



DRIVEN BY POSSIBILITY™

550C



**GATES SONIC TENSION
METER MANUAL**

**MANUEL D'UTILISATION POUR
LE TENSIONNOMÈTRE SONIC GATES**

**HANDBUCH FÜR GATES SONIC
VORSPANNUNGSPRÜFER**

**MANUAL PARA EL TENSIONNOMETRO
SONIC DE GATES**

**GEBRUIKSAANWIJZING GATES'
SONIC SPANNINGSMETER**

**MANUALE D'USO PER IL
TENSIONNOMETRO SONIC GATES**

**INSTRUKCJA OBSŁUGI
AKUSTYCZNEGO MIERNIKA
NAPRĘŻENIA SONIC 550C
FIRMY GATES**

**РУКОВОДСТВО ПО РАБОТЕ
СО ЗВУКОВЫМ ИЗМЕРИТЕЛЕМ
НАТЯЖЕНИЯ РЕМНЕЙ SONIC 550C
КОМПАНИИ GATES**

**PŘÍRUČKA PRO SONIC MĚŘIČ
NAPNUTÍ SPOLEČNOSTI GATES**



2021

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Thank you for purchasing the Gates Sonic tension meter. Please read this manual thoroughly to fully utilise all the meter's functions.

1. IMPORTANT WARNINGS!

- Do not drop this unit. Impact of any kind can result in damage.
- Do not disassemble the unit.
- Do not put the unit in a place where fire or explosion is possible.
- 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 use this in an area where a spark could cause an explosion.
- Do not bend the flexible arm sensor (microphone) within 20 mm (3/4 inch) of either end. Its construction is tubular, and it should not be bent at sharp angles.

2. COMPONENTS OF THE 550C METER

- | | |
|----|-------------------------------|
| 1 | Flexible sensor |
| 2 | Sensor connector |
| 3 | Power switch |
| 4 | Belt unit weight key |
| 5 | Belt width key |
| 6 | Up button |
| 7 | Down button |
| 8 | Frequency range button |
| 9 | OLED screen with backlight |
| 10 | Measure key |
| 11 | Belt span length key |
| 12 | Frequency/tension display key |
| 13 | Data selection key |
| 14 | Batteries |



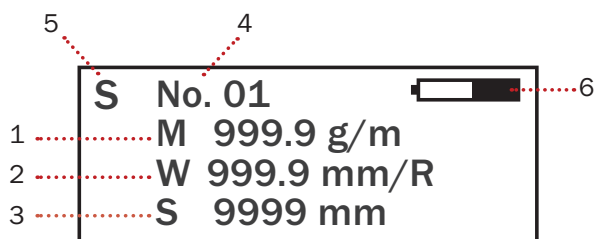
3. OPERATING PROCEDURE FOR THE 550C METER

The Sonic tension meter enables non-contact, simple and accurate measurement of installation tension by analysing sonic wave action, which is related to the belt characteristics. The sonic wave is generated by vibrating the belt span of the stationary belt, and it is captured by the sensor and processed to give belt tension which is displayed digitally.

ATTACHING SENSOR

Each of the male and female connectors has a notch on the surface. Align the notches and push the connectors together. To disconnect, hold the collar towards the sensor and pull out.

TURN ON THE POWER



- | | |
|---|-------------------------|
| 1 | "MASS" |
| 2 | "WIDTH" |
| 3 | "SPAN" |
| 4 | Storage Register Number |
| 5 | Frequency Setting |
| 6 | Battery Level Meter |

Press the "Power" key and the OLED screen displays the current input data storage register number. To change, refer to "Input data storage and retrieval".

The screen remain on for up to one minute of inactivity, and then the unit automatically turns off. The opening screen displays the contents of the data storage register that was last being used when the Sonic tension meter was turned off. Values for (1) "MASS" (Belt Mass Constant), (2) "WIDTH" (Belt Width), and (3) "SPAN" (Belt Span Length) are all displayed simultaneously.

Important Note:

Reasonable (non-zero) belt constant values must be used in the storage registers in order to receive belt tension readings. The unit will display span frequency values regardless of the belt constants entered, but will display "Error" and the red light will remain on if the calculated belt tension value is beyond the display range of the screen.

ENTER BELT UNIT MASS

M = g/m

(Grams per metre length – enter factors page 9-10-11).

Capacity available for input is from 000.1 to 999.9 g/m. Press the "Mass" key and enter numbers on the keypad. Make sure the decimal is placed correctly in the display panel. If your entry is incorrect press "Mass" again, and the cursor returns to the original position.

ENTER WIDTH OR NUMBER OF RIBS/STRANDS

W = mm/#R

Capacity available for input is from 000.1 to 999.9 mm or number of ribs or strands. For a synchronous belt, enter the width in millimetres. For an Industrial V-belt, enter the number of belts being measured. For a Micro-V[®] belt, enter the number of ribs. For a Polyflex[™] JB[™] or PowerBand[™] belt, enter the number of strands. Enter the number of ribs/strands only for the belt being tested.

When using the Sonic Tension Meter on drives with multiple single or PowerBand[™] or Polyflex[™] JB[™] belts, be sure to use the appropriate mass constant and enter the correct number of belt strands being measured. There is no need to multiply the mass constant by the number of ribs/strands, as the Sonic Tension Meter will calculate the correct total belt mass.

Example:

For a V-belt drive using four individual SPB belts enter "1" for the belt width ("Width" key). The Sonic Tension Meter will display the static belt tension per individual belt. When measuring the belt tension in the V-belt drive, make sure the V-belts do not interfere with each other while vibrating.

If the same drive used a 4-strand SPB PowerBand™ belt instead of single belts enter “4” for the belt width (“Width” key). The total belt tension for all four belts is measured as the entire belt vibrates. The Sonic Tension Meter will display the total static belt tension for the PowerBand™ belt (for all strands within belt).

ENTER THE SPAN LENGTH

S = mm

Capacity available for input is from 0001 to 9999 mm. The span length represents the distance between the contact points on adjacent 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.

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

Where:

CD = centre distance (mm)

D = large pulley diameter (mm)

d = small pulley diameter (mm)

INPUT DATA STORAGE AND RETRIEVAL

Weight, width and span values can be stored for up to 40 different drive systems. Press the “Select” key to toggle through the 40 storage registers or press a number between 0 and 39, then enter values for the belt constants. After this is completed, the belt values can be recalled for a drive by simply pressing the “Select” key and the number that corresponds to the storage register.

MEASUREMENT

Press the “Measure” key and the green LED will begin flashing. It will flash until a signal is received by the sensor. Tap the belt span to make the belt span vibrate. Hold the sensor approximately 1 cm (0.4 inch) from the belt or closer as long as the belt does not hit the sensor. The green light will turn off after a signal is received and remain off for about 1.5 seconds during processing. The measured belt tension is then displayed, the meter beeps three times and the green LED turns back on and remains on until another signal is received. If the belt tension or frequency cannot be measured, the red LED will turn on.

TENSION DISPLAY

T = kg or lb or N

The units of measured force can be switched between kg=kilograms, lb=pounds and N=Newtons. This can be accomplished as follows:

When the power is switched off, press the “0” and “9” and “Power” key down at the same time. Units can then be changed by pressing the “Select” key until the desired unit appears. Press the “Power” key again to return the meter to its normal operating mode.

FREQUENCY DISPLAY

F = Hz

Press the Hz key to view the frequency measurement.

When the Hz key is pressed again, the measured tension is re-displayed.

If the Hz key is pressed a third time, a double indication is given in Newton and Hz.

MEASUREMENT ERRORS

If the belt tension or frequency cannot be measured the red LED will turn on. If an error has been made in the measurement, “ERROR” will be displayed. Continue to retry the measurement until tension is displayed. It is not necessary to press the “Measure” key again. If the memory is not used, the tension meter switches to “ERROR” after three measurements. Switch the meter off and on again to continue measuring.

If the double display is used (Newton – Hz), then the unit for which a value cannot be displayed, will be indicated with a dotted line.

FREQUENCY RANGE

A frequency filtering feature is available to focus the meter frequency measurement response to a narrower range. This can be useful in improving the response of the meter, and in filtering out potentially interfering background noise.

The standard selected frequency range is between 10–1000 Hz. The 3 frequency ranges LOW (10-50Hz) or STANDARD (10-1000 Hz) or HIGH

(900-5000 Hz) will be displayed. Choose a range with the “UP” or “DOWN” button, and determine with “MEASURE”.

Note:

The letter in the upper left hand corner of the OLED display indicates the frequency range setting pointer (5) on page 4: H - High, S - Standard, L - Low.

BACKGROUND NOISE

The microphone gain level is set automatically when the unit is turned on, based upon environmental background noise.

Note:

If maximum microphone sensitivity is desired, turn the meter on without the microphone attached and wait for the meter to power up. Then connect the microphone so tension measurements can be taken.

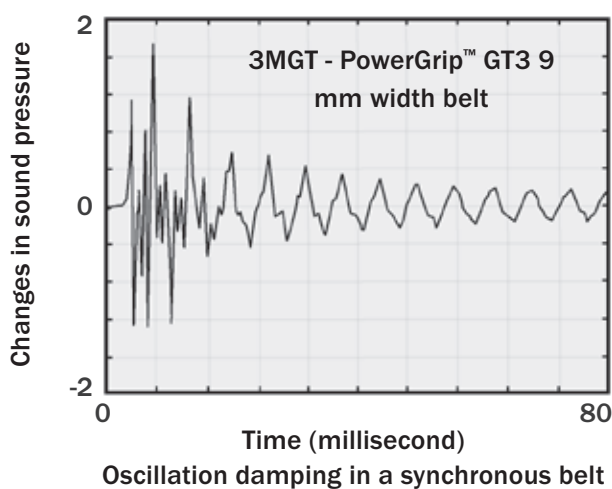
BATTERY GAUGE

A battery graphic is located in the upper-right hand corner of the OLED screen. This gauge provides an estimate of the remaining battery power.

A dark filled graphic indicates a full charge. When the battery level becomes critically low, the meter indicator as well as a “Low Batt” message both blink.

4. 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 the following diagram:



Using a microcomputer, a data processing method to capture a belt's natural oscillation frequency was developed. Using this method, the wave form 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.

$$\text{Formula: } T = 4 \times S^2 \times M \times W \times f^2 \times 10^{-9}$$

Where:

T = belt span tension (Newton)

S = length of the span to be measured (mm)

M = belt unit weight (g/m/mm)

W = belt width (mm) or number of belt strands

f = natural frequency of the belt (Hz)

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 the section on “Meter recalibration for non-standard belts”.

5. BELT INSTALLATION TENSION

Proper belt installation tension is essential in V-belt, Micro-V® and synchronous drives for optimum performance and reliability. The correct installation tension for a belt, or set of belts, depends upon the drive geometry and load conditions and must be calculated. Procedures for calculating belt tension are included in the appropriate drive design manual or software. To determine the belt tension recommended for specific drive applications, either refer to the appropriate drive design software DesignFlex™ Pro™ (available for download on <https://www.gates.com/gb/en/knowledge-centre/engineering-applications.html>), or contact Gates Application Engineering.

6. TIPS ON USING THE SONIC TENSION METER

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 exact results in every case. Numerous factors can 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.

The following suggestions are provided to help you achieve a high level of accuracy with Gates Sonic tension meter.

- 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.
 - 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.
 - When measuring the tension in **V-belts**, use spans that are more than 30 times the belt top width. 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 value can be measured depending upon the belt type and cross-section. Minimum recommended installation tension values are available for all belt sections from either drive design software, drive design manuals or Gates Application Engineering.
- Measuring tensions below these minimum recommended values should be avoided, as the meter may display "ERROR"/"Error-Re-measure" or provide inaccurate results.
- When measuring belt installation tension, turn the drive over by hand for several revolutions to fully seat the belt and equalise tension in all of the spans before making any measurements. Factors such as pulley/shaft eccentricity, belt/sheave groove variation, etc., can influence belt tension as the pulley 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. When the tension of 2 spans differs more than 30% approx., adjust them almost equally and measure again.
 - Wind can adversely affect 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 windscreen.
 - An optional inductive sensor should be utilised in noisy or windy environments for optimal results. The inductive sensor uses a magnetic field rather than sound waves. A simple way to use this sensor is with a magnet taped to the backside of the belt. Small "rare earth" magnets, which are included in the Inductive sensor package (Product No: 7420-00212) provide excellent results with minimal influence on the belt span frequency due to the added weight.
 - 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. Belt span frequencies for minimum and maximum tension conditions can be measured so assemblers/technicians can use the meter to verify that belt installation tension is within an acceptable range. These frequency values can also be found by using the DesignFlex™ Pro™ belt drive design software (available for download on <https://www.gates.com/gb/en/knowledge-centre/engineering-applications.html>).
 - Tension measurements made on belts at very low tensions may yield greater variability and a greater probability for errors. If a tension reading cannot be obtained, the belt may be too loose to generate a clear harmonic frequency signal. If this is the case, the belt may need to be tightened in order to obtain a tension reading.

7. METER RECALIBRATION 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. These 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.

8. SUMMARY OF FEATURES

- H 160 mm x T 26 mm x W 59 mm
- Batteries: 2 x AAA
- Suitable for multi-ribbed belts, V-belts and synchronous belts
- Measurement range: 10 Hz to 5,000 Hz
- Measured accuracy: $\pm 1\%$
- OLED screen
- Double display possible (Newton and/or Hz)
- Flexible sensor (Product No. 7420-00205)
- Cord sensor and inductive sensor available on request
- Stores weight, width and span constants for up to 40 different drive systems
- Auto gain adjustment function cancels out background noise automatically
- Shuts off automatically after one minute of inactivity, making it an energy-saving device
- CE approved
- RoHS compatible: the device complies with the European Directive (2002/95/EC) on the restriction of the use of certain hazardous substances in electrical and electronic equipment

9. OPTIONAL ACCESSORIES

- Cord sensor - Product No. 7420-00206.
Cord sensor is recommended for measuring tensions a distance from the Sonic tension meter (+/- 1 meter cord length).
- Inductive sensor (Magnets included) - Product No. 7420-00212. Comes as cord sensor type. Recommended for noisy or windy environments, for measuring steel reinforced belts and low frequency measurements (+/- 1 meter cord length).
- Magnets spare magnets are available Product No. 7420-01212 - Material Neodymium (NdFeB) - diameter 9,5 mm, thickness 1,6 mm.
- Sonic Flexible sensor (Product No. 7420-00205); Cord Sensor (Product No. 7420-00206) and Inductive sensor (Product No. 7420-00212) are compatible with all previous Sonic versions: eg Sonic 305C, Sonic 505C, Sonic 507C and Sonic 508C.

10. WARRANTY AND SERVICE

Thank you for using Gates Sonic tension meter. Gates warrants the meter to successfully operate for a period of one year (period of one year and six months for the sensors) from the date of purchase.

For certification needs contact your sales representative.

11. BELT UNIT WEIGHT CALCULATION

UNIT CONVERSION FORMULAS

$$\begin{aligned} \text{lb}_f \times 4.4482 &= \text{N} & \text{N} \times 0.2248 &= \text{lb}_f \\ \text{lb}_f \times 0.4536 &= \text{kg}_f & \text{kg}_f \times 2.2046 &= \text{lb}_f \\ \text{N} \times 0.1020 &= \text{kg}_f & \text{kg}_f \times 9.8067 &= \text{N} \end{aligned}$$

lb_f = pounds force

N = Newton

Kg_f = kilograms force

inches x 25.4000 = mm

mm x 0.0394 = inches

mm = millimetres

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.

SYNCHRONOUS BELTS**Poly Chain® GT Carbon™ (Volt*) (g/m)**

5MGT 3.0

8MGT* 4.7

14MGT* 7.9

Poly Chain® GT2 (g/m)

8MGT 4.7

14MGT 7.9

PowerGrip™ GTX (g/m)

8MX 5.8

14MX 9.7

PowerGrip™ GT3 (g/m)

2MGT 1.4

3MGT 2.8

5MGT 4.1

PowerGrip™ GT4 (g/m)

8MGT 4.9

14MGT 8.5

PowerGrip™ HTD™ (g/m)

3M 2.4

5M 3.9

8M 6.2

14M 9.9

20M 12.8

PowerGrip™ (g/m)

MXL (0.080") 1.3

XL (0.200") 2.4

L (0.375") 3.2

H (0.500") 3.9

XH (0.875") 11.3

XXH (1.250") 14.9

Twin Power™ (g/m)**PowerGrip™ GT2**

8MGT 6.9

14MGT 11.4

PowerGrip™ HTD™

5M 4.6

PowerGrip™

XL 1.9

L 3.2

H 4.6

Long Length (g/m)**Poly Chain® GT Carbon™**

5MGT 3.0

8MGT 4.7

14MGT 7.9

PowerGrip™ GT Steel Glass fibre

3MR - 3.01

5MR 4.50 4.50

8MR 6.44 6.44

PowerGrip™ HTD™ Steel Glass fibre

3M - 2.70

5M 3.90 3.90

8M 6.20 6.20

14M 9.90 9.90

PowerGrip™ Steel Glass fibre

XL - 2.32

L - 3.16

H 4.30 4.30

Synchro-Power™ Steel Aramid

T5 2.2 2.0

T10 4.4 3.6

T10HF 4.7 -

T20 7.5 5.9

AT5 3.3 2.7

AT10 5.7 4.2

AT10 Niro	5.7	-
AT10 HF	5.5	-
AT20	9.7	7.3
ATL5	2.8	-
ATL10	6.7	-
ATL10HF	7.2	-
ATL20	10.7	-
HTD5	4.4	2.9
HTD8	6.9	4.7
HTDL8	7.9	4.5
HTD14	10.8	8.4
HTDL14	12.2	-
HPL14RSL	14.0	-
STD5	3.9	2.9
STD8	5.1	4.3
XL	2.1	1.9
L	3.5	3.0
H	3.9	3.2
XH	10.5	9.1
Synchro-Power™		
T2.5	1.4	
T5	2.2	
T10	4.4	
AT5	3.3	
AT10	5.7	
DL-T5	2.3	
DL-T10	4.5	

V-BELTS	
Predator™ (g/m)	
SPBP/5VP	190
SPCP	354
8VP	513
Quad-Power™ 4 (g/m)	
XPZ/3VX	53.0
XPA	81.4
XPB/5VX	131.0
XPC	249.8
Super HC™ MN (g/m)	
SPZ-MN	72.2
SPA-MN	116
SPB-MN	186
SPC-MN	340
Super HC™ (g/m)	
SPZ/3V	72
SPA	116
SPB/5V	186
SPC	339
8V	510
Hi-Power™ (g/m)	
Z	60.5
A	110
B	183
C	316
D	605
Delta Classic™ (g/m)	
Z	53
A	95
B	169
C	262
D	552
Delta Narrow™ (g/m)	
SPZ	62.5

SPA	98
SPB	171
SPC	310
PowerBand™ (g/m/rib)	
Predator™ PowerBand™	
SPBP	266
SPCP	373
9JP/3VP	88.6
15JP/5VP	266
25JP/8VP	449
Quad-Power™ PowerBand™	
3VX	70.4
5VX	185
XPZ	92
XPA	145
XPB	228
Super HC™ PowerBand™	
SPB	196
SPC	353
9J/3V	96
15J/5V	241
25J/8V	579
Hi-Power™ PowerBand™	
B	200
C	343
D	665
Polyflex™ JB™ (g/m/rib)	
3M-JB	5.3
5M-JB	11.4
7M-JB	29.6
11M-JB	64.2
Polyflex™ (g/m)	
3M	3.5
5M	9.6
7M	26

11M	55
Micro-V® (g/m/rib)	
PJ	10
PK	19.5
PL	36
PM	95

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.

UK

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D

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PL

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CZ