

Operation Manual
for Stop Time Meter Safety Man Delta T



SMD-e 04/2001



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Appendix 1 Chart Software Structure

Part I

1. General Information

Today most of the machines with dangerous motions are safeguarded by light curtains, two hand controls, safety mats or emergency stop devices.

Once activated the safety device, the operator may not reach the nearest danger point before standstill of the machine. Consequently there must be a certain distance between safety device and nearest danger point, which is determined mainly by the stopping time of the machine.

The **Safety Man Delta T**, a portable measuring device, allows to evaluate the stopping parameters in a fast and simple way.

2. Terms

Stopping Time - Time interval between emergency stop and standstill of the machine.

Stopping Distance - Distance covered by the moving machine part after the emergency stop.

Test Stroke - One stroke of the machine without stop for evaluating the velocity to time course.

SPM - Start Point of Measuring – Position of moving machine part where the emergency stop is simulated and the measuring of the stopping performance begins.

SD - Safety Distance – Distance between safety device and nearest danger point.

Stopping Time

Stopping Distance

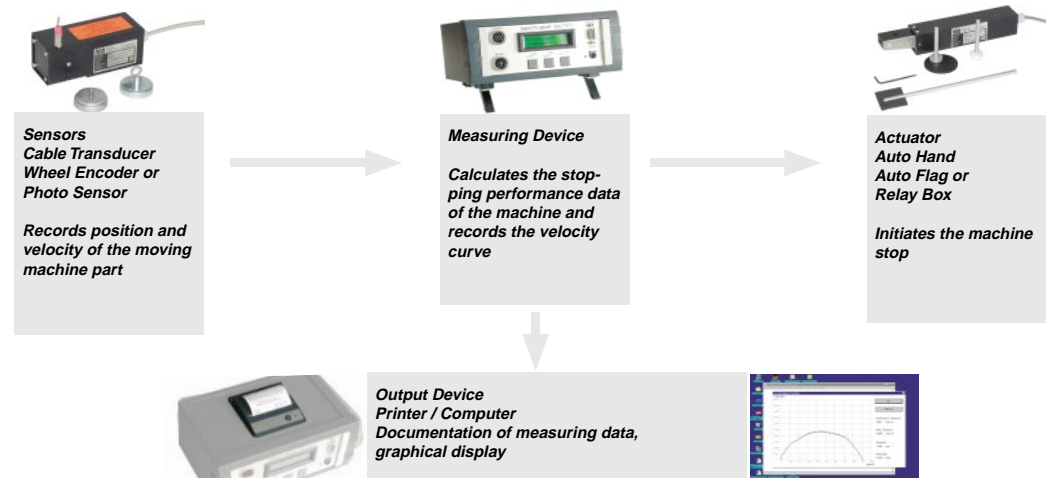
Test Stroke

SPM

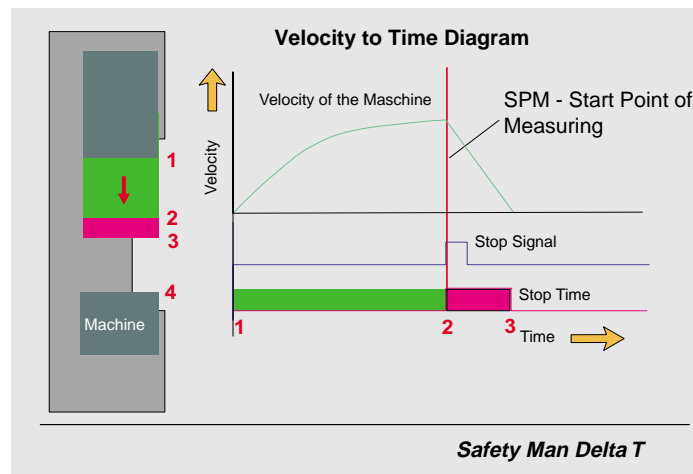
SD

3. Functions

The measuring configuration **Safety Man Delta T** is used to evaluate the stopping performance of machines. The configuration consists mainly of:



The **Actuator** is either a **Auto Hand** or a **Relay Unit**. The actuator **Auto Hand** is used as a Trigger Device, which is controlled by the **Stop Time Meter**. It initiates a machine stop by activating the safety device. The time period from the stop command to the standstill of the machine is measured, it is the overall stopping time of the machine.



As an alternative the Relay Unit can be used. By using a normally closed contact and interrupting the line between safety device and machine control the machine will be stopped.

The sensor is a cable transducer which permanently provides information of speed and position of the moving machine part. Herewith the measuring device evaluates stop time and stop Distance between stop signal and standstill of the machine. multiple measurements with a statistical analysis increase the accuracy. Other Sensors are wheel encoder or photo sensor.

All measuring results and selected parameters can be printed out or transferred to a computer system for documentation.

4. Safety Instructions – Appropriate Use



The stopping parameters have to be evaluated under worst case conditions. Means that the measuring should be started at the point of highest velocity.

The stopping time can also depend, for example, on the weight of die, condition of breaks and the operation temperature of the machine.



When positioning the sensor and measuring device make sure that they can not be damaged by moving parts of the machine .



Make sure that the safety device is working properly. Never bypass the safety device.

5. Norms and Regulations

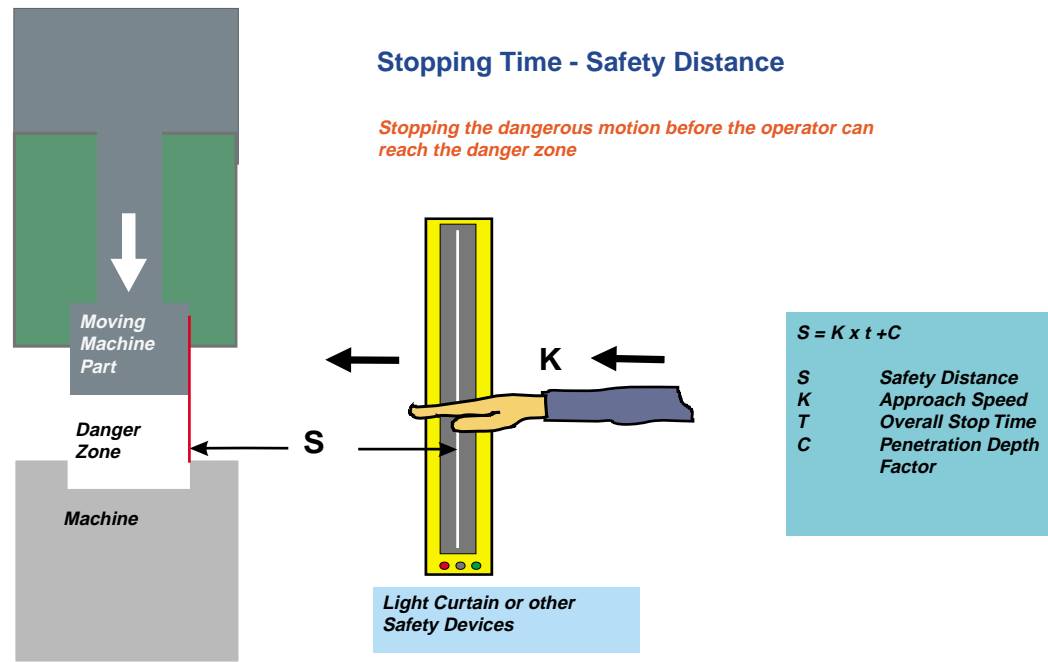
The measuring configuration **Safety Man Delta T** evaluates the stopping performance under consideration of the valid European norms and regulations.

Particularly is to make reference to EN 999, EN 294 and EN 50100-2.

Beside these norms one has to consider specific machine norms and the valid national and international norms and regulations.

6. Stopping Time – Safety Distance

In order to calculate the correct safety distance one has to consider the safety device. Depending on the safety device there are different formulas to use.



Safety Man Delta

6.1. Light Curtain

S	Minimum safety distance (in mm)
K	Approach speed 2 mm / ms using light curtain in normal approach
D	Resolution of light curtain
T1	Response time of the safety device (light curtain) in ms
T2	Stopping time of the machine

$$S = K \times (T1 + T2) + 8 \times (D - 14 \text{ mm})$$

Remark: this formula applies for all minimum distances of S up to and including 500 mm. The minimum value of S shall not be less than 100 mm.

If S is found to be greater than 500 mm using above formula it can be recalculated with 1,6 m/s. In this case the minimum value shall not be less than 500 mm.

6.2. Two Hand Controls

S	Minimum safety distance (in mm)
K	Approach speed 1,6 mm / ms
T1	Response time of the safety device in ms
T2	Stopping time of the machine
C	Additional distance

$$S = K \times (T1 + T2) + C$$

Remark: If the risk of encroachment of the hands towards the danger zone is eliminated while the actor is being operated e.g. by adequate shrouding, then C may be zero otherwise there is an additional distance of 250 mm. Anyhow the minimum allowable safety distance is 100 mm.

6.3. Scanning Devices

S	Minimum safety distance (in mm)
K	Approach speed 1,6 mm / ms
T1	Response time of the safety device in ms
T2	Stopping time of the machine
H	Height of the detection zone above the reference plane, e.g. floor in mm

$$S = K \times (T1 + T2) + (1200\text{mm} - 0,4 \times H)$$

Remark: The additional distance (1200 - 0,4 x H) may not be less than 850 mm. H shall not be greater than 1000 mm. However if H is greater than 300 mm (200 mm for non-industrial applications) there is a risk of inadvertant undetected acces beneath the detection zone.

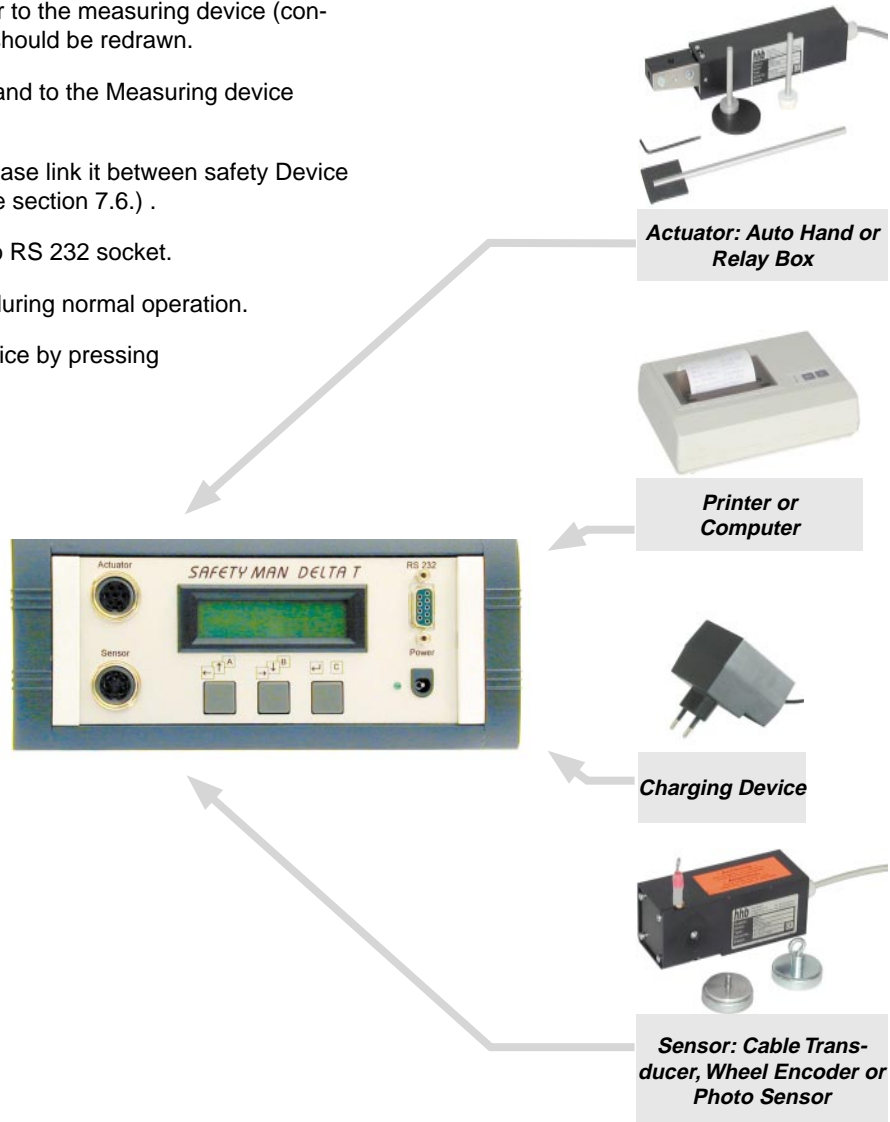


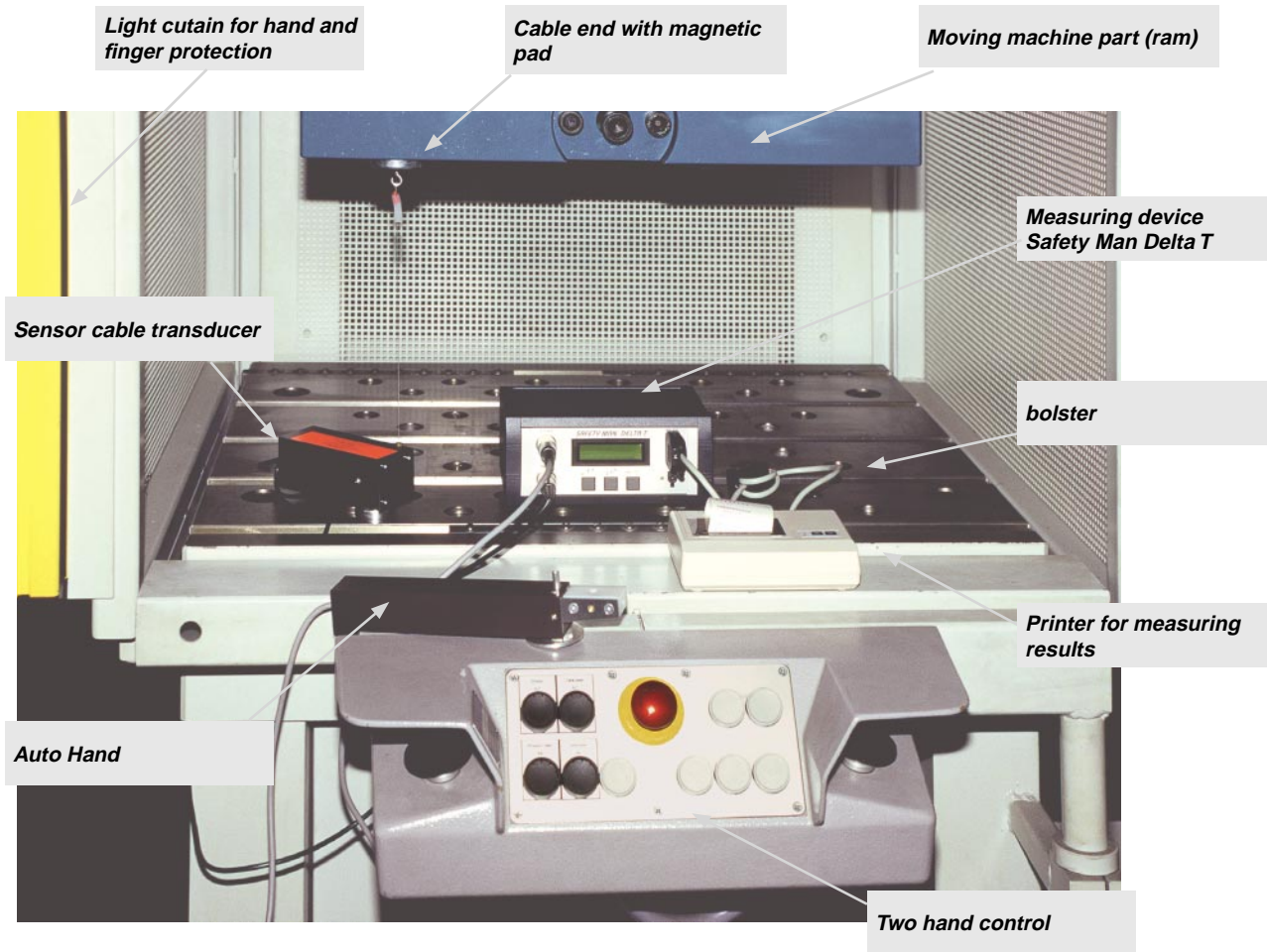
Remark: The above mentioned formulas correspond with EN 999.
For some machines there may be specific machine regulations with divergences.
In any case the valid national and international norms and regulations have to be considered.

7. Setting into Operation

7.1. Connection of Sensor, Actuator and Printer

- Make sure that the batteries of the measuring device are charged. If necessary recharge it.
- Connect the cable transducer to the measuring device (connection **Sensor**). The cable should be redrawn.
- Connect the actuator Auto Hand to the Measuring device (connection **Actuator**).
- When using the relay unit please link it between safety Device and machine control first (see section 7.6.) .
- A printer can be connected to RS 232 socket.
- Do not use charging device during normal operation.
- Switch on the measuring device by pressing A and C simultaneously.





7.3. Positioning of the Sensor (Cable Transducer)

- Bring the machine in upper dead centre position.
- Fasten the sensor with the magnetic pads on the not moving machine part (bolster). The magnetic pad can be fastened at different sides.
- Draw the cable end slowly out of the transducer and fix it with the magnetic pad on the moving machine part.
- Make sure that the sensor can not be damaged by moving machine parts.
- **Caution:** Never let the cable snap into the transducer. The transducer could be damaged.
- The cable direction should be right angled to the transducer.
- Make sure that the cable can run free.



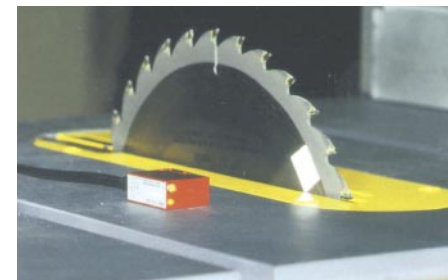
7.4. Positioning of the Sensor (Wheel Encoder)

- Clamp the Wheel Encoder into the magnetic/hydraulic holder.
- Fix the magnetic foot on the machine table and adjust the holder, so that there is a good friction between wheel and the rotating machine part.
- The rotating motion of the machine must match with the arrow on the wheel.
- Make sure that the sensor can not be damaged by moving machine parts.



7.4 Using the Photo Sensor

- Fasten the photo sensor approx. 100 to 200 mm in front of the moving machine part.
- Fix the reflex stripes on the moving machine part. The number of strips on the perimeter is depending on the desired resolution. Use tripelex foil only.
- Make sure that the photo sensor recognises all of the strips (Indication light)



7.5. Preparing the Actuator Auto Hand

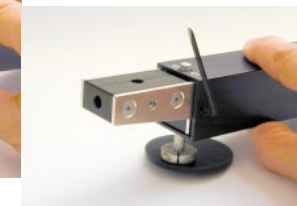
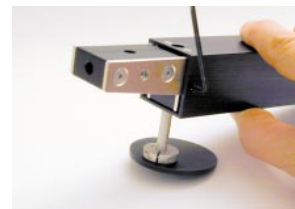
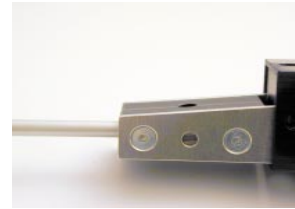
You will find an allen key at the rear of the Auto Hand. It works for allstaining screws at the **Auto Hand**.

Light Curtains

- Tense the rocking arm.
- Use software menu *MM Test Function - TF Actuator Check* to adjust the Auto Hand to the safety device.
- Make sure the rocking arm is in released position.
- Fix the flag to the rocking arm of the Auto Hand.
- Adjust it to the size of the light curtain. The stick for the flag is malleable.
- Place the Auto Hand at the light curtain (Sensing field must be interrupted).
- Tense the rocking arm.
- The sensing field shall be free in tensed position.
- Carry our TF Actuator Test to check if the flag breaks the beams.

Two Hand Controls

- Use software menu *TF Actuator Test* to check Auto Hand.
- Tense the rocking arm.
- Fasten the extender leg as shown.
- Adjust it to the button as a spacer in tensed rocking arm position. The button must be pressed in this position.
- Carry out TF Actuator Test and check if the Auto Hand releases the button.



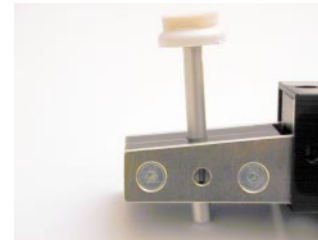
Emergency Stop Devices

- Use the Auto Hand as described under two hand controls, but in reverse position.



Recessed Switches

- Push buttons, which are recessed can be activated with a special extension (as shown in the picture).



7.6. Connecting of the Relay Unit

- Connect the Relay output (normally closed contact - brown/blue) between the safety device and the machine control. Refer to machine wiring diagrams. The contact must interrupt one of the safety device outputs.
- Plug it in the connection **Actuator** at the measuring device.
- Carry out *MM Test Function and Service - TF Actuator Test*



8. Start Point of Measuring SPM

In order to evaluate the longest stopping time of the machine, the stop should be initiated at the point of highest velocity of machine. The stop position is the Start Point of the Measuring (SPM). The SPM position can be defined with one of the following three methods:

8.1. Manual Setting of SPM

The distance between upper dead centre and SPM is defined by setting a counter manually (in mm) at the measuring device.

8.2. Teach-In Mode for SPM Setting

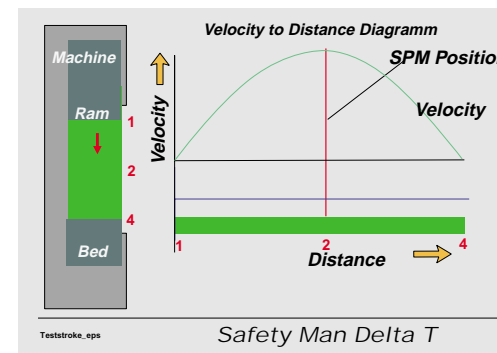
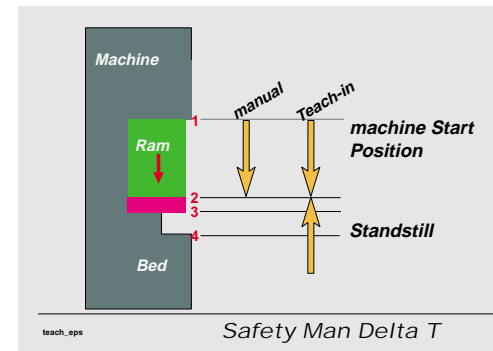
Hold the cable tip first to the start position of the machine and then to the desired SPM position and confirm both positions at the measuring device. The SPM position is so taught in.

8.3. SPM Definition with Test Stroke

A Test Stroke is carried out in order to evaluate the velocity curve. The position of highest velocity is then determined and automatically taken over as SPM.



Remark: Use this method on machines with eccentric drive only. It may not be used on machines with constant velocity.



9. Service

9.1. Charging Batteries of Measuring Device

In case that the capacity of batteries is not sufficient, there will be the following message on display *Low Battery*. You can finish your measurement within the next 5-10 minutes.

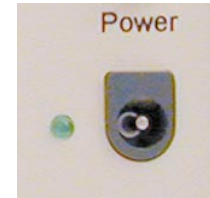
The charging device is matter of delivery, please use the original one only.

For charging, connect it to connection power. During loading the green indication LED shows following charging conditions:

- Flashing (short on / long off) batteries are very low
- Solid (on) during normal charging
- Flashing (on / off same period) batteries are charged
- Flashing (long on / short off) during discharging of the batteries



In order to ensure a long life time of the batteries it is recommended to discharge them completely after five time charging. The discharging of the batteries can be started by software in menu *MM Test Function and Service / TF Battery dis- & charge*.



9.2. Printer

The Printer can be activated and deactivated by using menu *MM Print Manager / PM Print Values setting yes*.

The printer will be switched on and off automatically by software in order to save power.

9.3. Changing of Printer Paper

Activate the printer in *MM Print Manager / Change of Paper*. Remove plastic cover and exchange paper roll. Feed in the paper end carefully in the paper slit. Press SEL button (off line mode - green indication is off) then press LF for paper traction. Now press SEL for on-line mode (green and red is on)



10. Trouble Shooting

<i>Failure (Failure Message)</i>	<i>Remedy</i>
<i>Actuator Fault</i>	<i>Actuator is defect or delay time is not correct. Carry out Actuator Test in menu TF.</i>
<i>Measuring device does not accept any commands</i>	<i>Press A B C simultaneously.</i>
<i>Battery low - please recharge</i>	<i>Finish your measuring at the machine and recharge the batteries.</i>
<i>Memory (soon) full</i>	<i>Data of 30 measurements are in memory. Save data in menu DM (Transfer to PC) and delete them afterwards.</i>
<i>No data in memory</i>	<i>No measuring data are available</i>
<i>Stop - Inversion of direction</i>	<i>Occurs in menu SM if measuring direction is wrong or machine moved more than 3mm in the wrong direction.</i>
<i>Other failures</i>	<i>Load default setting in menu TF and delete measuring data.</i>
<i>Stored data show incorrect formatting</i>	<i>Delete all measuring data in menu DM (all data will be deleted !)</i>
<i>Printer shows mistakes or is not working</i>	<i>Check if original cable is used Check Setting PM Values on</i>
<i>Printer or Actuator is not working correct or low battery message</i>	<i>Charge batteries and test again</i>
<i>Reduce resol. / Repeat meas.</i>	<i>indicates a range exceeding. The resolution will be reduced automatically and the measurement has to be repeated. The setting of the resolution will be kept up as long as the device is not switched off.</i>

11. Spare Parts

<i>Spare part</i>	<i>Order number</i>
Measuring device:	
Battery pack	81000010
Power supply	81900000
Sensor: Cable transducer (digital)	
Magnetic pad Transducer	82000010
Magnetic pad cable tip	82000020
Actuator: Auto Hand	
Flag for Auto Hand	83100200
Extender leg	83100100
Extension for rocking arm	83100300
Printer:	
Paper rolls 5 pcs.	84000010
Color tape	84000020
Printer cable	84000100
Instruction manuals:	
German	89092000
English	89092100
French	89092200
Spanish	89092300
Quick reference manuals:	
German	89098000
English	89098100
French	89098200
Spanish	89098300
Italian	89098400
PC Software	
PC cable	89091000
	81000040
Instruction manuals	
German	89099000
English	89099100
French	89099200
Spanish	89099300
Italian	89099400



12. Technical Data

Measuring Device:

Display:	2 Lines, 16 characters, illuminated
Accumulator:	7,2 V 1200 mAh
Operating Time:	Approx. 10 h
Outputs:	Actuator, RS 232
Inputs:	Sensor, power supply
Battery Charger	
Dimensions (W x H x L):	200 x 100 x 135 mm
Weight:	Approx. 1,4 kg

Cable Transducer (Standard):

Cable Length:	1,2 m or 1,5 m
Resolution:	0,5 mm
Fixture:	Magnetic pads
Dimensions (W x H x L):	50 x 50 x 140 mm
Weight:	Approx. 0,6 kg

Actuators:

Auto Hand (Option):

Trigger Device:	For light curtains and two-hand-controls-
Power Supply:	7,5 V (supplied by measuring device)
Dimensions (W x H x L):	220 x 35 x 35 mm
Weight:	Approx. 0,3 kg

Auto Flag (Option):

Trigger Device:	For light curtains
Power Supply:	5- 15 V (supplied by measuring device)
Dimensions (W x H x L):	50 x 85 x 50 mm 50 x 85 x 50 mm with flag
Weight:	Approx. 0,4 kg

Relay:

Power Supply:	6 V DC (from measuring device)
Contact:	Normally open 230V, 5A brown/blue
Dimensions (W x H x L):	50 x 25 x 100 mm
Weight:	Approx. 0,2 kg

Printer:

Dimensions (W x H x L):	110 x 40 x 160 mm
Weight:	approx. 0,4 kg
Method:	Needle
Paper Width:	57 mm
Characters:	24 per Line
Interface:	RS 232
Power Supply:	5 V DC (from measuring device)

Printer (integrated version since 11/2003) :

Method:	Thermo
Characters:	8 Dots/ mm

Power Supply:

Input:	230 V AC +/- 10%
Output:	15V DC

Transportation Case:

Dimensions (W x H x L):	450 x 380 x 160 mm
Weight:	Approx. 7 kg with devices or larger

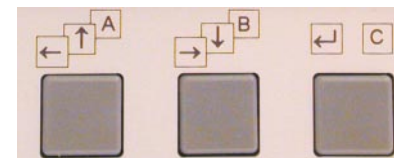
13. Software


13.1. Function of keys and operating advices

A + C Switch on the measuring device by pressing A and C simultaneously.

A / B The buttons A and B are used to navigate in the menus and for setting of values. In some cases they are also used for jumping over or breaking off.

C For selection, confirmation and the jump to the next point.




 The measuring device switches off automatically when not being operated for more than ten minutes.

At some places in menu *SM Stop Time Measuring* and *VM Velocity Measuring* the last setting will occur again. You can accept it by pressing the B key or re-enter with the C key.

In the menu *SM Stop Time Measuring* and *VM Velocity Measuring* you can often return to the last action by pressing the A key.

In menu the *SM Stop Time Measuring* after the display of the results, you can cancel the last measurement (pressing A or B) or break off (pressing A +A or B + B).

 Switching off with menu *MM Unit Power Down*.

13.2. Main Menu

The main menu consists of following 8 Sub Menus:

- P1** *Parameter 1 Basic Settings*
- P2** *Parameter 2 Safety Distance*
- P3** *Parameter 3 Measuring*
- SM** *Stop time Measurement*
- VM** *Velocity Measuring*
- TF** *Test- and Service Functions*
- DM** *Measuring Data Management*
- PM** *Print Manager*
- PD** *Switch Off*

Remark: The first two characters will always indicate the menu you have selected



13.3. Sub Menu



The setting of the parameters in menu **P1** and **PM** usually have to be carried out once during setting the system into operation.



In **P2** you will find parameters, which have to be modified depending on the safety device the machine is equipped with. Make sure that the setting is correct for each individual machine. The correct calculation of the safety distance requires the right specification for the safety device (setting of resolution, response time and approach speed in **P2**). When using the Auto Hand or Auto Flag the setting for the reaction time of the safety device should be 0.



All setting remains in memory even if the system is switched off. Values remarked with # are default settings and can be reactivated at any time in menu **TF** by selecting „Default Values“.