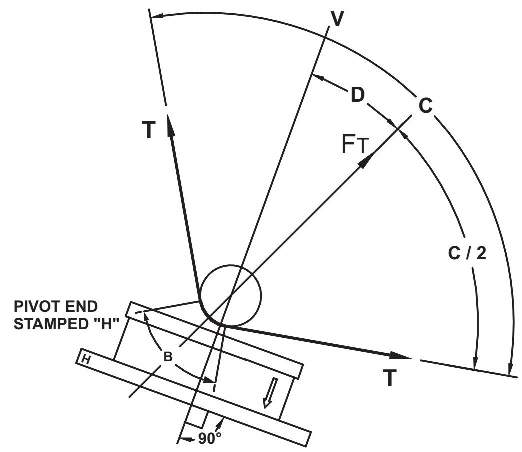


TENSION NET FORCE =

$$\frac{(+)\ [4T\sin(B/2)]\ [L\cos(D) + H\sin(D)]}{2L}$$

WRAP 3

F_T **pulls from** the top plate and away **from** pivot end



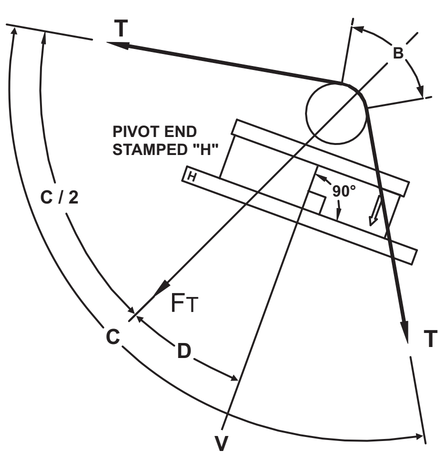
TENSION NET FORCE =

$$\frac{(-)\ [4T\sin(B/2)]\ [L\cos(D) - H\sin(D)]}{2L}$$

D must not exceed 45° for Wraps 1 & 4

WRAP 2

F_T **pushes toward** top plate and **toward** pivot end

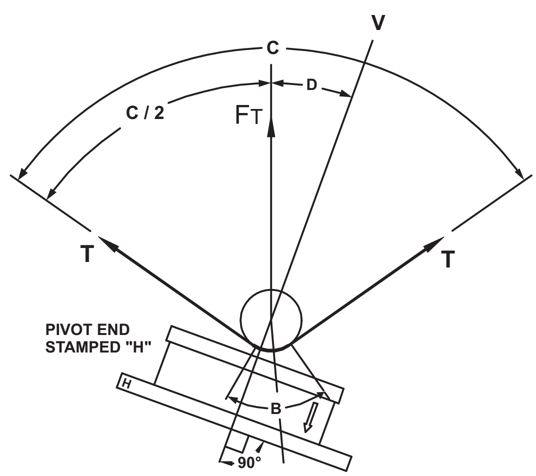


TENSION NET FORCE =

$$\frac{(+)\ [4T\sin(B/2)]\ [L\cos(D) - H\sin(D)]}{2L}$$

WRAP 4

F_T **pulls from** the top plate and **toward** pivot end



TENSION NET FORCE =

$$\frac{(-)\ [4T\sin(B/2)]\ [L\cos(D) + H\sin(D)]}{2L}$$

D must not exceed 30° for Wraps 2 & 3

SPECIFICATIONS

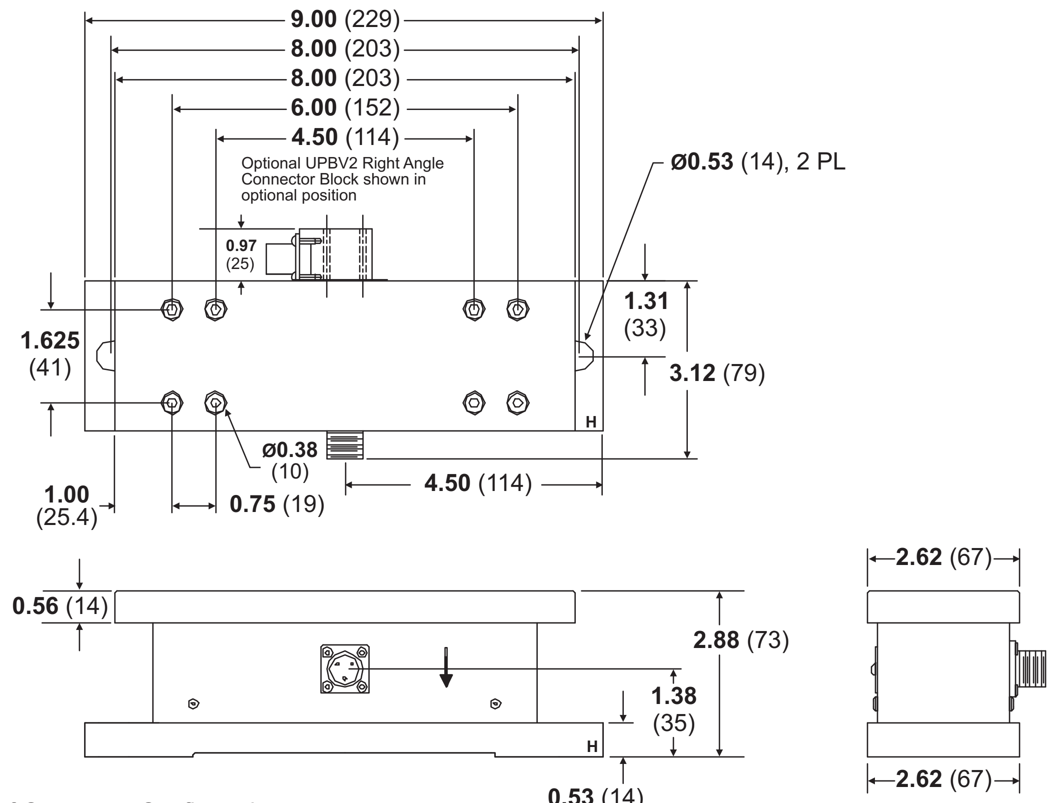
ELECTRICAL

Excitation: 5 Vdc, regulated (+10 Vdc, XR)
Output: 250 mVdc, nominal (500 m Vdc, XR)
Strain Gage Resistance: 100 ohms, nominal
Non-Repeatability: +/- 0.25% Full Span (FS)
Combined Non-Linearity and Hysteresis:
+/- 0.50% FS
Temperature Range: -10°F to 200°F (-23°C to 93°C)
Connector Pin Assignments:
A = output, B and C = 5 Vdc
Mating Electrical Connector:
3-pin Amphenol with Clamp (DFE# 721-1445)
Electrical Connector Position:
Refer to Dimension drawing below

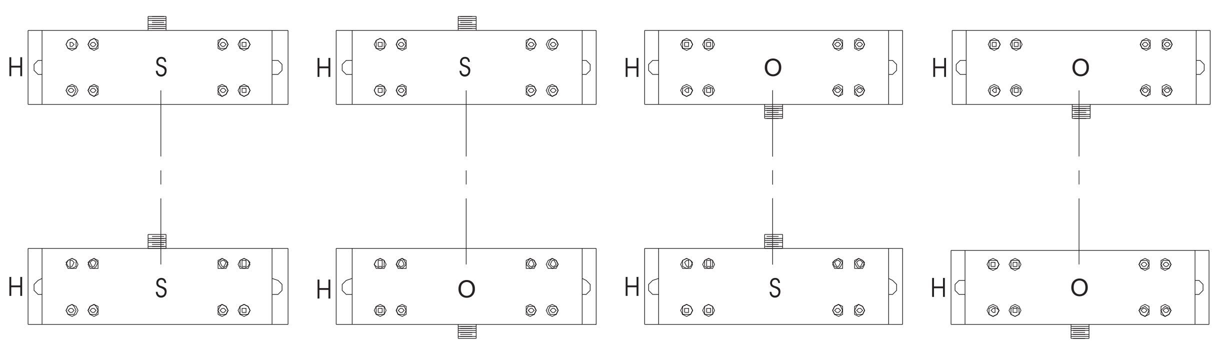
MECHANICAL

Deflection: 0.040 inch max. (1 mm)
Load Ratings: 100, 200, 400 lbs. (450, 900, 1800 N)
Overload Capacity: 2,000 lbs., min (8900)
Materials: 303/304 Stainless Steel, 7075.T6 Aluminum
Load Direction: +/- 45° of perpendicular to top plate
Weight: 7 lbs. (3 kg)

DIMENSIONS



Examples of Connector Configurations:



"H" Denotes Hinge End of Transducer
"S" Denotes Standard Connector Position
"O" Denotes Optional Connector Position

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