



**Belt Tension Setting Equipment**

**Belt Tension Meters**

**Park Brake Setting Equipment**

# Introduction

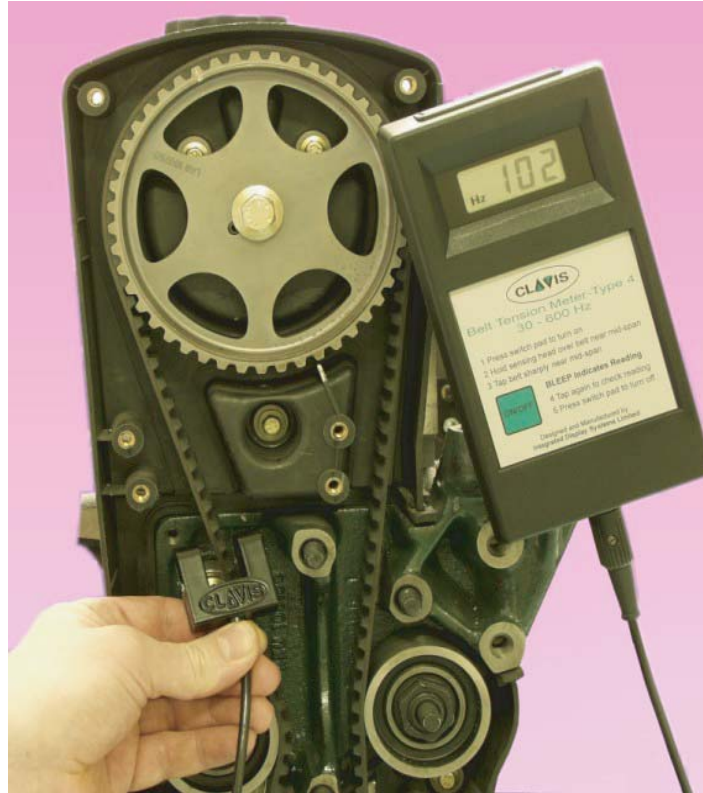


## Introduction:

In 1988 CLAVIS invented a new type of belt tension meter. It was no longer necessary to rely on the thumb for an estimate of belt tension. Suddenly all force/displacement type tension gauges were shown to be clumsy, inaccurate and in many cases difficult to use. The CLAVIS gauge became the automotive industry standard for belt tension measurement.

It only took CLAVIS a small step to introduce equipment using the same principle for automated belt setting on high speed automotive engine production lines.

In recent years CLAVIS have introduced a revolutionary system for the setting of parking brake (hand brake) cables.



Suitable for use with both disk or drum braked vehicles the ability to set and to record the setting (for legislative reasons) has resulted in installation successes around the world.

## !!!NEWS!!!

2 new meters have been introduced this year. The first is the Type 13 SR (Super Rugged) suitable for use in extremes of temperature and submersible up to a depth of 15 metres.

The second is a revision of the Type 14 meter for use where data logging in a production environment is required.

In brief: In the beginning...

# How it Works



The Clavis belt tension meter measures the natural frequency of vibration of a belt span. This frequency is directly related to the tension in the belt. As the tension in the belt is increased the frequency of vibration also increases. The belt is forced into vibration by gently tapping or plucking it. The vibration is usually not visible and also inaudible.

The relationship between the measured frequency and the tension of the belt should be determined from a calibration test on the belt span. A Clavis calibration rig is available for those users of this instrument who wish to perform their own calibrations, or we can undertake your calibration in our laboratory. Alternatively the relationship between belt tension (T) and frequency of vibration (f) may be calculated from knowing the mass per unit length of the belt (m), and the belt span (l), using the expression;

$$T = 4 m l^2 f^2$$

Where T is in Newtons, F in Hertz, l in metres, and m in Kg/metre. However as the belt does have some flexural stiffness the predicted tension for a given frequency will be slightly greater than the actual tension. This is most noticeable on short belt spans where the belt bending stiffness is the greatest. For belt spans greater than 250mm a calculation based on the above expression will provide results within 10% of the actual values.

## Operational Use

1. Connect the sensing head to the lower central socket, and turn on the unit by pressing the ON/OFF button.
2. Hold the sensing head steady across the belt span as shown in the photograph.
3. Tap the belt gently near mid span using the handle of a small screwdriver or similar tool, to cause the belt span to vibrate.
4. The meter will now display the frequency of vibration, and BLEEP to indicate that a valid reading has been taken.
5. If a reading is not obtained check that the sensing head is not touching the belt, and try again.



**In brief: Tension measurement based on the guitar tuning principle. Just pluck the belt and the meter measures the tension by 'listening' to the vibration**

## TYPE 3

CLAVIS

### TYPE 3: Optical Meter

This meter is particularly suitable for long span synchronous belts which vibrate at low frequencies below 30Hz. Measurements down to 10Hz are easily achievable so that tension measurements may be made in belt spans of 5 metres or more. Measurements may be taken down to 4 Hz provided that the sensor head is fixed.

The sensor head is 'beamed' onto the belt from distances of up to 50mm (2 inches) or more and may be directed at the flat side of the belt or the edge. The sensor is also relatively insensitive to the angle of approach. An additional advantage of the optical head is that the sensor is totally unaffected by any level of background acoustic noise. In many industrial environments Infra Red noise signal pollution may be just as prevalent as acoustic noise. The CLAVIS optical sensor and meter uses advanced signal processing techniques to avoid such interference. It should be remembered that at very low frequencies handshake may impart a false vibration onto the sensor head. A guide finger on the sensor may be adjusted to rest against a supporting face to minimise handshake vibrations.

**In brief: For Industrial applications, long belt spans, vee and synchronous belts, 10-300Hz measurement range, single sided optical technology**

# TYPE 4



## BELT TENSION METER TYPE 4

The industry standard meter now has an enhanced specification:-

- \* 30-600Hz Range
- \* Clavis Patented sensor
- \* 160 hour battery life
- \* Meter calibration checker
- \* Interchangeable sensors
- \* Carrying case
- \* Calibration Certificate

The Clavis hand held belt meter can be used for all belt tension gauging applications. It produces readings which accurately reflect the tension in the belt, consistently and without operator skill. CLAVIS tension meters were introduced in 1988.

The equipment consists of a small sensing head which is held across the belt to be measured. The belt is then tapped to induce the belt to vibrate at its natural frequency. The vibrations are detected and the frequency of vibration is then displayed on the measuring unit.



The unit is suitable for measuring tension in all types of power transmission belts, ranging from toothed timing belts, poly-vee belts, and simple vee belts. The frequency measurement range is from 30Hz to 600Hz which covers most automotive applications. A general purpose head is supplied. A range of interchangeable sensing heads with differing dimensions is available upon request.

Rechargeable batteries provide 80 hours of operation (dry batteries provide 160 hours). The meter automatically switches off 10 minutes after the last reading is taken, to prolong battery life. A 'LO BAT' indicator on the display shows when the unit needs recharging. The charging socket is adjacent to the sensing head connector. An overnight charge will fully restore the batteries. During charging the 'LO BAT' indicator will flash. The meter may be powered directly from the charger if required.

**In brief: Universal tension meter especially suitable for all automotive applications. Supplied with Type 3 acoustic sensor**

# TYPE 4



## Additional notes

The range of the meter is from 30 to 600Hz. In most applications the meter is used to make comparative tension checks. Often two or three spans may be available on which to take measurements. As the frequency depends upon the span length, the span to be used for measurement must be defined. Normally it is found that the longer spans are easier to vibrate than the very short span lengths. If the belt tension adjuster is on the measurement span, ensure that the variation in span length created by the adjuster will not be significant.

## Calibration

The Clavis Belt Tension Meter is based upon a microprocessor using digital signal processing techniques. A 8.0000 MHz quartz crystal provides the fundamental frequency reference which should ensure, for the life of the instrument, an accuracy of;

- + or - 1 digit below 100Hz
- + or - 1% of reading above 100 Hz

A high precision steel resonator is supplied for an easy spot frequency check of calibration. The resonator should be tapped on a hard surface and held steady between the jaws of the sensor. The meter should read 250Hz with a tolerance of + or - 1%. It is important that both the sensor and the fork are held still, otherwise doppler frequency change may occur due to relative motion. However as with all gauging equipment a more comprehensive calibration check should be made periodically. A Clavis Belt Tension Meter Calibrator is available for this purpose, or the unit may be returned to the manufacturer for a calibration check and the issue of a certificate of calibration.

**In brief: Standard Accessories supplied with the Type 4 Meter**

**Universal Type 3 sensing head, Battery Charger, Carrying Case, Calibration Resonator, Certificate of Calibration**

# TYPE 5/6



## Type 5: KgF Display Version

The TYPE 5 version of the meter has all the capability and functions of the Type 4 meter but with the following additional facilities.

The frequency range is from 10.0 Hz to 600 Hz, which will cover virtually all belt tension measuring applications.

The display may show the belt tension in KgF units of measurement.

This value is calculated from the belt span and belt mass data, which is entered into the meter. Up to 3 sets of data may be stored in the meter for easy recall. The display may be changed from a Hz to a KgF reading by the press of a single key. Rechargeable batteries provide 30 hours of continuous operation. Automatic power off occurs 2 minutes from the last use of the meter. A carrying case and a mains supply charger is supplied with the meter.

(Alternatively the TYPE 6 meter is available which produces a Newton display)

Standard Accessories supplied with the Type 5/6 Meter are;  
Universal Type 3 sensing head, Battery Charger, Carrying Case, Calibration Resonator, Certificate of Calibration



**In brief: A meter for the display of tension in Newtons or KgF**

# TYPE 13 SR



## Type 13 SR (Super Rugged)

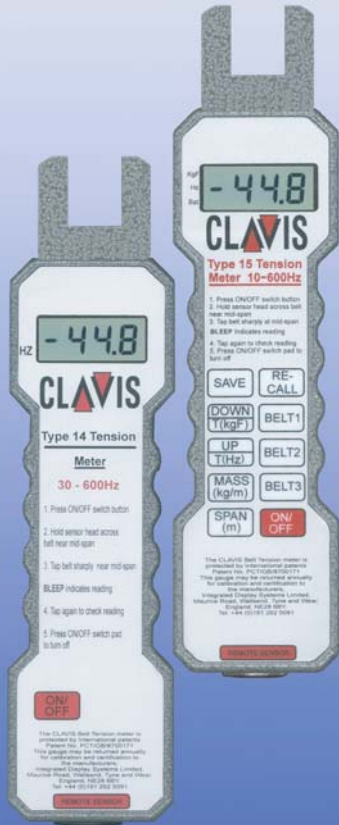
If you are cold climate testing in the Artic Circle or maintaining a battalion of armoured fighting vehicles like some of our customers then the only meter to choose is the Type 13 SR (Super Rugged). Capable of operating between a temperature range of -40 to +80 degrees Centigrade and fully submersible down to a depth of 15 metres (50 feet) this meter will survive the most arduous of conditions. The housing is CNC machined from aluminium billet and features extensive neoprene rubber gaskets to ensure that the electronics package is completely sealed from the external environment. The sensor head is a specially adapted CLAVIS optical sensor head. An LED display with a 25mm character height enables the belt frequency to be read even though the display may be covered by frost or snow. A rapid charger is included, to recharge the batteries in 3 hours. The charger may use either a 110/230 VAC mains supply or the 12 volt vehicle battery via the accessory socket.

This meter is also suitable for the most hostile of production environments.



In brief: Super Rugged optical meter , -40C to 80C operating range, submersible to a depth of 50 feet.

# TYPE 14/15



**The Type 14** meter is housed in a rugged ergonomic housing which has been CNC machined from aluminium billet. Any CLAVIS sensor may be plugged into the base of the meter if access using the integral sensor is difficult. The meter is powered by a single 'AA' battery which will provide 40 hours of continuous operation. The Type 14 meter may also be supplied with a cylindrical sensor mounted on a flexible gooseneck, in place of the jaw sensor. The frequency range of this meter is 30-600 Hz.

**The Type 15** meter has the functions of the Type 5 meter (ie. the ability to calculate the belt tension in KgF from the belt mass and span). The Type 15 meter also has the capability to record belt tension measurements, making it very suitable for quality assurance purposes. The stored values can be replayed onto the display of the meter or transferred through the integral serial port to a PC. Windows software is supplied with the meter to view the data and to present it in an Access database format.



In brief: Rugged universal tension meter with integral sensor head. Type 15 version with KgF display and data recording

# DUCATI Tension Meter



The sensor has an adjustable depth stop so that it can be rested on the timing casing behind the belt. Although our optical meter is typically a low frequency unit from 10-300Hz, we extended the range to 600Hz to cover all possible Ducati belt applications.

Ducati Motorcycles have for a long time realised the importance of accurate belt tension setting, both to ensure long belt life and to maximise performance. We were asked by Ducati to produce equipment to be used on their production lines to set belt tension and a handheld meter for use by their racing teams and dealer network. We designed the handheld meter to use an optical sensor which could be 'beamed' onto either the flat face of the belt or the edge of the belt. This was of particular importance as the belt is quite heavily masked when the engine is located in the frame.



The CLAVIS production line measurement tools have electro-mechanical hammers which force the belts into vibration. There are two separate sets of sensors and hammers for the vertical and horizontal cylinders.

**In brief: A tension meter particularly designed for use with Ducati motorcycles**

# Special Application Meters



We are always available to redesign our standard product to match specific applications. An example of this is the Type 14 meter which we adapted for use by Mahindra of India. The requirement was to use the meter for over checking of tension on two belts and for these values to be recorded on a data collection system. We fitted the Type 14 with two additional buttons which transmit the belt values through a serial data port on the meter. A separate button is designated for each belt. The meter was also configured to run from a mains power supply so that continuous operation is possible.

A simple change to the CLAVIS optical meter was a redesign of the sensor head for the U.K. Royal Mail. With over 70 sorting offices throughout the country, millions of letters are sorted each day by sophisticated letter sorting machines which are driven by synchronous drive belts. Correct belt tension is essential for these machines to run with the minimum of down time. The orientation of the belts on this equipment required the sensor to be 'side looking' rather than the standard 'end looking'.



In brief: Tension Meters re-configured for your specific application

# Sensor Heads



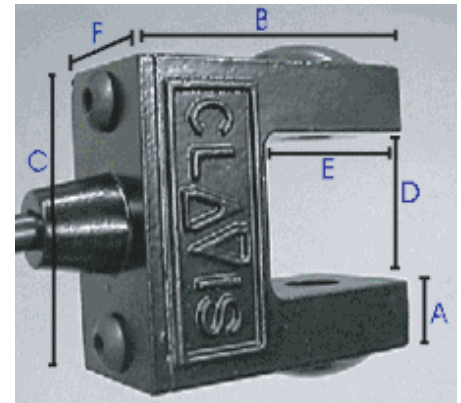
## Sensor Heads

The purpose of the sensor head is to detect the natural frequency of vibration of the belt. As the level of this acoustic signal is very small special patented techniques must be employed to recover this signal from the often high levels of ambient noise in a busy industrial environment. The twin transducers of the sensor head should be positioned in the centre of the belt for optimum performance. For belts up to 25mm wide the standard type 3 sensor is suitable.

For wider belts a sensor with longer jaws which enables the transducers to be positioned over the centre of the belt is more suitable. It is important that the belt vibrates freely and does not come into contact with the sensor head. Therefore for belts with a heavy section the type 5 sensor is advised.

On some applications it may not be possible to gain access to both sides of the belt. The type 10 cylindrical sensor is suitable in this case as it needs only to be pointed towards one face of the belt. However, its performance in rejecting high levels of background noise is poorer when compared with the standard dual transducer sensors, and therefore it may not be suitable for some measurement situations.

The CLAVIS optical sensor is a high performance sensor which can be 'beamed' onto the belt from distances up to 75mm. It can be directed onto either the flat side of the belt or onto the edge of the belt. It is therefore suitable for applications where the belt is difficult to access. It was primarily developed for belt tension measurement on Ducati motorcycles where belt access is partially masked by the frame of the motorcycle.



**In brief: In a range of sensor heads to suit every belt configuration**

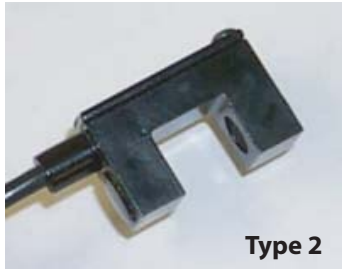
# SENSOR HEADS



Type No. & Description (dimensions in mm)	A	B	C	D	E	F	ENTRY
<b>2 - small</b> - For small belts up to 10mm wide	9	22	34	15	13	16	TOP
<b>3 - Standard</b> - General purpose for all belts up to 25 mm wide. Particularly suitable for automotive belt drives.	11	36	40	18	22	16	REAR
<b>5 - Large</b> - For wider synchronous and polyvee belts up to 60mm wide, where good access is available	13	52	50	25	34	20	REAR
<b>6 - Top entry</b> - version of standard Type 3 sensor	11	36	40	18	22	20	TOP
<b>7-Top Entry</b> - sensor for heavier section belts, giving good clearance between jaws	10	42	50	30	22	20	TOP
<b>8-Long Reach</b> - For wide belts up to 150mm wide. May be used on all belts if positioned correctly	13	105	50	25	80	20	REAR
<b>9-Medium Reach</b> - Low profile sensor for wider polyvee belts up to 75mm	10	57	39	18	35	20	REAR
<b>10-Cylindrical</b> - For all applications where only single sided access is possible. Can be used on belts of any width.	19 dia	100 long			10 dia	60 long	miniature version
<b>11-Cylindrical Magnetic</b> - For steel corded synchronous belts or tension measurement in steel cables	16 dia	80 long					
<b>12-Optical</b> - High performance sensor for single sided access applications. Can only be used with meters having optical provision.	36 wide	105 long					

In brief: Dimensions for all the CLAVIS sensor heads

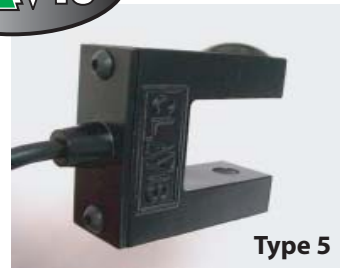
# SENSOR HEADS



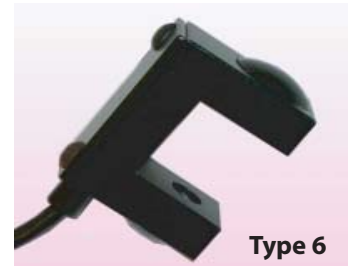
Type 2



Type 3



Type 5



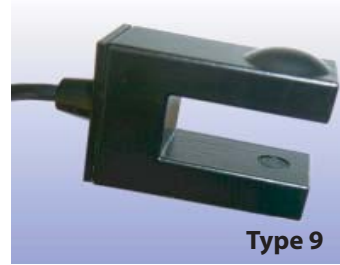
Type 6



Type 7



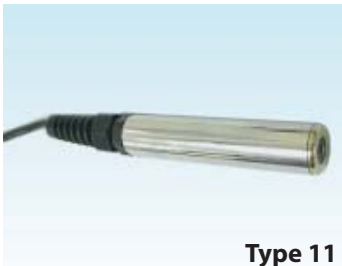
Type 8



Type 9



Type 10



Type 11



Type 12



Custom Sensor

**Your Design Here!**  
**We regularly make  
sensor heads to  
customer  
specifications**

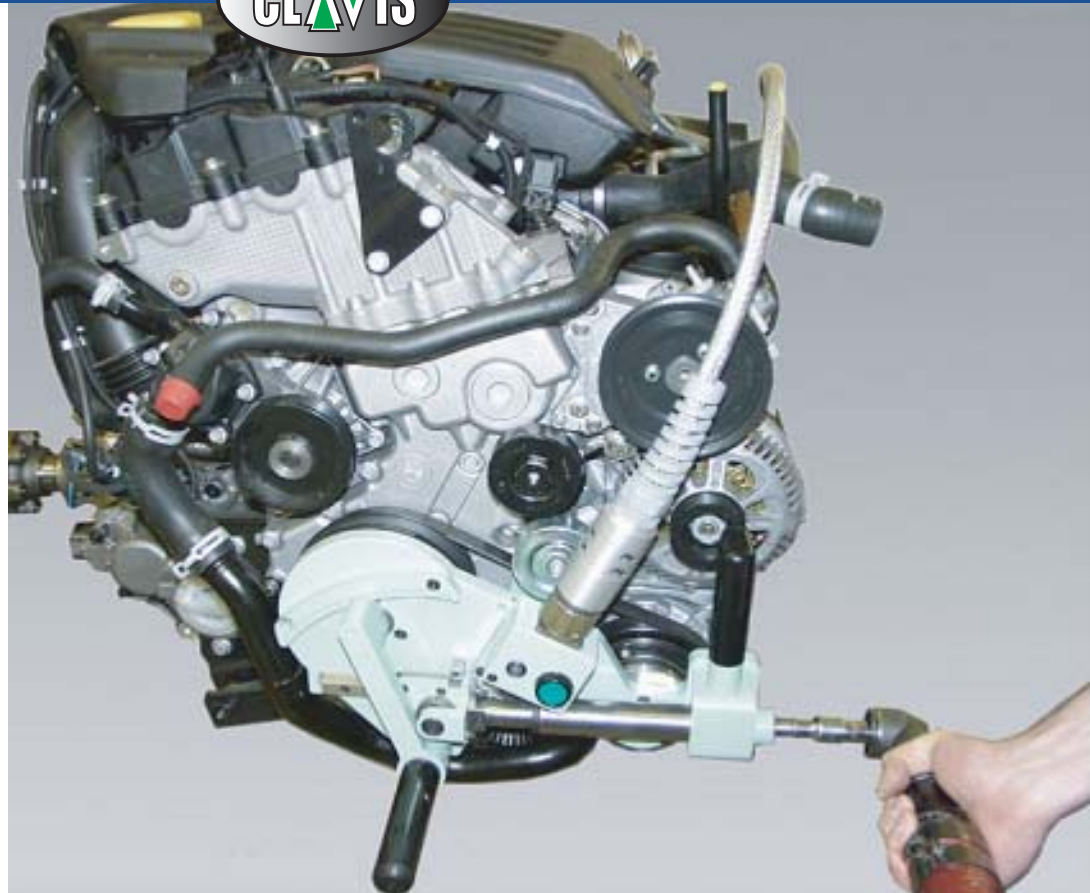
In brief: Sensor heads for every application

# BELT TENSION SETTING



On this engine the belt adjuster is a pivoted idler pulley which is swung against the belt. The requirement was to design a tension setting tool which used a single power tool for both making the adjustment and also to torque down the idler locking bolt.

This was accomplished by designing a jig plate which had a screw jack type configuration which operated on the idler pulley. A CLAVIS optical sensor and electromechanical hammer made the tension measurement which controlled the power tool in a closed loop mode. Once the setting was made the operator transferred the same power tool to the locking bolt. Finally the operator transferred the power tool back to the screw jack to reverse back to the start position ready for the next engine. All the operations are performed at high tool rpm so that the cycle time for the complete setting sequence was less than 25 seconds.



**In brief: An example of belt tension setting equipment. We design equipment like this for engine manufacturers throughout the world.**

# SABRE



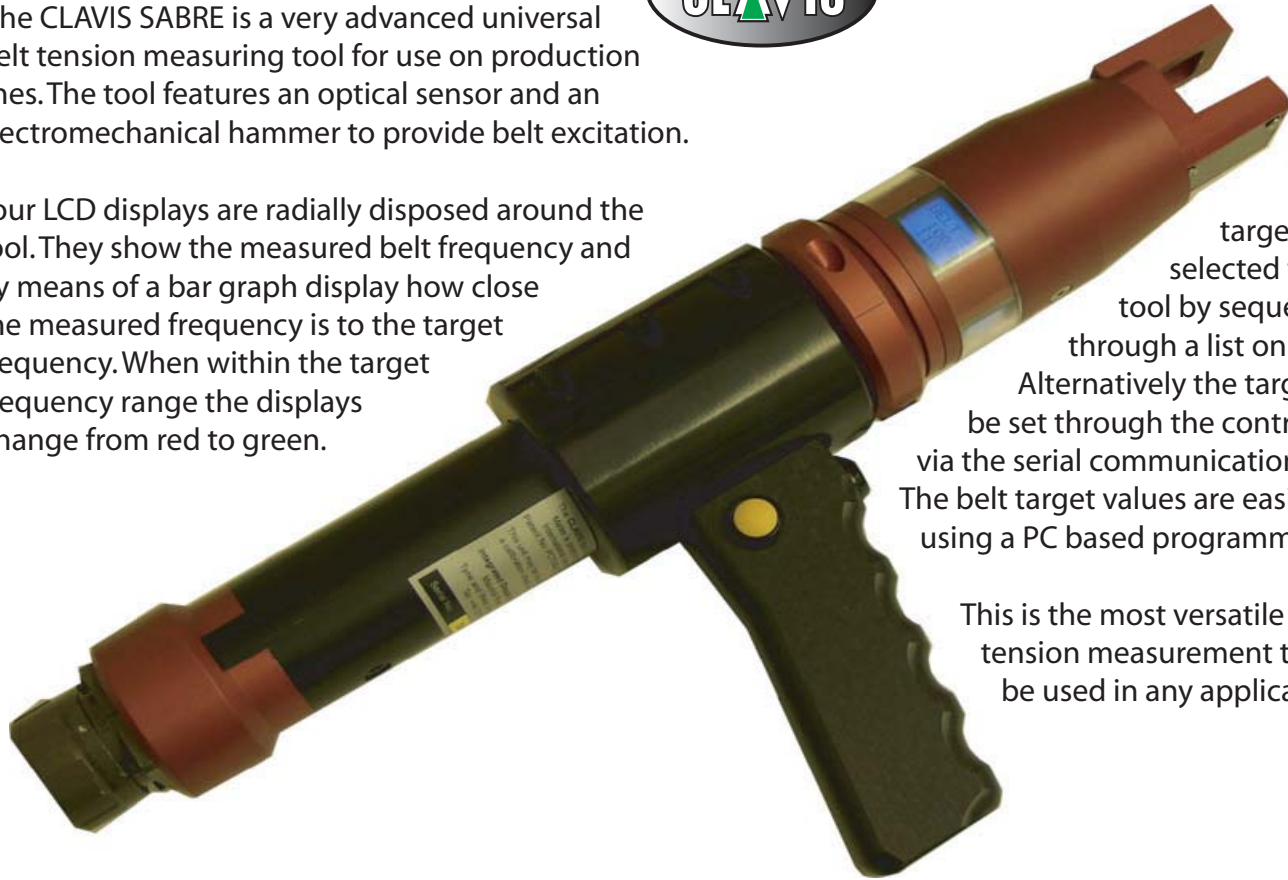
In brief: Universal tool for setting belt tension in a high volume manufacturing environment

# SABRE



The CLAVIS SABRE is a very advanced universal belt tension measuring tool for use on production lines. The tool features an optical sensor and an electromechanical hammer to provide belt excitation.

Four LCD displays are radially disposed around the tool. They show the measured belt frequency and by means of a bar graph display how close the measured frequency is to the target frequency. When within the target frequency range the displays change from red to green.

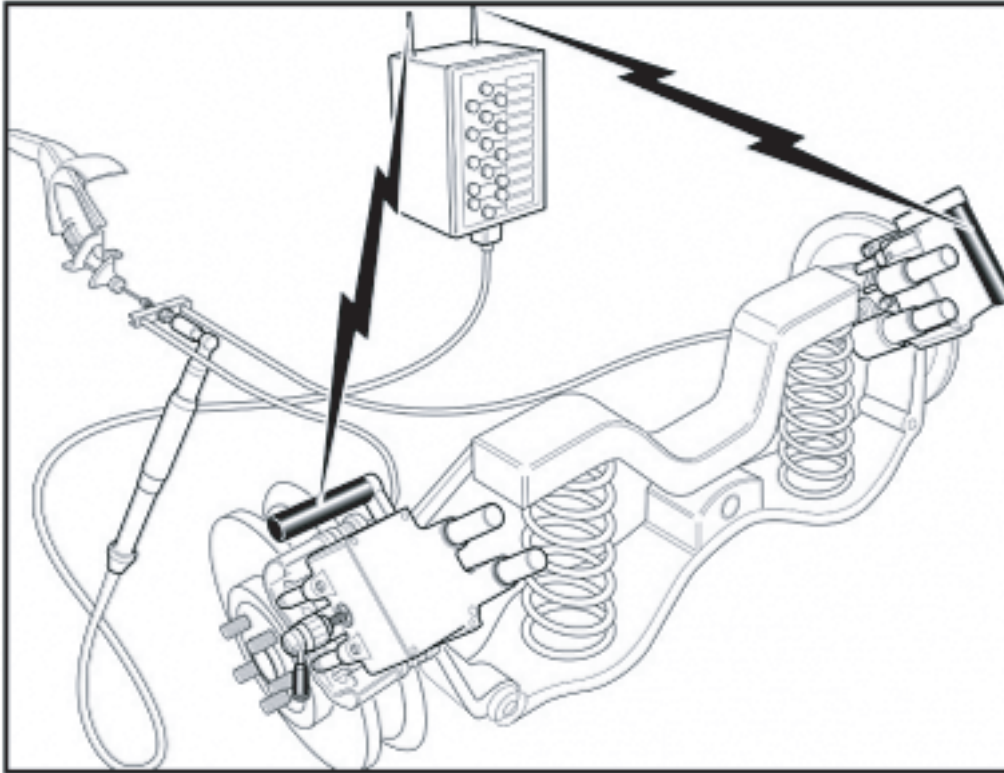


The target belt can be selected from the tool by sequencing through a list on the display. Alternatively the target belt may be set through the control cabinet via the serial communication port. The belt target values are easily set up using a PC based programme.

This is the most versatile of belt tension measurement tools, able to be used in any application.

**In brief: A tension measuring tool to enable you to shoot yourself out of any problem**

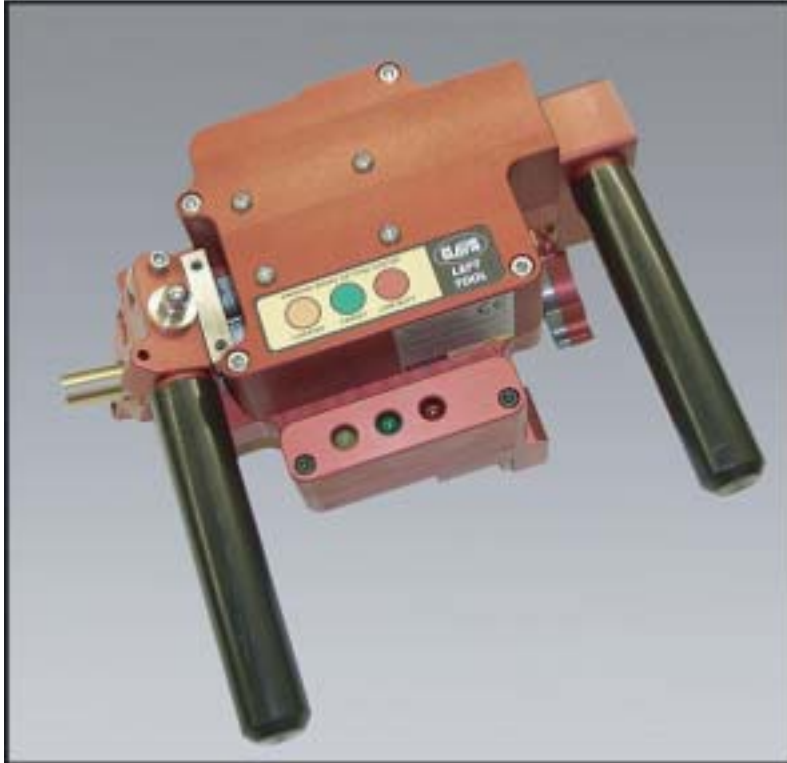
# BRAKE SETTING



1. Unique, patented system for parking brake cable length setting
2. Sets the length of the parking brake cable with high precision
3. Performs the 'scragging' operation automatically as part of the cycle
4. Caliper lever movement restricted by measurement tool so that the caliper is not subject to scragging forces
5. Equally suitable for disc and drum brake configurations.
6. One measurement tool able to accommodate differing caliper lever configurations
7. Intelligent measuring tools able to detect failures in process during parking brake system assembly
8. System is set with the handbrake lever in the fully off position
9. High speed operation suitable for continuous 3 shift working.
10. System approved by major brake component manufacturers including AP, Bosch, Continental Teves and TRW.

**In brief: Equipment used for the setting of park brake (hand brake) cables during high volume vehicle manufacture**

# BRAKE SETTING



The measurement tools which are temporarily locked onto the brake during setting are lightweight but still extremely robust. This equipment was supplied to light truck plants in China, Turkey and the UK. Each plant received a set of equipment for the production track and a mobile trolley mounted set for use in the garage repair area. It enables the park brake cable length to be set accurately minimising handbrake warranty claims.

In brief: Disk or drum brake setting equipment for any vehicle

# OUR COMPANY



CLAVIS equipment is designed and manufactured in the North East of England by Integrated Display Systems Limited. Our company has been recognised by two awards for technical excellence by Her Majesty the Queen in 1997 and 2004. We have installed our equipment in automotive manufacturing plants worldwide.

Your local distributor



**Integrated Display Systems Limited,  
Maurice Road, Wallsend, Tyne and Wear, England, NE28 6BY.**

**Tel: +44 (0)191 2627869 Fax: +44 (0)191 2620091**

**Email: [sales@clavis.co.uk](mailto:sales@clavis.co.uk)**

**Web: [www.clavis.co.uk](http://www.clavis.co.uk)**

**In brief: A company located in an area of engineering tradition, using new technologies to manufacture tension measuring and setting equipment for world markets.**