LINEAR & ROTARY MOTION CONTROL

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SM4

UNIVERSAL BELT TENSION METER

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The SM4 Tension Meter is designed to measure the static tension of all belts (timing belts, flat belts, V-belts) in all belt materials, regardless of the tension member material.

The SM4 is more accurate and easier to use than force deflection or elongation methods.

Pre-Tension

The pre-tension Fv is determined by the maximum operating force Fu. The purpose of pre-tension is to allow both sides of the belt between the pulleys to run without sagging. It is important to recognise the difference between the loaded (taut) and unloaded (slack) side of a drive when power is applied. The tension increases in the loaded (taut) side and decreases proportionately in the slack side.
The pre-tension is set correctly when the unloaded (slack) side of the belt always remains taut under the maximum operating load. Any sag or flap may indicate that the pre-tension is too low.

For recommended pre-tension see page 5.

Advantages of Correct Pre-Tension

Correct pre-tension enhances the operation of any belt drive by:

- **increasing service life**
- **improving reliability**
- **minimising bearing load**
- **advancing positioning accuracy**
- **reducing noise level**

Operating Instructions

Set-Up

1. Insert battery at the back of the tension meter, connect it and close the case.
2. Press the button. The red dot in the display will light up, indicating that the tension meter is operational.

Using the Tension Meter

1. Make sure the belt drive is static (not in motion).
2. Hold the tension meter close to the static belt section to avoid any misreading due to hand movement.
3. Place the probe a few millimeters above or below the belt.
4. Tap the belt to generate vibration. At the same time press and hold the button.
5. The red dot in the display lights up in response to the belt frequency. When a measurement is obtained,
the device will beep and display the frequency of vibration in Hertz (the red dots do not represent commas).
6. If no reading is obtained, repeat steps 1 - 5.
7. To reset the display, release the button.

Calculation

Use the SM4 to check and monitor belt pre-tension

Calculate the pre-tension Fv using the frequency f taken from the SM4:

$$Fv = \frac{K \cdot b \cdot L^2 \cdot f^2}{100}$$

Fv [in N]:	Pre-Tension
K:	Constant for each pitch (see table below)
b [in mm]:	Belt width
L [in m]:	Length of free vibrating belt span
f [in Hz]:	Static belt frequency

Example: A 25 AT10 belt with a pulley center distance of L = 0.8m. If the measured frequency is 40Hz, it indicates that the belt is tensioned to :

$$Fv = \frac{2.5 \cdot 25 \cdot 0.8^2 \cdot 40^2}{100} = 640N$$

Use the SM4 to set the belt pre-tension

See page 5 for the recommended pre-tension or duplicate the pre-tension of an existing identical system.
Calculate the required frequency value f as a function of the tension Fv :

$$f = \sqrt{\frac{100 \cdot Fv}{K \cdot b \cdot L^2}}$$

Fv [in N]:	Desired pre-tension
K:	Constant for each pitch (see table below)
b [in mm]:	Belt width
L [in m]:	Length of free vibrating belt span
f [in Hz]:	Static belt frequency

Example: A linear drive belt 50ATL20 is to accelerate a load of 1500N. A pre-tension Fv of 1500N is presumed . The carriage is positioned at a distance L = 1.0m. The tensioning clamp should be tightened to allow a static belt frequency of :

$$f = \sqrt{\frac{150000}{4.3 \cdot 50 \cdot 1.0^2}} = 26Hz$$

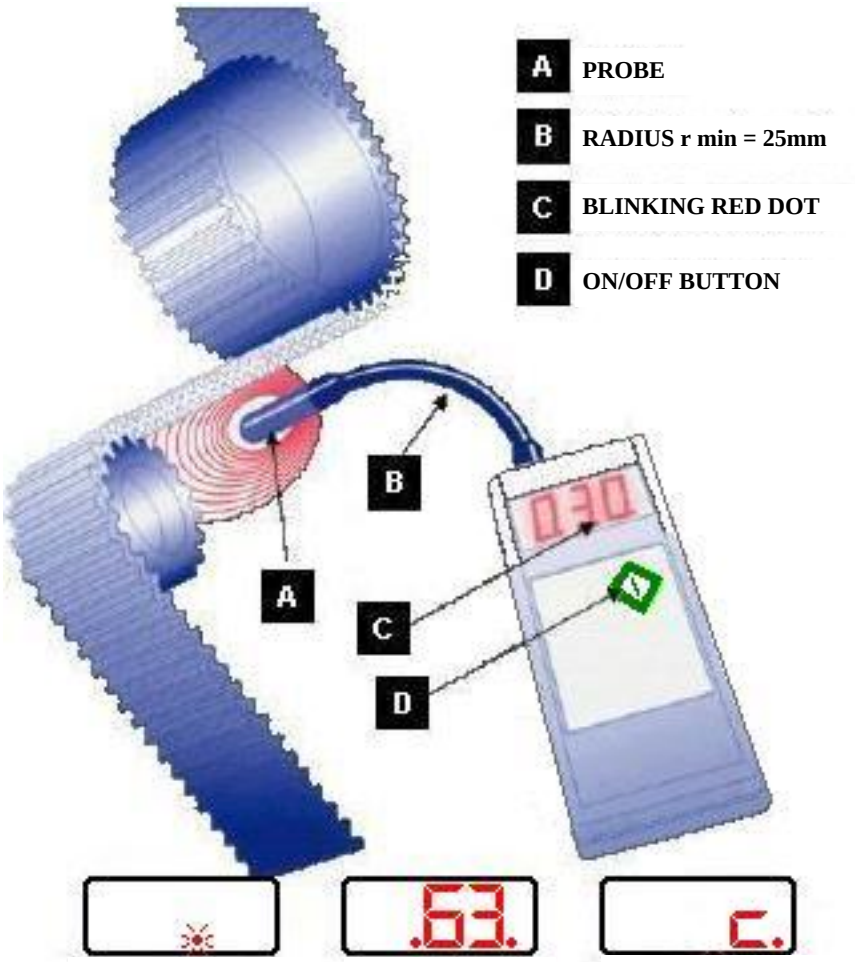
Table of Constant "K"

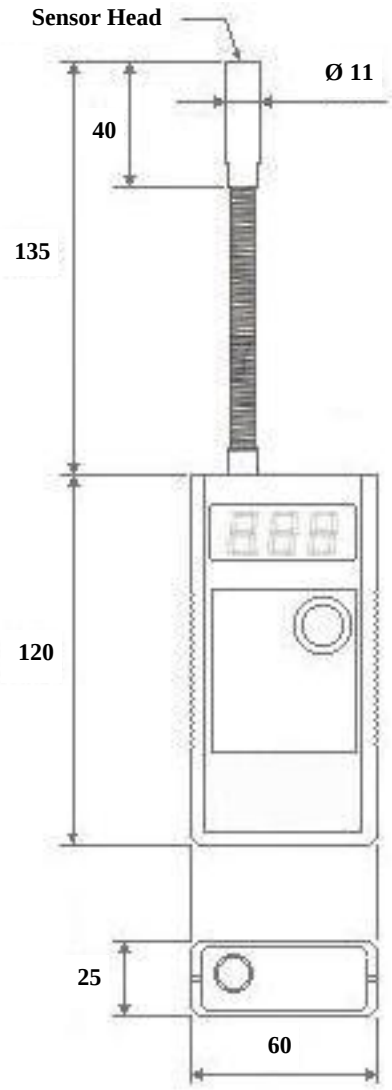
Belt Type	Single Sided*	Double Sided - DL*
T2	0.40	—
T2.5	0.42	—
T5	0.90	1.20
T10	1.90	2.30
T20	3.00	4.00
AT3	0.90	—
AT5	1.35	1.40
AT10	2.50	2.80
AT20	4.00	5.30
ATL5	1.45	—
ATL10	2.70	—
ATL20	4.30	—

Belt Type	Single Sided*	Double Sided - DL*
MXL	0.40	—
XL (T1/5")	1.00	—
L (T3/8")	1.50	—
H (T1/2")	1.80	1.90
XH (T7/8")	4.20	—
BAT10	2.50	—
BATK10	2.50	—
SFAT10	2.50	—
SFAT15	3.20	—
SFAT20	4.00	—
HTD 8M	2.35	—
HTD 14M HF	4.15	—

For K values not listed in table, please contact PIES Australia. *** Standard Steel Tension Member**

SM4 TENSION METER





Remarks

- Accuracy is +/- 5%
- Frequency Range is 6 - 350 Hz
- It is recommended that several readings be taken in order to obtain an average for increased accuracy.
- The beep indicates when a reading is obtained and the frequency is displayed.
- No hand movement is permitted at low frequency.
- Change the battery when the letter “c” appears in the display.
- Note: The tension of ALL belt types and materials can be measured.

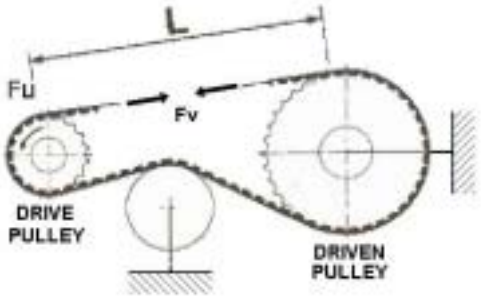
RECOMMENDED PRE-TENSION

The peripheral force (force transmitted through the belt) must be known to determine a recommended pre-tension. These recommendations are general and offered as a starting point. Adjustments may be necessary as determined by system performance.

Fv (pre-tension) as a function of Fu (peripheral force) - see the following tables :

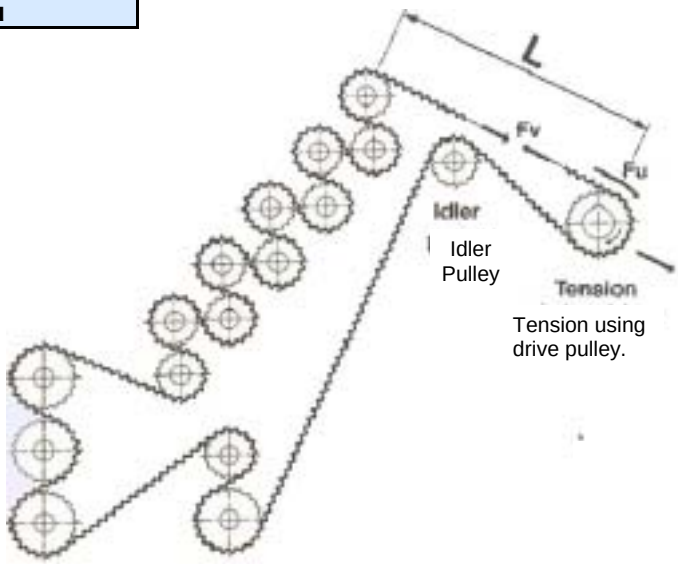
TWO PULLEY DRIVE :

Number of teeth (Zb) on Belt	Static Tension Fv
Zb < 60	Fv = 1/3 Fu
60 ≤ Zb ≤ 150	Fv = 1/2 Fu
150 ≤ Zb	Fv = 2/3 Fu



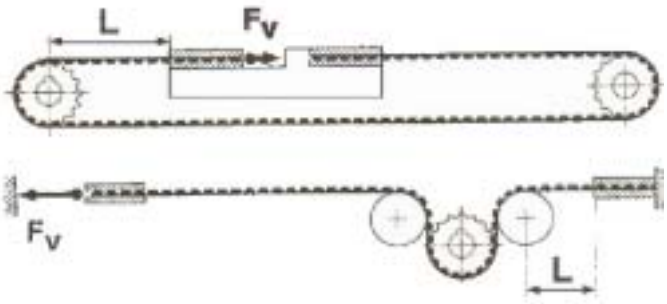
MULTIPLE PULLEY DRIVE :

Center Distance L	Static Tension Fv
Taut Side < Slack Side	Fv = Fu
Taut Side > Slack Side	Fv > Fu



LINEAR DRIVE :

Center Distance L	Static Tension Fv
Any	Fv = Fu



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