



KISTLER

measure. analyze. innovate.

Weigh-In-Motion

Lineas®
WIM Sensor
with
Quartz Technology

Lineas[®] – WIM technology for traffic on the go

When it comes to monitoring road traffic loads, attention is now increasingly focused not only on gross vehicle weight but also on axle and wheel load. The authorities have an appropriate interest in detecting vehicles with excessive axle loads.

Road damage caused by overloaded trucks

Heavy vehicles – and trucks in particular – impose a burden on the road infrastructure, as there is an exponential relationship between axle load and road damage. While the main factor affecting road repair and maintenance requirements is the number of trucks, trucks with axle loads higher than the legal limit cause a disproportionately high percentage of the damage to the infrastructure. Furthermore, overloading – whether of one or more axles or the whole vehicle – is also likely to have an adverse impact on traffic safety.

Statistics

The statistics provided by Lineas include the number of vehicles per hour, the classification of vehicles, whether they are empty or fully loaded, the number and spacing of axles, the speed of the vehicles and the intervals between them.

Overload detection

- Pre-selection
A WIM station a few kilometers ahead of the static scale monitors all vehicles. Overloaded trucks are diverted from the road for inspection and static weighing.
- Weight Enforcement
The weight limits are enforced by means of high speed WIM, including video/still cameras.
- Bridge & Construction Protection
Overweight vehicles are prevented from crossing limited capacity bridges. The measures can be combined with video/still cameras for law enforcement purposes.

Toll roads

The system is used to measure vehicles for a weight-based toll. In future, the toll will depend on the road-user charge – i.e. by weight – rather than by classification. A fully loaded truck will be charged more than an empty truck, since it subjects the infrastructure to a much higher degree of wear.

Road research

The system is used to conduct research into the effects of traffic on the pavement.

Pavement management system

The decision-making process is designed to help the authorities to prevent pavement problems through judicious maintenance, as well as to diagnose and repair damages in a timely and cost-effective manner.

The system consists of a comprehensive database and historical information on pavement condition, structure and traffic, combined with a set of tools to determine existing and future pavement conditions, to predict financial needs, and to identify and prioritize pavement preservation projects.



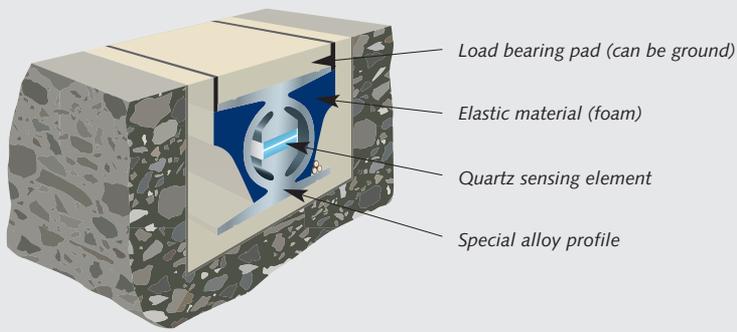
Lineas[®] quartz crystal sensor

The Lineas is a rugged, reliable, maintenance-free quartz sensor, ensuring precision, stability and long life, as well as covering all speeds from walking pace to motorway driving.

Easy installation, high accuracy, long stability

The Lineas is the only sensor that can be ground flush if the pavement becomes cracked or rutted. Thanks to its modular design, the Lineas is easily adapted to the width and surface of the road.

☐ Sensor cross-cut



How does the Lineas[®] sensor work?

A wheel rolling over the Lineas applies vertical forces to the quartz crystals in the sensor, with virtually no deformation. The piezoelectric quartz discs yield an electrical charge proportional to the forces applied. The piezoelectric sensitivity is virtually independent of temperature, time and speed. The electric charge signals are converted by a charge amplifier into exactly proportional voltages that can be further processed as required.

The Lineas sensor performs to the highest accuracy from the glacial cold of Iceland to the hot desert of Qatar, from the Swiss Alps to Florida. As the temperature dependence is negligible with less than 1 % for a temperature range of 50 °C, a calibration once a year is often sufficient and this saves the operator time and money. Since the sensor is fully bonded with the pavement, it cannot be dislodged and no extra maintenance is required. This is an important safety factor.

The accuracy of the measured wheel load is not influenced by tire type, tire quantity or tire pressure. In the case of dual tires, the Lineas measures one signal and expresses it as one wheel load, which is equal to the sum of both wheel loads.

The accuracy of the measurement is not affected by truck or car tires with normal tread patterns.

☐ Lineas[®] signals



☑ Lineas[®] Features

Accuracy

- + Solid-state quartz sensor – i.e. no signal drift
- + Decoupled from lateral forces – i.e. no ghost axles appear
- + Uniform sensitivity – i.e. independent of travel pass
- + Negligible temperature influence – i.e. less than 1 % for a temperature range of 50 °C
- + Wide measuring range – i.e. bikes can be weighed as accurately as heavy vehicles
- + Capable of measuring at any speed – i.e. from walking pace to motorway driving

Durability

- + Quartz has absolutely stable electrical and mechanical properties – i.e. no problems with fatigue or aging

Installation

- + Quick and easy installation on the road – i.e. no heavy machinery required

Maintenance

- + Lineas is the only sensor that can be ground flush in the event of cracking or rutting of the pavement

Flexibility

- + Modular design: 0,75 m & 1,00 m lengths adapt to every road width
- + Elastic properties closely match those of road surfacing materials

Safety

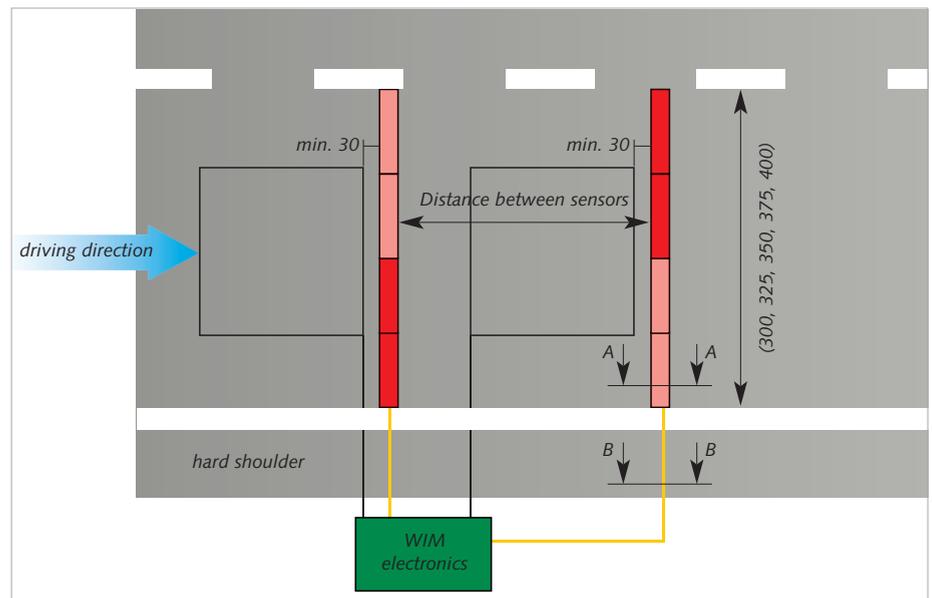
- + Stable securement in the road – no need for screws or bolts

☛ For more product information, please review data sheets for Types 9195E, 5153A or 5038A2Y43

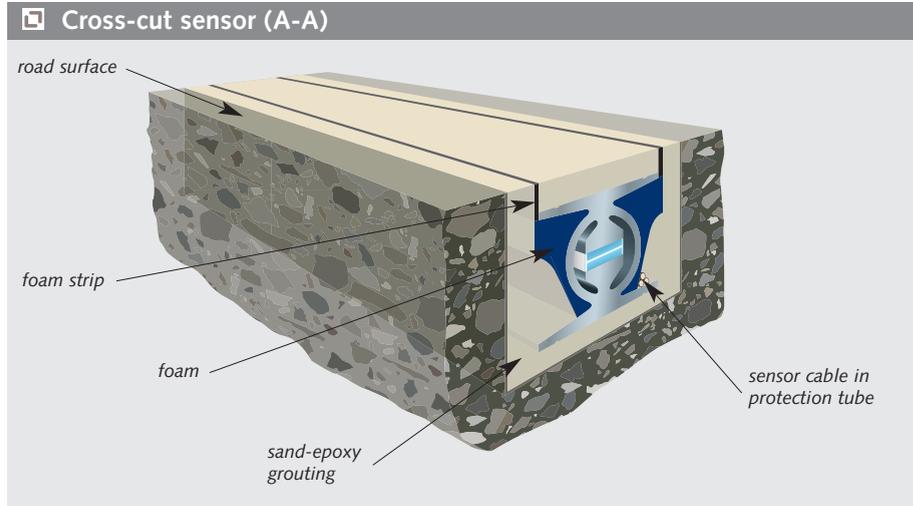
Layout of a WIM station

The Lineas sensors come in lengths of 0,75 m and 1,00 m, so that they can be combined to cover the full width of a lane or of a road. Typically, four sensors cover one lane, while two Lineas sensors are usually connected in parallel as a single channel in advance of the charge amplifier. This kind of connection allows separate measurements of left and right wheel loads.

Standard WIM system – 2 rows of 4 Lineas

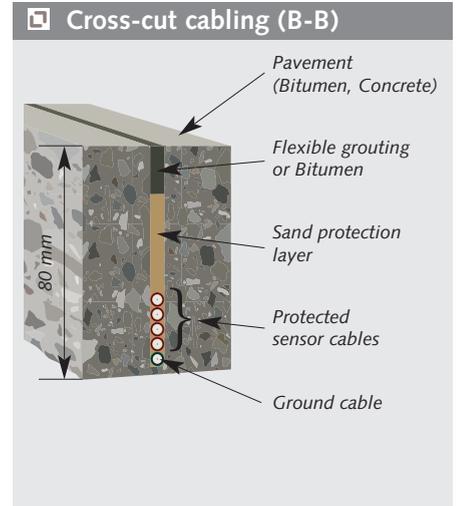


█ Lineas sensor
 Inductive loops
 — Sensor cables
 All dimensions in cm



Cross-cut sensor

The sensor surface has a 10 mm thick topcoat made of the same material as the grout. As the sensors are fully embedded in the grout and held securely in place without screws or other mechanical means, no extra maintenance is needed.



Cross-cut cabling

A 7 mm or 8 mm wide slot with a minimum depth of 80 mm is cut into the pavement. The sensor cables are then laid in the slot. They must be held in position by a joint filler or similar material before the cable slot is filled with a flexible grouting compound or bitumen.

Installation of a WIM station

The installation of Lineas WIM sensors is fast and easy, requiring just a few steps. Depending on the ambient temperatures, the lane is usually closed for just 6 to 8 hours. The only heavy machinery needed is the pavement cutter or milling machine.

Kistler trains and supervises the installing engineers until they are ready for Kistler certification.

Calibration

Once the sensors and equipment have been installed and connected, the site can be calibrated after a minimum of 3 days.



Commissioning

Once the results of the calibration fall within the required limits, the functioning of the system is fully checked. If everything works in accordance with the specifications and requirements, the system can be handed over to the end user.

Operation

At this stage, the system is monitoring, collecting and transferring data according to the requirements.

Maintenance

Kistler recommends regular inspection of the sensors and the surrounding pavement and equipment.

Cutting the pavement

The pavement, whether of bitumen or concrete, needs to be cut or milled. Dry cutting is recommended. The cut must be made to a depth of 55 mm and a width of 72 mm.



Cleaning the slot

The pavement between the cuts has to be removed to create a slot of 55 mm by 72 mm. The slot must be dry and free of loose material before grouting is carried out.



Mounting the sensor

Lineas sensors must be assembled into a row in a clean and dry environment. This is usually done in a workshop, warehouse or other building.



Grouting

The Kistler grout should be thoroughly mixed and then poured into a slot that is dry, clean and straight.



Setting the sensor row

The assembled sensor row is lowered into the grout carefully. Any excess grout is then wiped off and weights are placed on the sensors to hold the row in place.



Grinding

After the grout has completely cured, the sensor surface and grout require grinding in order to leave a finish that is completely flush with the surrounding pavement.



Reliable measurements worldwide

Statistics

WIM statistics are obtained for provincial roads in the Netherlands. The data is transferred by GSM.

Only one tire is measured and it is assumed that the load is evenly distributed within the same axle.



Provincial Roads, Netherland

Statistics and pre-selection

There are two rows of Lineas sensors in each direction inside the Gotthard tunnel to monitor all south- and northbound vehicles. Vehicles are then weighed downstream on static scales. Enforcement is then a matter for the authorities.



Gotthard Tunnel, Switzerland

Tolling

The Shadow Toll System on the M1-A1 motorway link operates under a concession awarded to a private contractor for an agreed period of time on a DBFO basis (Design, Build, Finance and Operate).

A special feature of the system is that the Administration will pay the contractor on an annual basis, depending upon the volume of traffic using the road. The term "shadow tolling" is used as there are no physical tollbooths and the users do not actually pay charges to the operators.



A1 Yorkshire Link, England

Pre selection

Heavy vehicles are taken off the highway and measured at the WIM station. A green light indicates "return to the highway", while a red light means that the vehicle has to be reweighed on the static scale, followed by any necessary enforcement measures.



Abu Samra, Qatar

Road research

Two extra lanes beside the actual highway have been fitted with Lineas sensors for pavement testing. At certain times the traffic is re directed to measure the pavement loads, as well as other traffic and construction data.



Incheon, Korea

High speed weigh-in-motion

All vehicles coming out of Nagoya harbor are weighed dynamically with a high degree of accuracy, regardless of their speed, to see whether they are overloaded. The vehicles are classified simultaneously.

The results clearly show that the end-user's requirements are being fully met.



Highway Route 23 at Nagoya, Japan

Bridge protection, enforcement

The Loschwitz bridge in Dresden was built between 1891 and 1893 and from its color it is known as the "blue wonder".

The bridge is open to trucks of up to 15 tons gross vehicle weight and to cars and buses of all kinds. Heavier vehicles are not supposed to cross the bridge but, in the past, the ban was often ignored. For this reason, the city authorities installed an automatic WIM station in September 1999 to protect the bridge against overloaded vehicles. Heavy vehicles which are not authorized to pass the bridge are diverted. If such a vehicle fails to follow the diversion but heads for the bridge, it is captured on video and gets a fine.

This WIM station helps the city to avoid expensive maintenance and repair costs.



Loschwitz Bridge, Dresden, Germany

Traffic management

The N18 between Arnhem and Enschede is a national road connecting the south of the Netherlands with the north.

The weight of loaded trucks travelling south or north on the N18 is measured dynamically about 200 m before they reach the traffic lights. Trucks with a gross vehicle weight of 10 tons or more are given priority. The priority is defined by the system software to leave the green light on for longer until the truck passes the crossing. If the light is at red when a heavy truck rolls over the WIM station, it will turn to green earlier to allow the vehicle to pass through without interruption. At a distance of 300 m there is another controller which is networked with the first one.

As there is another priority system for the emergency services, a vehicle of 10 tons or above which triggers a green light phase can be stopped to allow an emergency vehicle through.



N18, Netherlands

Company profile

Kistler is a privately owned Swiss company which develops and manufactures sensors and electronics for measuring pressure, force and acceleration.

Innovative technologies, established process expertise, customized solutions and comprehensive user support are the solid foundations on which Kistler's growing reputation as a world leader in measurement and instrumentation is built.

measure. analyze. innovate.

The Kistler baseline is our commitment: Our core strengths are the development, manufacture and use of sensors to **measure** physical properties. Kistler system technology and expertise enable the signals from our sensors to be **analyzed**. And finally, the process know-how enables our customers to **innovate** with their products and out-perform their competitors.

Successful research

Research and development enjoys top priority at Kistler, supporting the company's ability to develop world firsts. For example, the first quartz force sensor in the world, the first high-temperature pressure sensors, the first triaxial force sensors and automatic sensor identification all came from Kistler. And there will certainly be more revolutionary developments to come!

Kistler today

Today, the Kistler Group employs over 600 people in 18 group companies around the globe. Our skilled workforce is the foundation of our worldwide reputation.

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