Gates Sonic Tension Meter Manual

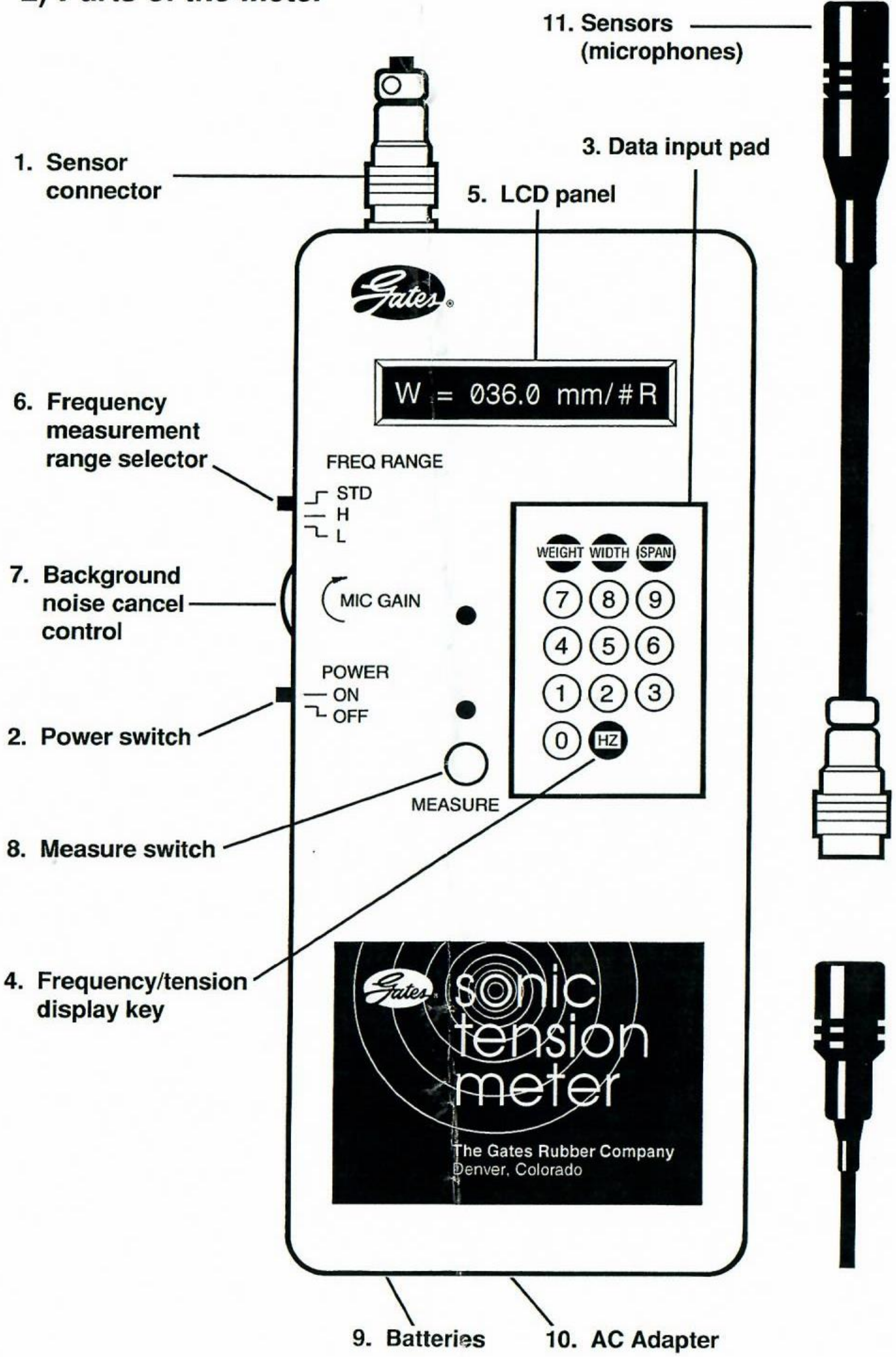
Contents:

We're glad you've purchased the Gates Sonic Tension Meter. Please read this manual thoroughly to fully utilize all the functions of this meter.

1) *Important warning!*

- **Do not** drop this unit. Impact of any kind can result in damage.
- **Do not** put water, solvent, or any other liquids on this unit.
- **Do not** leave this unit in a dusty environment.
- **Do not** leave this unit where it will get hot, such as in a car or in direct sunlight.
- **Do not** use volatile solvents to clean this unit.
- **Do not** pull hard on the cord of the sensor (microphone) from either end.
- **Do not** bend the flexible arm sensor (microphone) within 20mm (3/4 in.) of either end. Its construction is tubular and it should not be bent at sharp angles.

2) *Parts of the meter*



3) *Operating procedure*

1. Attaching sensor. Each of the male and female connectors has a notch on the surface. Fit the connectors together at the notch and push them together. To disconnect, hold the collar on the sensor and pull out.

2. Turn on the power.

3. Enter belt unit weight.

M = □□ . □□ gf/Cm □

Unit weight data is provided in section 4 of this manual.
Capacity available for input is from 00.01 to 99.99 g_f/cm .
Push the WEIGHT button and enter numbers on key pad. Make sure the decimal is placed correctly in the display panel. If your entry is incorrect push WEIGHT again and the cursor returns to the original position.

4. Enter width or number of rib/strands.

W = □□□ . □ mm/#R

Capacity available for input is from 000.1 to 300.0 mm or number of ribs or strands. For a synchronous belt enter the width in millimeters. For a Micro-V® belt enter the number of ribs. For a PolyFlex® JB® belt enter the number of strands. Enter the number of ribs/strands only for the belt being tested.

If the belt width is greater than 300 mm, use the following example as a guide. For a belt 500 mm wide enter W=250.0, which is one-half of 500 mm. Double the displayed tension to yield the actual belt span tension.

5. Enter span length.

S = □□□□ mm

Capacity available for input is from 0001 to 3000 mm.
The span length represents the distance between the contact points on adjacent sprockets/pulleys/sheaves. This distance may be measured directly, or it may be calculated from the formula below. Calculating the span length gives the best results.

$$\text{Span Length} = \sqrt{CD^2 - \frac{(D-d)^2}{4}}$$

Where, S= Span length (mm)
CD= Center Distance (mm)
D= Large pulley diameter (mm)
d= Small pulley diameter (mm)

For span lengths greater than 3000 mm, use the following example. For a belt span length of 4000 mm enter S=2000, which is one-half of 4000 mm. Multiply the displayed tension by four to yield the actual belt span tension.

Operating procedure — Continued

6. **Set frequency range.**

   In most cases, select "STD" mode corresponding to 10 - 600 Hz.
   Select L mode for the low frequency range of 10 - 50 Hz.
   Select H (300-600 Hz) for high frequencies.

7. **Cancel background noise.**

   Place the sensor close to either the back side, or the working side of the belt, approximately at the center of the span. Using the MIC GAIN control increase the sensitivity of the sensor until the MIC GAIN light goes on. Then slightly reduce the sensitivity level until the light goes off. Tap the belt span and make sure the MIC GAIN light goes on.

8. **Measurement.**

   Push the MEASURE button and the MEASURE light begins flashing. Tap the belt span to make the belt vibrate. Hold the sensor approximately 1 cm (0.4 in.) from the belt. The MIC GAIN light should turn on indicating that the sensor (microphone) is receiving signals. Additional measurements are made automatically as the sensor continues to receive signals. Note: Environmental noise can trigger the unit if the MIC GAIN control is not correctly adjusted.

9. **Tension display.**

   T = □□□□ N

   Tension is displayed, and the meter beeps, 1.5 seconds after the MEASURE light goes on.

10. **Frequency display.**

    f = □□□□ Hz

    Push the Hz button to view the frequency measurement. When the Hz button is pressed again, the tension is re-displayed.

11. **Measurement errors.**

    If there is an error, the LCD panel will display ERROR-REMEASURE. Continue to retry your measurement until tension is displayed. It is not necessary to push the MEASURE button again.

4) *Belt Unit Weights* (grams/cm2)

Note: Unit weights are for standard stock belts only. Non-standard belt constructions may yield inaccurate results, and may require special unit weights or special calibration procedures.

PowerGrip® Timing Belts

MXL (0.080") - 0.13	
XL (0.200") - 0.24	Twin Power XL - 0.19
L (0.375") - 0.32	Twin Power L - 0.32
H (0.500") - 0.39	Twin Power H - 0.46
XH (0.875") - 1.13	
XXH (1.25") - 1.49	

PowerGrip HTD® Belts

3M (3mm) - 0.24	Twin Power 3M - 0.27
5M (5mm) - 0.39	Twin Power 5M - 0.46
8M (8mm) - 0.62	Twin Power 8M - 0.72
14M (14mm) - 0.99	Twin Power 14M - 1.23
20M (20mm) - 1.28	

PowerGrip GT® Belts

2M (2mm) - 0.14	8M (8mm) - 0.58
3M (3mm) - 0.28	14M (14mm) - 0.97
5M (5mm) - 0.41	

Poly Chain® GT® Belts

8M (8mm) - 0.47	14M (14mm) - 0.79

Note: For a single V-Belt, enter 1 rib/strand with "per belt" unit weight. When measuring a multiple rib/strand belt, enter the number of ribs or strands with "per rib/strand" unit weight.

Polyflex® V-Belts

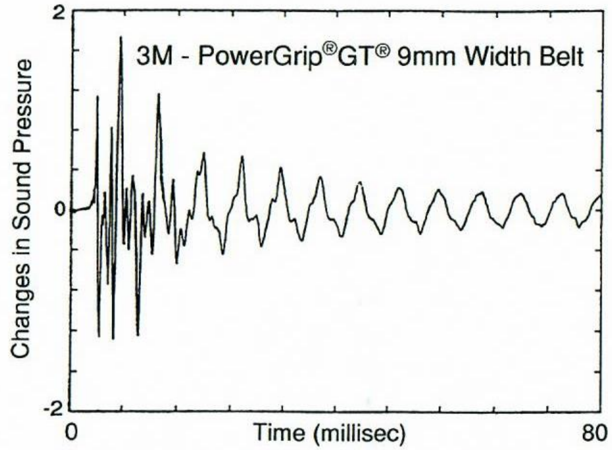
3M Singles - 0.42 / belt	
5M Singles - 1.12 / belt	5M JB - 1.31 / strand
7M Singles - 2.75 / belt	7M JB - 3.43 / strand
11M Singles - 5.61 / belt	11M JB - 7.40 / strand

Micro-V® Belts

J Section - 0.84 / rib
L Section - 3.09 / rib
M Section - 12.41 / rib

5) *Gates Sonic Tension Meter operating theory*

When an impulse is applied to a belt span it first oscillates in all modes of vibration, but the higher frequency modes decay faster than the fundamental mode. This leaves a continuous sinusoidal wave that is related to a specific belt tension. See diagram below.



Oscillation Damping in a Synchronous Belt

Using a microcomputer, we developed a data processing method to capture a belt's natural oscillation frequency. Using this method, the wave form's frequency can be determined easily.

The new system uses special sensors to detect belt oscillation wave forms. Data from these sensors is sent to the microcomputer inside the sonic tension meter for processing and conversion into the natural frequency. To calculate belt tension, the sonic tension meter system uses the "transverse vibration of strings theory." To operate the meter, the unit weight, span length and width of the belt must be entered.

Formula: $T = 4 \times S^2 \times M \times W \times f^2 \times 10^{-8}$

Where, T = Belt span tension (newtons)
S = Length of the span to be measured (mm)
M = Belt weight unit $(g_f/cm)^2$
f = Natural frequency of the belt (Hz)
W = Belt width (mm)

Unlike a string, belts have cross-sectional rigidity. Therefore tension values measured by the meter may be higher than the actual belt tension, depending on the operating conditions under which the effects of rigidity arise. When the actual belt tension must be more precisely measured, a simple calibration test may be necessary. This calibration procedure is discussed in section 8.

6) *Belt installation tension*

Proper belt installation tension is essential in V-belt and synchronous drives for optimum performance and reliability. The correct installation tension for a belt, or set of belts, depends on the drive geometry and loading, and must be calculated. Procedures for calculating belt tension are included in each of our drive design manuals. To determine the belt tension recommended for specific drive applications, consult the appropriate drive design manual, or contact Gates Application Engineering at (303) 744-5800.

The following catalogs may be helpful.

Poly Chain® GT® Drives	No. 17595
PowerGrip HTD® Systems for Industrial Drives	No. 17190
PowerGrip® Timing Belt Systems for Industrial Drives	No. 17181
Light Power and Precision Drives	No. 17183
Polyflex® JB® Belts	No. 18595
Micro-V® Drive Design Manual	No. 15408
Heavy-Duty V-Belt Drive Design Manual	No. 14995-A

7) *Tips on using the Gates Sonic Tension Meter*

The Gates Sonic Tension Meter is capable of measuring belt tension with greater accuracy and consistency than traditional methods. It should not, however, be expected to produce exacting results in every case. While numerous factors can be found to influence the accuracy of the meter's output, one must remember that traditional methods of belt tensioning such as force/deflection, or belt elongation are approximate.

We offer the following suggestions to help you achieve a high level of accuracy with the Gates Sonic Tension Meter.

- Use the standard frequency setting in most cases. When background noise interferes with the belt vibration signal, the special high and low frequency settings can help. Generally, larger section belts and longer belt spans yield lower frequencies, while smaller section belts and shorter spans yield higher frequencies. It's a good practice to begin making measurements using the standard frequency range setting. To obtain a span frequency value depress the Hz button. If the frequency is high or low select the appropriate range.

- After you have entered the correct numbers into the meter take at least three readings to confirm that results are consistent and that the meter is not erroneously reading background noise.

Tips on using the Gates Sonic Tension Meter—*Cont.*

- When measuring the tension in synchronous belts, use spans that are more than 20 times longer than the tooth pitch. Using spans shorter than this may result in readings that are higher than the actual tension due to belt cross sectional stiffness.

- There are limits as to how low a span tension the meter can measure, depending upon the belt type and cross section. Minimum recommended installation tension values are available for all belt sections from either drive design manuals or Gates Application Engineering. Measing tensions below these minimum recommended values should be avoided.

- When measuring belt installation tension, turn the drive over by hand for several revolutions to fully seat the belt and equalize tension in all of the spans before making any measurements. Factors such as sprocket/shaft eccentricity, belt/sheave groove variation, etc. can influence belt tension as the sprockets or sheaves rotate. If the measured belt tension changes significantly as the drive is rotated, and accurate measurements are needed, determine the low and high values and average them together.

- Wind can adversely effect the ability of the meter to make a reading by creating excessive background noise. If measuring in a windy location, shield the sensor from the wind or use a microphone wind screen.

- If a specific process is used to set belt tension in a particular application, and the meter is used only to monitor the resulting belt tensions, the frequency mode can be used rather than displaying an absolute tension value. The belt frequencies for minimum and maximum tension conditions can be measured so that assemblers/technicians can use the meter to verify that the belt installation tension is within an acceptable range.

8) *Re-calibration for non-standard belts*

Measuring the tension of special belts with extra thick backings, alternate materials, etc. may yield less than accurate results using unit weights for standard belts. In these cases, a simple calibration process may be used. The belting can be placed on a fixture with a known span length under various known tensions (hanging weights can be used). By taking frequency measurements at various tensions, span frequency vs. tension data can be collected. This data can then be used in a graphical format, or in equation form to convert measured span vibration frequencies to accurate belt tensions. Data of this type is specific to each application, and cannot be applied

to drives with different span lengths. Because the resulting data may not be linear, it is best to measure the tension of non-standard belts in terms of frequency rather than deriving a new belt unit weight to measure in terms of absolute tension. A process of this type can be used to measure the tension in industrial V-belt drives.

9) *Using the DA model*

Using the accompanying software, the DA model outputs data directly to an IBM compatible computer through the RS-232 serial port.

This function is useful in a production assembly setting. Each time a tension measurement is made, the tension value and frequency can be stored or recorded. This data can be compiled for documentation and/or statistical analysis. With custom programming, the frequency reading can also be imported into the tension equation for direct tension calculations. This allows greater flexibility in controlling basic input and output parameters.

The driver program provided with each DA model was created with Microsoft QuickBASIC. This program will send each tension measurement and frequency reading directly to the computer screen with an option to write the data to a file of choice. Program source code and installation/operating instructions are provided in a README.TXT file on the accompanying 3.5 inch floppy disk in ASCII file form. This provides more sophisticated users with the flexibility to make modifications needed for custom applications.

10) *Warranty and service*

Thank you for using the Gates Sonic Tension Meter. Gates warrants the meter to successfully operate for a period of one year (or six months for the sensors) from the date of purchase and will repair any defects for which Gates is responsible without charge within this period.

For repairs contact your local Gates sales representative.

Note that the Gates Sonic Tension Meter does not require calibration. If you wish to check it, you can test it by directing the sensor toward a sound of a known and constant frequency between 10-600 Hz to verify that the meter reads correctly in the frequency mode.