



1 Tunnel surfaces or objects infringing the gauge profile are recorded and identified.

2 HSP is a robust encapsulated measurement system for mobile applications. A semi-automatic cleaning unit can be added.



## HIGH SPEED PROFILER HSP

### Measuring geometrical changes of structure gauge

Shifting ballast beds or objects infringing the clearance profile pose hazards for rail vehicles. Railroad operators have to carry out inspections regularly to avoid rail vehicles being obstructed or being put at risk. The High Speed Profiler HSP records clearance profiles fast and non-tactile. The optical system provides three-dimensional data in real time using the track's center line as reference. Tunnel surfaces or objects infringing the gauge profile are recorded and identified by software. Thus, maintenance teams receive very detailed information on the infrastructure.

### Two laser modules per sensor head

The HSP sensor head comprises two distance measuring systems: High-frequency modulated laser beams are deflected by one rotating mirror on the surroundings.

A collecting lens focuses the returning light on two detectors. The HSP is based on phase measurement for determining the distance. The exact position of each measurement point is calculated from the distance value and angle of the scanning mirror. A complete profile is derived from the mirror's rotational movement, the inspection car's motion provides a third dimension. With a rotation speed of up to 277 revolutions per second and a sampling frequency of 1 MHz each beam measures 3,600 distance values per rotation. In this manner 554 profiles per second are measured by one sensor head. They are processed and displayed by a dedicated computer inside the inspection car before transferring the data to the inspection car's PC network.

### Robust housing

The sensor head features a hermetically sealed housing facilitated by its fixed optical

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window. A cover protects the head against dirt or vandalism, if not in operation. It is combined with a semi-automatic cleaning system for the optical window allowing to easily regain full accuracy after extended operation periods in dirty environment. Interface requirements on the carrier are minimal. The HSP design is in accordance with EN 60825-1:2001-01.

### Modular Design

Several sensor heads can be arranged at the vehicle's front covering extreme speed and resolution requirements. For instance, a system consisting of

three heads yields one clearance profile every 17 mm at 100 km/h. The data can be compensated by an additional track alignment and compensation system.

### Complete solution

Fraunhofer IPM installs the profile scanner on site and provides training of the operators. Delivery includes a supply unit as well as an industrial PC which stores and processes the data automatically. The data can be transmitted to a network via TCP/IP. The High Speed Profiler HSP is eye-safe according to IEC60825.

- 3 Image based on profiles taken with HSP, analyzing the clearance.
- 4 HSP (system with two sensor heads) mounted on the Deutsche Bahn inspection train LIMEZ III.

### Technical Specifications

**CLASS 1  
LASER PRODUCT**

Measurement range	1.5– 10 m
Distance resolution	about 1 mm
Intensity resolution	12 bit
Uncertainty at an object reflectivity of 90 %	3 mm at 5 m ( $\sigma$ -value)
Uncertainty at an object reflectivity of 10 %	7 mm at 5 m ( $\sigma$ -value)
Scanning angle	$\approx 350^\circ$
Scanning speed	277 revolutions per second
Profiling speed	554 profiles per second
Measurement rate	2 x 1 million measurements per second
Number of measurements per profile	3,600 corresponding
Point distance at 5 m	8.7 mm
Profiling density at 50 km/h	one profile each 5 cm
Ambient temperature	-20 °C to + 70 °C (in operation; temperature control included)

All specifications and features are subject to modification without notice.

### Railway Measurement Technology at Fraunhofer IPM

Fraunhofer IPM develops optical measuring systems for monitoring the condition of rail infrastructure. Experts in measuring techniques and optics, designers, electrical and software engineers work together on supplying turnkey solutions for the special requirements of infrastructure operators and providers of surveying services. The robust measuring systems are deployed throughout the world and are characterized by their speed, precision and reliability. Other railroad measurement systems made by Fraunhofer IPM:

- Clearance Profile Scanner CPS
- Contact Wire Recording System CRS
- Laser Pole Detection System LPS
- Wire Wear Monitoring System WWS
- Sector Profile Scanner SPS
- Rail Track Scanner RTS