Operating Instructions
Belt Tension Meter
BTM-1
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Introduction

Thank you for choosing your new Habasit measurement system - the Belt Tension Meter. We hope to be able to fulfill your expectations of this modern measurement system. Before making any measurements, be sure to read and follow the safety guidelines and precautionary measures. We wish you great success in using your new measurement system.

Safety guidelines

The Belt Tension Meter uses an extra bright, red LED (660 nm). For this reason, it is not necessary to take measures to protect your eyes. However, do not look directly into the bright measurement beam at close range. Consider the following safety precautions.

Caution

Before making measurements, ensure that the instrument is switched off (master switch) and secured against unintentional restarting.

• Personnel must be informed in a timely manner that measurements will be performed.
• If necessary, clearly mark and cordon off the service area at or around the machine, for example, by using lines or ropes.
• The measuring and setting of the belt tension must only be performed by qualified, instructed technical staff while following the specific instruction manual for the instrument as well as the extended documentation from the supplier.

Caution

This instrument must not be operated in rooms with high humidity. Avoid direct exposure to heat, for example, through sunlight. Moisture and rain, as well as extreme heat or cold, will damage the instrument.

Note

Do not let the instrument drop or be bumped sharply. The delicate optics could be damaged and the measurements made unusable.
Caution
For connecting the Belt Tension Meter to a PC, only use the special BG 810000 cable. If a normal RS232 cable is used, the instrument can be damaged.

Notes on batteries/rechargeable batteries
If the instrument is not to be used for a long period of time, then the battery/rechargeable battery must be removed. Otherwise, there is a risk of discharging or ruining the battery/rechargeable battery, and consequently damaging the instrument.

Caution
Regular batteries must not be recharged, heated, or disposed of in an open flame (explosion hazard!).

Note
Please contribute to the protection of the environment. Discharged batteries and rechargeable batteries should not be disposed of along with household waste. They can be taken to collection sites for used batteries or special waste. Find out where these sites are located.

At the end of its service life, this product must not be disposed of along with normal waste but must be taken to a collection site for the recycling of electrical and electronic devices. The materials can be reused according to how they are labelled. By recycling, reusing the materials or other forms of reusing old equipment, you will make an important contribution to the protection of our environment.
Care Instructions

The Belt Tension Meter has been developed for industrial use and is protected against sprayed water and dust in accordance with IP10; the measurement probe is protected in accordance with IP66. For cleaning the housing, a soft cloth, with mild soapy water if necessary, should be used; the detector surface should only be cleaned with alcohol.

When cleaning the detector surface of the measurement probe, do not use paper towels or materials that could scratch the detector surface. For optimal operational conditions, the detector surface as well as the connections should be protected from becoming soiled or, for example, from coming into contact with oil or grease.

Maintenance

In case of any malfunction, contact Habasit. Do not open the instrument yourself. The warranty will expire if unauthorized persons attempt to repair or otherwise tamper with the instrument. Storage must always take place under dry conditions. Transport the instrument only in its original case.

Note

The manufacturer assumes no responsibility for damages that arise as result of improper maintenance or repair work by third parties.

Disclaimer

Habasit is not liable for damages that arise as a result of improper use. Knowledge of this handbook is also part of proper use. For this reason, strictly follow the instructions in this handbook and in the technical documents for the sensors. We cannot be liable for errors that arise due to not following the operating instructions.
Intended use

The Belt Tension Meter is a precision measuring instrument for measuring the belt tension of flat belts and timing belts on power transmission applications. Furthermore it allows measuring the rotary speed of industrial machines and units by using a reflecting point.

Note

The Belt Tension must only be used for the purposes specified above. Unintended usage, use of unsuitable components, or modifications in regard to intended use can lead to malfunctions in operation for which Habasit assumes no liability.

Delivered items

This Belt Tension Meter measurement instrument is delivered in a durable plastic case. A measurement probe and a 9 V battery are also supplied.

Product advantages

- Precise measurement of belt tension
- Precise measurement of rotary speed
- Precise calculation of belt span tension
- Built-in frequency test for checking the measurement probe
- Required for recording in accordance with DIN EN ISO 9001ff
- Operational guidance and readout of measured values in a choice of 4 languages
- Simple and reliable operation
- Compact and handy design, rubber-coated for protection
Preparation measures

Connecting the measurement probe

Remove the measurement probe from its case. Insert the measurement probe connector into the socket on the Belt Tension Meter. Secure the connector by tightening both screws.

Caution
Do not over tighten the two screws.

Operational elements

The operating buttons control various functions. The display shows settings and measurement results. The measurement probe registers the characteristic frequency of the tensioned, free belt by using pulsed light or the rotary speed, and communicates the measurement values to the Belt Tension Meter.

Operating buttons

- Input belt weight [kg/m²] (1st click)
- Access belt database (2nd click)
- Input strand length
- Input belt width
- Enter
- Skip menu (>1s)
- Scroll-up
- Increase setting
- Scroll-down
- Decrease setting
- On-Off
- Save measurement
Operating instructions – Belt tension meter BTM-1
Version 1.0

Checking calibration

Please follow the instructions below. This ensures that the device works properly and avoids incorrect measurement results.

The Frequency test is an important and useful additional function for checking the measurement probe.

During this "self-test", the Belt Tension Meter display generates a nominal frequency of 25 Hz using the display backlight. That is, the illumination of the display is switched off and on at a frequency of 25 Hz. If it is functioning properly, the measurement probe must readout this 25 Hz in the display. The readout can vary in the range from 24.7 Hz to 25.3 Hz.

1. Switch on the Belt Tension Meter using the button.
2. Switch to the "Freq-Test" using ; see "Menu structure", p. 18.
3. Activate the frequency test using ; the display begins to "flicker" at a nominal frequency of 25 Hz.
4. Hold the measurement probe up close to the display.
5. The measurement probe measures the display frequency; the result is indicated in the display and an acoustic signal is generated if the measurement is successful.
6. Switch off the frequency test by using ; switch back to the measurement mode using .

Note
If the result deviates from the nominal value of 25 Hz (readout in display: 24.7 – 25.3 Hz), then check the cables as well as the battery voltage.
If in doubt, contact Habasit Technical Support.
**Operation**

Operating the Belt Tension Meter is simple and straight forward.

**General information on "belt tension"**

**Measuring the belt span tension**

The strand or span is the part of a belt which is between two pulleys. The length is identical with the shaft distance.

To calculate the belt tension or trum force, the measured values of the

- belt mass
- belt length
- belt width

are required.

The trum force is calculated using the following formula:

\[ F = 4 \cdot m_{R}^{''} \cdot \frac{b_0}{1000} \cdot L^2 \cdot f^2 \]

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Description</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>F</td>
<td>belt force (trum force)</td>
<td>[N]</td>
</tr>
<tr>
<td>m_{R}^{''}</td>
<td>belt mass per square meter</td>
<td>[kg/m²]</td>
</tr>
<tr>
<td>b_0</td>
<td>belt width</td>
<td>[mm]</td>
</tr>
<tr>
<td>L</td>
<td>free oscillating belt length</td>
<td>[m]</td>
</tr>
<tr>
<td>f</td>
<td>measured characteristic frequency of the free belt</td>
<td>[Hz]</td>
</tr>
</tbody>
</table>
Measuring procedure

The belt tension can only be measured when the drive is switched off and stopped.

**Caution**
Before making measurements, ensure that the machine is switched off (master switch) and secured against unintentional restarting.

The installed and tensioned drive belt is set into natural oscillation with a short impulse or by striking it lightly.

This static characteristic frequency is measured by the probe by using light pulses. There must be a sufficient amount of light reflected from the belt. If the intensity is low because of a dark belt color it helps to mark the belt locally with a bright color (e.g. correcting fluid or small piece of adhesive tape, etc.).

By using the measured frequency along with the mass of the belt (from the integrated belt database, for example) the width and the length of the free belt strand the Belt Tension Meter calculates the trum force.

The readout of the measured values will be indicated according to the settings; for example, frequency in Hertz or force in Newton’s.
Positioning of the measurement probe

The distance between the drive belt and the measurement probe should be between 3 - 20 mm. The measurement of the belt tension should take place at the longer strand of the belt, in the middle between the two drive rollers.
Belt Selection

The belt tension meter provides a data base with most of the Habasit flat- and timing belts. You can select by pressing 2x the button. If the required belt type is not available you can create a user defined type. Thus you need to know the weight per square meter [kg/m2].

➤ How to get belt weight information?

Flat belts (data sheet available):

For flat belts you can find the required value (grammage) in the data sheet.

Timing belts (data sheet available):

For timing belt you will only find a weight per meter [kg/m] of belt length associated with a specific belt width.

Example for AT10-S-01:

Here you have to calculate the required weight in [kg/m2] by selecting the weight per meter of the widest belt, dividing this value by the width and then multiplying by 1000.
Step by Step:

- Selection of the weight for a 25mm wide belt
  \( m = 0.15[kg/m] \)
- Dividing the weight by the nominal belt width of 25mm
  \( \rho = \frac{m[kg/m]}{b[mm]} = \frac{0.15}{25} = 0.006[kg/(m*mm)] \)
- Convert from \([g/m^2]\) to \([kg/m^2]\) by multiplication with 1000
  \( 0.006[kg/(m*mm)] \times 1000[mm/m] = 6.0[kg/m^2] \)

No datasheet values available (flat or timing belts)

If no datasheet is available it is possible to measure the weight and then to calculate the grammage. A precondition for this is to have an accurate scale available, which can measure with an accuracy of +/-1% of the measured value.

Procedure:

The weight of a piece of belt with a width "b" and a length "l" has to be measured with a scale. The weight [kg] has to be divided by the width [m] and by the length [m].

Example for AT10-S-01:

- You have a piece of 15mm width and 0.5m length.
- The weight is 45g = 0.045kg
- The weight has to be divided by the dimensions in meter [m].
  \( \rho = \frac{m[kg]}{b[m]}\times \frac{1}{l[m]} = \frac{0.04}{0.15} / 0.5 = 6.0[kg/m^2] \)

Input of calculated value in the BTM-1

1. Switch on the device
2. Open belt selection menu by 2x pushing the button.
3. Select belt type zero “0”.
4. Enter the calculated value.
Measurement Procedure

Switch on the Belt Tension Meter pushing 🍩. The instrument is ready for taking measurements.

1. Input the belt strand length and width → see "Menu structure" p. 18.
2. Select the belt type → choose belt nr. 0 for individual type or select a belt type from the implemented belt database. In case of using individual types it is required to input the belt weight per square meter.
3. Set the drive belt into natural oscillation by striking it.
4. Hold the measurement probe over the drive belt at approximately the center of the free belt span length.
   The distance from the belt can be between 3 and 20 mm.
5. The result is displayed in Newton or Hertz. A successful measurement is acknowledged by a longer acoustic signal.
6. Check the setup and repeat the measurement.

General installation instructions for belt drives
As a consequence of thermoplastic materials belts relax after a certain time of installation. Therefore it is recommended to check and adjust the tension after a few hours of operation. Along with the recommended tension by the belt supplier the admissible radial forces of the bearings have to be considered as well → Radial force = 2x trum force.

Interpretation of measurement deviations
Measurement deviations of about +/-10 % within repeated measurement of the same application don’t necessarily indicate a problem of the device. In most cases this is attributed to mechanical tolerances of the belt drive and variation in excitation of the belt vibration. Therefore it is recommended to make several measurements and take the average.
Storing measurements

For documentation purposes, you may store the measurements that have been made in the instrument. The instrument has internal storage for up to 255 measurements. Using the optional Belt Tension Meter PC-Software, convenient options are available for producing measurement data reports.

Procedure:
1. Measurement performed, measured value is displayed.
2. Press button → “Storage No.” appears in the display.
3. Using arrow buttons to select storage No.
4. Confirm with → “Store?” appears in the display.
5. Confirm with for OK or cancel using for Esc.
6. After storing, the Storage No. appears in the display.

Calling up stored measurements

You may call up measurements stored in the instrument at any time.

Procedure:
1. Press → Storage No. X appears in the display.
2. Using arrow buttons to select Storage No.
3. Press → the measurement result appears in the display.
4. If necessary, select an additional Storage No. using .
5. To end, press button twice.

Switching off the instrument

Press and hold down until “Off” appears in the display.
## Specifications

<table>
<thead>
<tr>
<th>Specification</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Model:</td>
<td>BTM-1</td>
</tr>
<tr>
<td>Measurement range</td>
<td>1 - 500 Hz</td>
</tr>
<tr>
<td>Modulation</td>
<td>5 kHz</td>
</tr>
<tr>
<td>Sensor test</td>
<td>25 Hz incl.</td>
</tr>
<tr>
<td></td>
<td>“OK” message</td>
</tr>
<tr>
<td>Readout error</td>
<td>+/- 0.3 Hz</td>
</tr>
<tr>
<td>Resolution</td>
<td>+/- 0.1 Hz</td>
</tr>
<tr>
<td>Operation</td>
<td>-20°...+85°C (-68°...+185°F)</td>
</tr>
<tr>
<td>Storage</td>
<td>-40°...+105°C (-40°...+221°F)</td>
</tr>
<tr>
<td>Humidity</td>
<td>20 .. 95 %</td>
</tr>
<tr>
<td>Housing plastic (PVC)</td>
<td>IP10</td>
</tr>
<tr>
<td>Measurement sensor</td>
<td>plastic; IP66</td>
</tr>
<tr>
<td>Housing dimensions WxHxD</td>
<td>75 x 115 x 35 mm (2.95 x 4.53 x 1.38 in)</td>
</tr>
<tr>
<td>Carrying-case dimensions</td>
<td>230 x 220 x 75 mm (9.06 x 8.66 x 2.95 in)</td>
</tr>
<tr>
<td>Display</td>
<td>2 line LCD 12 x 60 mm (0.47 x 2.36 in)</td>
</tr>
<tr>
<td></td>
<td>with background illumination</td>
</tr>
<tr>
<td>Languages language</td>
<td>selection for four languages</td>
</tr>
<tr>
<td>Input limits free belt strand</td>
<td>30 – 9'999 mm</td>
</tr>
<tr>
<td>Input limits belt mass</td>
<td>0.001 - 9.999 kg/m</td>
</tr>
<tr>
<td>Input limits belt width</td>
<td>1 – 999mm</td>
</tr>
<tr>
<td>Number of storage locations</td>
<td>255</td>
</tr>
<tr>
<td>Voltage supply</td>
<td>9 V alkaline battery, type E-Block 6LR61</td>
</tr>
<tr>
<td>Interface</td>
<td>RS232, DSUB9</td>
</tr>
</tbody>
</table>
At the lower left in the display of the Belt Tension Meter, each active function key appears superimposed on the corresponding menu item.
## Problem solving

Although everything was prepared properly, no measurement is performed.

<table>
<thead>
<tr>
<th>Potential Cause</th>
<th>Proposal for Adjustment</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 The belt frequency is to low</td>
<td>Increase tension, choose shorter trum or reduce trum length by fixing the belt on one side to a fix part of the machine. Change trum length in the settings accordingly.</td>
</tr>
<tr>
<td>2 “Low-Bat” is displayed</td>
<td>Battery needs to be changed.</td>
</tr>
<tr>
<td>3 Device is in power-off mode.</td>
<td>Power-save function switches-off after 10 Minutes of inactivity.</td>
</tr>
<tr>
<td>4 Light beam of probe is not reflected sufficiently</td>
<td>To improve reflection properties apply a piece of bright adhesive tape on the area of measurement.</td>
</tr>
<tr>
<td>5 Distance of measurement is not within recommended tolerance</td>
<td>Please make sure that the distance between belt and probe is between 5 – 20mm</td>
</tr>
</tbody>
</table>

Displayed test result is not reasonable.

<table>
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