Figure 1: Speed measurement system

- **Measures speed**
- **Generates T0 trigger**
- **Measures the braking distance**
- **Records position and speed history after T0**

Impact Analyzer

The Impact Analyzer is generally used for sled tests. It consists of 3 components: the raster, the laser unit and the PCMCIA plug-in card as an interface between the PC and the laser unit. The statuses of the lasers are transmitted via a PCMCIA interface to the PC of the system controller and analyzed there to determine the speeds. When used in a MESSRING facility the laser unit is connected to the system's controller cabinet for the power supply and for the connection to the PLC. This allows to actuate the trigger manually. The connections “RS485” are connected via the PCMCIA adapter card to the facility control PC in the control room to analyze the flanks of the laser beams for the speed measurements.

Application (hydro-sled system)

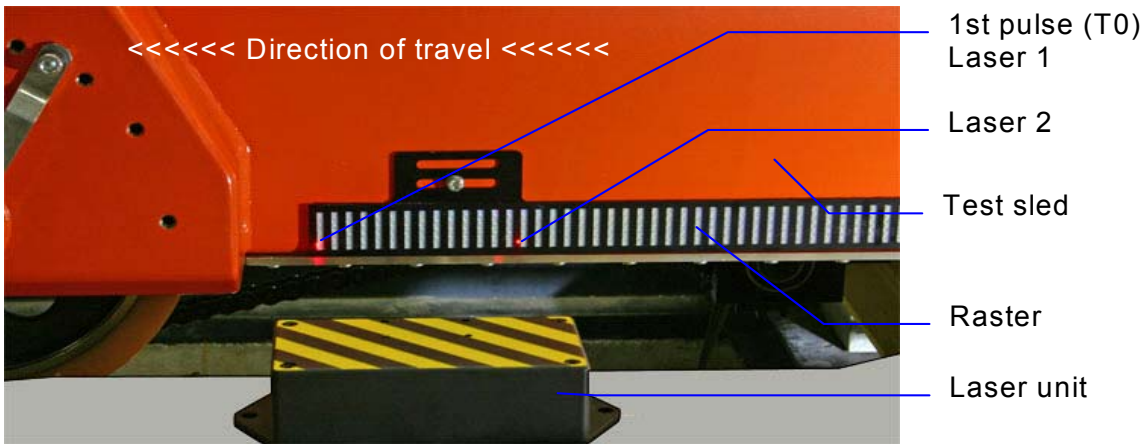

Figure 2: Speed measurement system

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Trigger signal T0

The trigger is actuated by the first flank (change from bright to dark) of laser 1 (in direction of travel at the brake end). This T0 trigger then connects for 1 second to the outputs Trigger 1, 2, 3. In response to every subsequent flank to laser 1 the trigger output is again activated for 1 second. The statuses of the trigger outputs are displayed by the green trigger status LED on the laser unit. To check the trigger behavior of all the participants connected in the trigger distribution the trigger can also be manually actuated via the facility control system. In this case the PLC generates a so-called force trigger signal to terminal 1_4. The trigger signal is then put out as a "real" trigger event to the outputs “Trigger out” 1, 2, and 3.

Speed before T0

For speed measurements 10 pulses of laser 2 are analyzed which occur before the recording of the T0 signal by laser 1. These pulses are transmitted via a PCMCIA card to a PC where they are analyzed.

Behavior after T0

The history of speed and position is still of interest after the sled impact. This history is recorded and analyzed with a pc by analyzing the pulses of both lasers. The analysis also considers the direction of travel.

Input and output circuit of the trigger unit

Power supply	24V DC (< 300 mA),
Force Trigger	Power input 14…30V DC from the PLC switches the outputs “Trigger out” 1, 2, and 3 to test the trigger loop if there is no signal from laser 1.
Trigger PLC	Transmits the trigger signal to the Programmable Logic Control (PLC) and hence to the system controller
Trigger out 1, 2, 3	Switch outputs decoupled via an optical coupler with shared monitoring LED (trigger active).

Outputs RS485

The flanks of the lasers are put out at the outputs RS485 A and RS485 B. Output A is connected with Input 1 of the PCMCIA plug-in card in the PC of the facility control system. Output B is connected with input 2.

Technical Data

Laser Sensors	
Color	670 nm, visible, red
Focus	400 mm ±10 mm (in front of the outlet)
Messzyklus	15 µs
Delay	<35 µs
Width of spot (laser beam)	<1 mm (in an area from 50 up to 1.000 mm)
Distance of laser beams (center)	137,5 mm
Jitter	15 µs
Geometric error	< ± 0,1 mm repeatability ± 0,5 mm width of spot (laser beam)
PCMCIA-Card	
Input	4 x RS4856
Measuring cycle	100 ns ±20ppM@10…50°C
Raster	
Length	1.000 mm
Dimensions, Raster	10 ± 0,2 mm
Width of reflection	4,5 mm
Overall allowance	< ± 0,4 mm@21°C
Spot width (laser beam)	<1 mm*
Speed measurement, resulting overall error	
At 10km/h	± 15,1 µs jitter (0,03%), ± 0,1 mm sensor (0,07%), ± 0,25 mm raster (0,18%), ± 0,002% clock= **±0,3%***
At 50km/h	± 15,1 µs jitter (0,15%), ± 0,1 mm sensor (0,07%), ± 0,25 mm raster (0,18%), ± 0,002% = **±0,4%***
At 80km/h	± 15,1 µs jitter (0,24%), ± 0,1 mm sensor (0,07%), ± 0,25 mm raster (0,18%), ± 0,002% = **±0,5%***
Position measurement	
Overall error, resulting	± 1 mm error of laser beam, ± 0,5 mm sensor, ± 0,4 raster, ± 1 digit (=2,5mm) ≤ **± 5mm**
T-Zero	
Overall error, resulting	± 1 mm uncertainty of raster in position, ± 35 up to 50µs delay for the second laser
Resolution	± 2,5 mm (caused by angular phase shift of 90°)

* Allowance of the average velocity during the last 140 mm before the impact. Variation of temperature at the raster may cause an additional error of ± 0,0012 %/°C.

Housing	
Dimensions (WxDxH)	234x106x57 mm
Distance of mounting bores	234 mm

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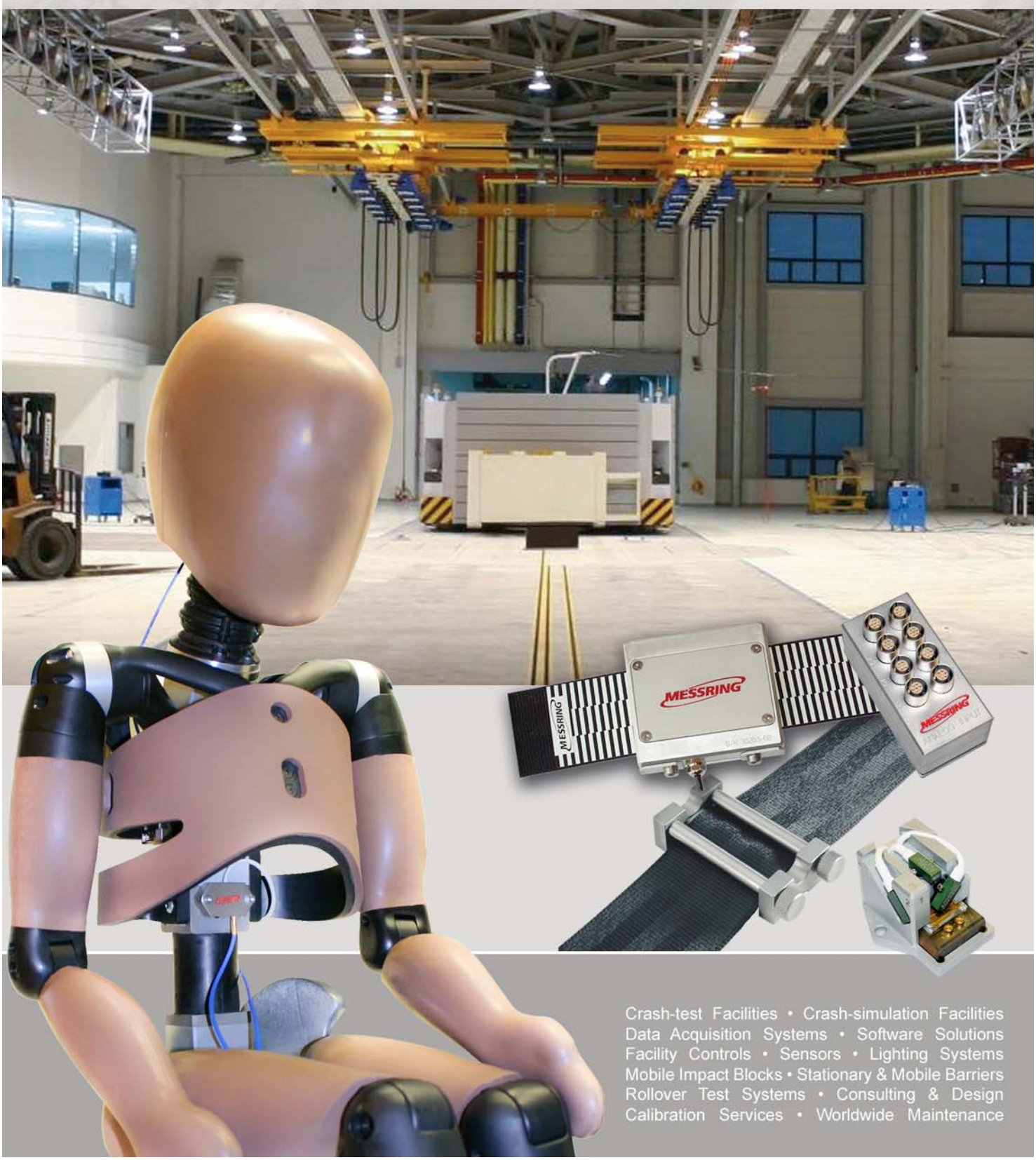

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