

High Speed Profiler

Measuring geometric changes of structure gauge

The HSP laser scanner can be mounted on mobile platforms. The sensor head contains two laser modules for highly precise geometrical measurements.

Shifting ballast beds or objects that obstruct the clearance profile pose a hazard to rail vehicles. To avoid risks, railroad operators must perform regular inspections. The High Speed Profiler (HSP) by Fraunhofer IPM records clearance profiles fast and non-contact using two laser modules per sensor head.

Infrastructure data in real time

The HSP records tunnel surfaces and identifies objects that obstruct the gauge profile. The optical system provides three-dimensional data in real time, using the center line of the tracks as a reference. Maintenance teams use the very detailed information to assess railway infrastructure condition.

Two laser modules per sensor head

The HSP sensor can be mounted on the front or back of the inspection car. Its sensor head contains two distance measuring systems. High-frequency modulated laser beams are deflected onto the surroundings by a rotating mirror. A collecting lens focuses the returning light onto two detectors. Phase shift technology is used to determine the distance. The exact position of each measurement point is calculated based on the distance value and the angle of the scanning mirror. A two-dimensional image is derived from the mirror's rotational

movement; the inspection car's motion provides the 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. This totals 554 profiles per second for each sensor. A dedicated computer inside the inspection car processes and displays the data before transferring it to the inspection car's PC network.

Robust housing

The sensor unit has a fixed optical window and is located in a hermetically sealed housing, which protects the sensor head from dirt and vandalism when not in operation. The sensor unit is combined with a semi-automatic cleaning system for the optical window, making it easy to regain full accuracy after operation in a dirty environment. The interface requirements on the carrier are minimal. The HSP design complies with EN 60825-1:2001-01.

Railroad measurement systems by Fraunhofer IPM

Fraunhofer IPM develops optical measurement systems for monitoring and mapping rail infrastructure. Experts in optics, system designers, and electrical and software engineers work together to supply turnkey solutions for the special requirements of infrastructure operators, planners, and providers of surveying services. The robust measurement systems are used around the world and are characterized by their speed, precision, and reliability.



Left: Image based on profiles taken with the HSP to analyze clearance.

Right: The two sensor heads of the HSP mounted on the Deutsche Bahn GMTZ inspection train.

Modular design—complete solution

Several sensor heads can be arranged at the front of the vehicle to cover extreme speed and resolution requirements. For instance, a system consisting of three heads produces a clearance profile every 17 mm at 100 km/h.

Fraunhofer IPM installs the HSP on-site and provides operator training. The delivery includes a supply unit and an industrial PC that automatically stores and processes the data. The data can be transmitted to a network via TCP/IP. The HSP is eye-safe according to IEC 60825.

Technical specifications

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 (σ -value)
Uncertainty at an object reflectivity of 10 %	7 mm at 5 m (σ -value)
Scanning angle	$\approx 350^\circ$
Scanning speed	277 rev./s
Profiling speed	554 profiles/s
Measurement rate	2×1 million measurements per s
Number of measurements per profile	3,600 corresponding
Point distance at 5 m	8.7 mm
Profiling density at 50 km/h	one profile every 2.5 cm
Ambient temperature	-20°C to 70°C (in operation; temp. control incl.)

All specifications and features are subject to modification without notice.

CLASS 1
LASER PRODUCT

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