Stopping time and machine diagnosis tool

Smart

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Stopping time

Why measure stopping time?

– to find out which safety arrangements can be used in a certain area around a machine, and where they should be located.

Stopping time

The safety distance (how far away from the risk area a safety component must be placed) is based upon the machines stopping time. The basic idea is that a safety component should be placed so far from the risk area that it is not possible to enter the area before the machine has stopped.

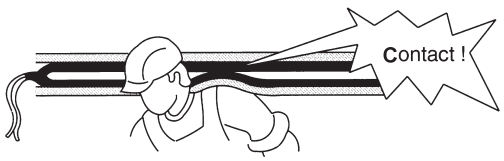
The stopping time for manually operated machines is especially important when light beams and light curtains are used as safety components. By reflex action the operator tries to grab or adjust if something has gone wrong in the machine tool, even if the machine has started. It is then imperative that the machine stops before the hand reaches the risk area. A short stopping distance is also of importance for getting good ergonomics.

Grabbing or adjusting is also common when using automatic machines. Usually this is done to prevent production down-time by quickly adjusting a work piece. The stopping time is also of great importance if someone trips and falls into the machine.

Stopping time, walking speed (1.6 m/s) and hand speed (2.0 m/s) is used for the calculation of safety distances. Sometimes a fixed minimum distance is also used. See the standard EN ISO 13855 for more details on the calculation of safety distances.

Stopping distance

For safety contact strips it is extra important that the stopping distance is monitored. An incorrect stopping distance could in many cases result in very high risks. The stopping distance is also needed during area limiting e.g. for robots when dividing the working area into sectors.



For door sensitive edges, it is important that the stopping distance is shorter than the soft part of the sensitive edge.

Regulations and standards

It is also important to measure the stopping time, to meet the requirements set by the machinery standards, directives and regulations. Here we can help, with our long experience in the practical application of regulations and standards, from the viewpoints of both the authorities and production. In addition we collaborate with the standardisation committees responsible for producing these standards. One example is EN ISO 13855, which deals with the placing of safety devices around a machine based on its stopping time. The standard is general for all types of machinery, although for some, where there is a harmonised C standard, the requirements for minimum distance and stopping time measurement will apply. In the case for example of mechanical press tools there is also a requirement in EN 692 for how stopping time measurements are to be performed, and in the case of hydraulic press tools this is in EN 693.

Where the safety distance is small, one can for example sit close to the machine and work, as in the picture on the left. If the safety distance is greater, it may be necessary to approach the machine to intervene, and also perhaps use additional protection to prevent starting when someone is within the protected distance.

Annual checks

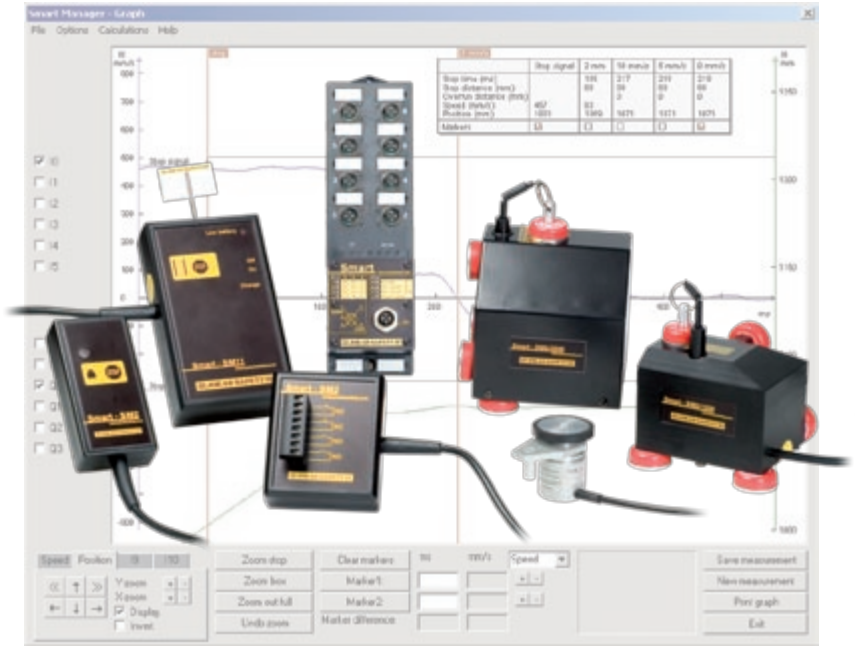
Wear in a machine is something that can affect braking and motors, which means that the stopping time of a machine can change with time. Certain other changes in a machine, such as changing the weight of a workpiece or alterations in pneumatic pressure, can also affect the stopping time. For these and other reasons it is important to perform an annual check on the stopping time.

How the stopping time affects the choice of protective equipment – an example

There was a case where we measured the stopping time of the rollers in a textile industry company. The company had planned to place light beams or a light curtain in front of the rollers to prevent the operators from being caught in the material and dragged in. The stopping time measurement showed that it took over one second for the rollers to stop. During this time the material was pulled in by almost two metres. In order to obtain sufficient protection distance, the light beams would have needed to be positioned almost three metres from the machinery, and a light curtain about two metres away. The factory did not have so much space, nor was it realistic. The solution became instead vertical sliding safety barriers.

Stopping time and Machine Diagnosis Tool

Smart



Approvals:

CE

Smart shows graphs/values for:

- Stopping time
- Stopping distance
- Speed
- Position of stopping signal

Features:

- Easy to use
- Measurements with or without electrical connection
- Ideal for machine performance diagnosis
- Calculation of correct safety distances

Smart is ideal for safety supervision and for diagnosis of machine operation

Smart has many valuable features for machine diagnosis:

- Graphic presentation of measurements
- Easy to analyse stopping characteristics and movement
- Gives parameters for safety design (e.g. stop time)
- Calculates minimum allowed safety distance
- Shows how the stop distance can be optimised
- Electrical reaction time and mechanical/hydraulic breaking can be identified and analysed
- Digital in/out signals and analogue inputs

Smart is perfect for periodic monitoring of safety parameters and other conditions for the maintenance and trouble-shooting of machines. Because Smart can compare old and new graphs, it becomes easy to find out the reasons for machine malfunctions. One can also supervise machines during operation and compare how they perform over time.

Stopping units and sensors

Smart is a further development of our well established JSSM1 Stopping Analyser. All the stopping units and sensors for the JSSM1 can also be used with Smart. The amount of connection possibilities have also increased. Smart has 9 digital I/O, one input for an incremental sensor (for position and speed) and two analogue inputs. This makes it easy to measure sequences in conjunction with motion lapse and other analogue values.

Webbsupport - Smart

On our web site http://customer.jokabsafety.com we have a special page for you as a Smart customer. Here you can keep up to date by downloading the latest version of Smart Manager, manuals, drive routines or read the FAQs.

Smart Manager

Smart is controlled in real time by a computer using the Smart Manager program. This performs measurements, and the measured data can be saved and analysed. The measurements are saved in an SQL database, with the ability to export data to Microsoft Excel if necessary. The program calculates the stopping time and protective distance, and can print out the results, together with a graph of the event sequence. Smart Manager is available in several languages: English, Swedish, Danish, German, French, Czech and Polish. Translation into other languages can easily be arranged as necessary. The program is free, and is available for downloading from our web site when purchasing equipment to measure stopping times.

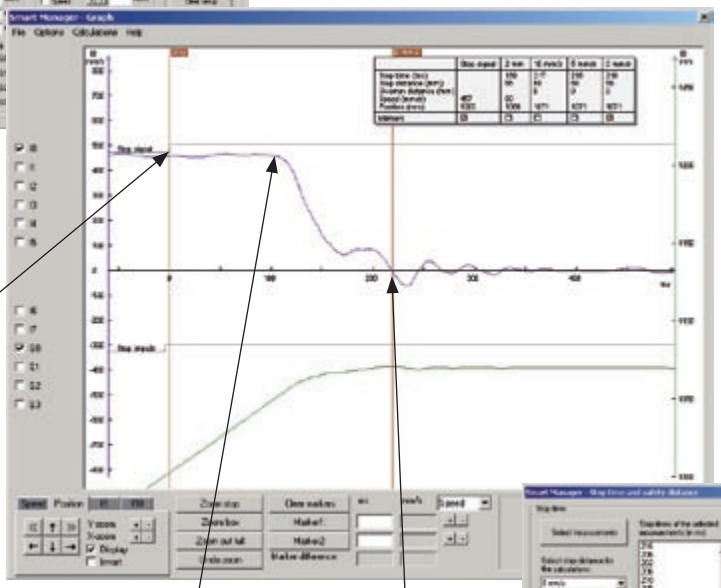
Benefits:

- Simple program structure
- Shows the entire stop sequence
- Provides a machine movement "fingerprint"
- Compares measurements
- Calculates stopping time
- Saves measurements to a database
- Exports measured data to Excel
- Prints out a complete measurement report

Start menu

Measuring form

- *Current values from sensors and the system*
- *Start conditions*
- *Stop signal conditions*
- *Shutdown conditions*
- *Measuring settings can be saved*



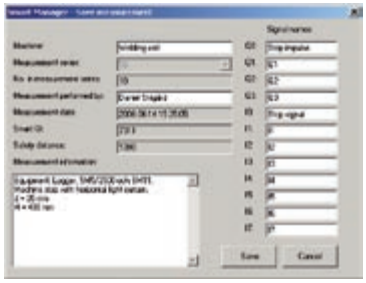
Measured result

- *Stop time data*
- *Zoom control*
- *Own cursors*

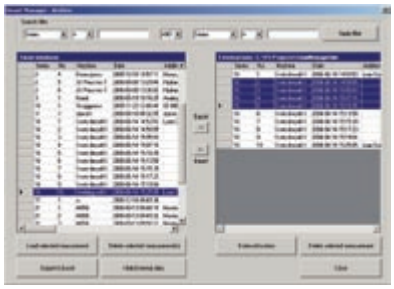
Calculations

- *Min., max. and average value and standard deviation from a series of measurements*
- *Protective distance can be calculated*

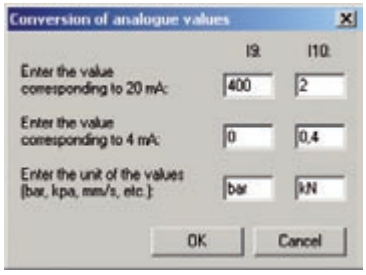
System requirements
Windows XP/2000/Me/NT
100 MB free disk space



Saving
- *Select measurement series*
- *State extra information, e.g. the conditions and special circumstances for the measurements.*



Archiving
- *Search filter*
- *Saved measurements*
- *Exported measurements*



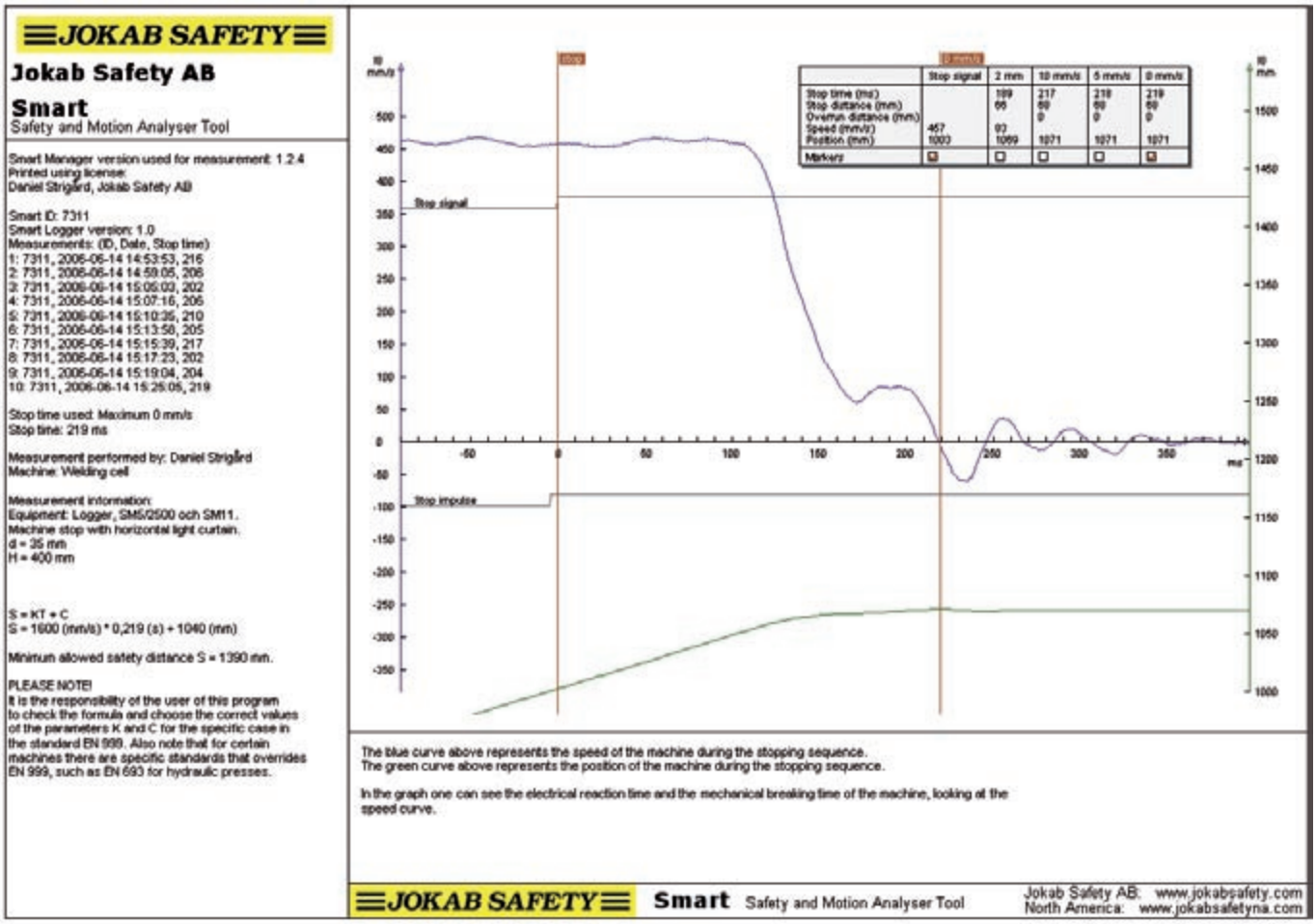
Conversion of analogue signals

Smart can measure and show graphs for two different analogue sensors at the same time, with its inputs for 0/4-20 mA. Conversion of the measured current values can be done automatically by setting minimum and maximum values and the units for the inputs. In this way, for example, the results from an analogue pressure sensor can be shown and calculated as 0-400 bar instead of 4-20 mA, or an analogue load cell as 0-2 kN. This also means that if it is desired for the system to be triggered at a certain force, that force can be defined instead of needing to calculate the equivalent current value.

Printout

Printing out is one of the most important functions of the program. Here is shown all the vital information about the measurements that is needed for such items as annual checking or providing the basis for CE labelling of a machine. Since the entire measuring sequence is shown in graphical format, one can understand why the stopping time has a certain value and also, in some cases, see what needs to be done to minimise the stopping time. The graph also acts as a kind of “fingerprint" of the machine movements, which means that different measurements can be compared with each other to see how the stopping sequence varies from time to time, or from year to year. In this way the effects of e.g. worn brakes or the effect on the machine control system can be seen. In order to get a complete basis from a measurement it is also important to state what assumptions have been made and what conditions applied when deciding when and how the stop signal was given.

Among other things, the stop signal details the person measuring, the measuring equipment, the machinery, the calculations and the protective distance. The printout also has a replaceable company logo and a field for extra information.



Smart and accessories

Smart Logger

The Smart Logger is the principal unit for data collection. The logger has a USB connection to the PC and 8 off M12 connections: one for the power supply to the I/O, one connection for an incremental sensor, two connections for analogue sensors and four connections for other I/O signals.
The Logger encapsulation is watertight, with M12 connections to prevent the entry of particles and fluids in the workshop environment. To prevent the Smart Logger from being damaged by incorrect currents and voltages from external equipment, all inputs and outputs, and external units, are electrically isolated from the processor in the Smart Logger by means of opto-couplers.

Manufacturer:	ABB AB/Jokab Safety, Sweden
Article number/Ordering data:	2TLJ070300R0100 Smart Logger
Dimensions:	62 x 220 x 80 mm. (wxhxd)
Weight:	0.5 kg
Protection class:	IP 67
Supply voltage:	24 VDC
Response speed:	max 1 ms
Positional accuracy:	+/- 0.1 mm
Digital I/O:	8 inputs, 4 outputs (NPN OC)
Analogue inputs:	2 off, 0/4-20 mA
Encoder:	1 connection for a pulse sensor

SM2 Button unit

The SM2 is used in conjunction with the Smart Logger for measuring with a manual stop impulse, without an electrical connection to the machine. When an SM2 is, for example, pressed against an emergency stop button to stop the machine, the SM2 sends a signal to the Smart Logger to start the measurement. An LED on the SM2 lights when the desired stop position is reached. The SM2 is connected to the Smart Logger by an M12 connection.

Manufacturer:	ABB AB/Jokab Safety, Sweden
Article number/Ordering data:	2TLJ070300R0200 SM2 Button unit
Dimensions:	Size: 50 x 100 x 25 mm. (wxhxd)
Weight:	0.2 kg
Application area:	Two-handed control unit, Emergency stop, etc.
Supply voltage:	Fed from the Smart Logger

SM3 Relay unit

The SM3 is used in conjunction with the Smart Logger for automatic stopping time measurements at the set position, or alternatively a manual stop pulse. When a stop signal comes from the Smart Logger a relay switches in the SM3.
The SM3 then sends a signal to the Smart Logger to start measuring, and also activates the relay outputs to stop the machine. The relay in the SM3 is reset via the software when a new measurement is to be made. The SM3 is connected to the Smart Logger by an M12 connection.

Manufacturer:	ABB AB/Jokab Safety, Sweden
Article number/Ordering data:	2TLJ070300R0300 SM3 Relay unit
Dimensions:	85 x 72 x 49 mm. (wxhxd)
Weight:	0.2 kg
Application area:	Electrical connection providing a stop pulse.
Supply voltage:	Fed from the Smart Logger
Relay outputs:	2 NO, 2 NC, 6A/250 VAC.
Encoder:	1 connection for a pulse sensor

SM11 Flag unit

The Smart Logger is used in conjunction with the SM11 for automatic measurements of the stopping time and stopping distance. The unit is located in a light curtain with the flag parallel to the beam. When the flag is activated, the light beam/light curtain is interrupted, and the machine stops. The SM11 is connected to the Smart Logger by an M12 connection.

Manufacturer:	ABB AB/Jokab Safety, Sweden
Article number/Ordering data:	2TLJ070300R1100 SM11 Flag unit
Dimensions:	145 x 85 x 37 (wxhxd). Shaft ø3 x 45 mm
Weight:	0.6 kg
Application area:	Ligh curtain, light beam
Protection class:	IP 40
Batteries:	10 rechargeable 1.2 V NiMH batteries. Total 12 V
Power:	Max 1200 mAh (approx. 200 operations).
Temperature:	0 to +45°C.
Installation:	On a table or a standard ¼" camera tripod
Charger:	SM14

SM5 1250/2500 Linear sensor

The SM5 is an incremental pulse sensor for connection to a Smart Logger. The sensor is protected by a robust enclosure. The sensor and end of the cable are secured to the machine by powerful magnets. The SM5 is connected to the Smart Logger by an M12 connection.

Manufacturer:	ABB AB/Jokab Safety, Sweden
Article number/Ordering data: SM5/1250: SM5/2500:	 2TLJ070300R0400 Linear sensor 2TLJ070300R0500 Linear sensor
Dimensions:	SM5/1250: 106 x 88 x 100 mm (wxhxd) SM5/2500: 114 x 125 x 116 mm (wxhxd)
Weight:	SM5/1250: 1 kg SM5/2500: 1.4 kg
Application area:	Linear movement, e.g. press tools
Supply voltage:	Fed from the Smart Logger
Max length:	1250 or 2500 mm
Max speed:	5 m/s
Resolution:	0.1 mm

SM7 Rotation sensor

The SM7 is an incremental sensor for connection to a Smart Logger. The sensor detects rotational movement via a wheel rolling against a shaft. The stand secures the sensor with the aid of just one knob. The stand itself is secured to the machine by a powerful magnetic foot. The SM7 is connected to the Smart Logger by an M12 connection.

Manufacturer:	ABB AB/Jokab Safety, Sweden
Article number/Ordering data:	2TLJ070300R0700 SM7 Rotation sensor
Dimensions:	Sensor size: 46 x 40 x 59 (wxhxd) Stand size: Extended, approx. 400 x 50 x 90 (wxhxd)
Weight:	1.7 kg including stand
Application area::	Rotating motion, e.g. lathes, rollers
Supply voltage:	Fed from the Smart Logger
Max speed:	5 m/s
Resolution:	0.1 mm
Wheel circumference:	125 mm

SM13 Battery pack

SM13 is a battery pack for the Smart Logger, which makes the Smart a completely mobile measuring tool. With the SM13 you don't need to connect the Logger to a wall socket for power, and can easily move it from one machine to another when you are measuring. Since the SM13 battery pack is the same physical size as the SM11 flag unit, it fits snugly into the SM9 carrying case. The charger for the SM13 is called the SM14 and provides a charging time of about 3 hours 15 minutes (2100 mAh). The SM14 also acts as afast charger for the SM11.

Manufacturer:	ABB AB/Jokab Safety, Sweden
Article number/Ordering data:	2TLJ070300R2300 SM13 Battery pack
Dimensions:	145 x 85 x 37 mm (LxWxH)
Weight:	0.8 kg
Protection class:	IP 40
Connector:	Negative pole at the centre of the charging connector
Current rating:	Maximum 0.9A
Power:	2100 mAh. With normal use lasts about 10-12 hours. (Higher capacity on request.)
Batteries	20 rechargeable 1.2 V NiMH batteries of size AA(R06). Total 24 V

SM9 Carrying case

The SM9 is a practical carrying case with pockets to suit the various Smart units. Part of the protective foam insert in the lid of the case can be removed to make room for a laptop computer, so that all the equipment required can be carried in a single case.

Manufacturer:	ABB AB/Jokab Safety, Sweden
Article number/Ordering data:	2TLJ070300R0900 SM9 Carrying case
Dimensions:	535 x 155 x 430 mm (LxWxH)
Weight:	3.5 kg

Other accessories

Name	Article number	Description
SM6	2TLJ070300R0600	AC/DC converter for Smart
SM14	2TLJ070300R2400	Charger for flag unit SM11 and battery pack SM13.
USB cable	2TLJ070300R1500	USB cable for communication with computer
Extension cables	2TLJ020056R2000, 2TLJ020056R2100, 2TLJ020056R2200, 2TLJ020056R2300 and 2TLJ020056R2400	ABB Jokab Safety's extension cables with 5 conductors ideal for all Smart accessories