



KISTLER

measure. analyze. innovate.

**Flexible to create
and easy
to integrate.**

Get Better. With Kistler.

Weigh-in-Motion

Measuring equipment for a wide variety of traffic data collection, enforcement and toll collection applications.



Traffic data collection

You Don't Lose a Pound.

Collecting a wide range of traffic data in real time will provide you with a comprehensive overview of the traffic flow. This will help you to design new roads and bridges, optimize road maintenance, increase traffic safety and improve the traffic flow. The Kistler WIM equipment provides highly flexible traffic monitoring options – and it is reliable and maintenance-free.

Road and Traffic Policy

A strong economic development requires an adequate road infrastructure and an efficient transport system involving expensive and normally irreversible investments. The development plans begin with a comprehensive evaluation of the current situation and a best possible prediction of future traffic development. Monitoring and recording the actual traffic data with the Kistler WIM equipment provides you with all the essential information for development of the best and most economic road and traffic policy.

Benefits

- Collecting accurate and reliable data on the actual traffic loading.
- Providing comprehensive input for an optimized road maintenance planning.
- Providing realistic input for an improved design of roads and bridges.
- Detecting overloaded vehicles to protect roads and bridges.
- Gathering traffic data for predictions on traffic development.
- Monitoring correct use of permits and routes for special transports.

Design of New Roads

Authorities responsible for the construction of roads and bridges need realistic information on traffic flow and loading. The damage to the road pavement is related to the fourth-power of the passing axle loads, whereas damage to the bridges is related to the total weight of the vehicles driving over it. The history of actual traffic loads measured by the Kistler WIM equipment are an important source of information for design codes regulating the construction of new roads and bridges.

Planning of Road Maintenance

Only a WIM system is capable of measuring the actual pavement loading real time. This loading information enables you to calculate the remaining operational life of the infrastructure and to plan when and where maintenance is required. Experience has shown that well planned preventive road maintenance will avoid further deterioration of the roads and more costly repairs later on. Using the WIM information to plan maintenance operations will significantly reduce overall costs and therefore optimize public spending.

Detection of Overloading for Protection of Bridges

Several countries and regions recognized the importance of well-maintained bridges as the key to efficient daily transport of people and goods. Bridges need to be protected, so that they do not get damaged from overloaded trucks. Consequently, many bridges have a maximum weight limit for the passing traffic. Traffic data shows that many overloaded trucks are driving over bridges every day, causing severe structural damage to the bridge. The Kistler WIM equipment monitors traffic and can detect overloaded trucks before they drive onto a bridge, so they can be stopped or diverted to another stronger bridge.

Special Transports

Any vehicle that exceeds traffic regulations on weight and overall dimension is considered a special transport, and therefore needs a permit from the transport authority. The authority will charge a fee for the permit and may define a specific route for the transport. A WIM system monitors traffic 24/7 and can identify traffic violators conducting a special transport without the proper permit.

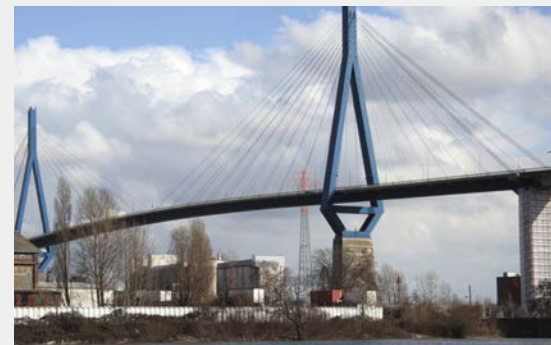
Weigh the Freight.

Reliable WIM Data Help to Improve the Pavement Performance in the USA

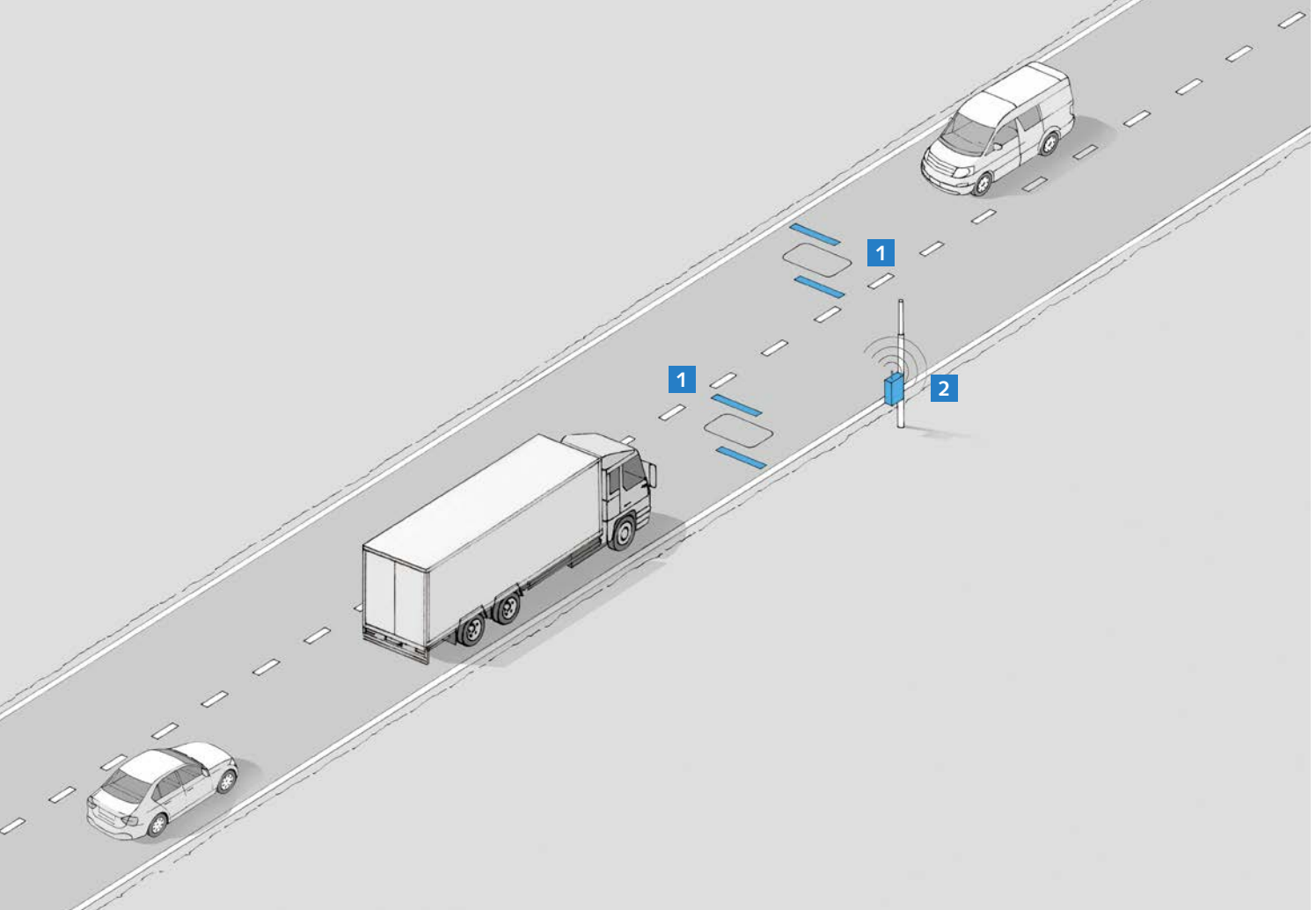
The Federal Highway Administration (FHWA) set up a program for Long Term Pavement Performance (LTPP) 30 years ago to continuously improve the design and performance of the pavements. A broad network of over 500 WIM system sites has been installed to comprehensively measure the actual traffic loading by axle load and total weight of all passing vehicles. As the accuracy and the reliability of the WIM data are important for a significant analysis, the FHWA did approve the Kistler Lineas® sensor technology to be widely deployed.

Hamburg (Germany) Controls the Freight Traffic Over the Koehlbrand Bridge with Kistler Lineas WIM Sensors

The German Road Administration (BAST) installed also 30 Kistler WIM stations on their highway network for traffic data collection. Local authorities are focused on the bridges with intense traffic volume like the Koehlbrand-Bridge which connects the port of Hamburg with the freeway A7. The Hamburg Port Authority (HPA) employs a WIM System with Kistler Lineas WIM sensors to monitor and control the actual traffic load on the 3,6 km long cable-stayed bridge which requires a special permit for vehicle heavier than 40 tons. The WIM measurement shows that the number and weights of the heavy vehicles passing the bridge were much higher than expected.



Koehlbrand Bridge in Hamburg, Germany



WIM site for traffic data collection

Plug and Collect.

The Kistler WIM Data Logger can be easily integrated into your overall solution to collect a wide range of traffic data in real time. The Kistler WIM Data Logger, in combination with Lineas® WIM sensors, measures the weight and axle load of all vehicles passing the WIM site and provides data on the real traffic loading. This data can easily be processed further by your overall system and customized to meet your customer's needs.

The Lineas WIM sensors have proven their reliability and accuracy over many years and in tough conditions.

Kistler Lineas WIM Sensors

The Kistler Lineas WIM sensors can be installed in any kind of road pavement like solid asphalt, drain asphalt and concrete. The installation is quick since the sensors are easily grouted into a slot in the pavement. They do not require any maintenance and in case of pavement rutting, the sensors topcoat can be re-ground to match the profile of the road surface. Thanks to the outstanding stability of the measurements and durability of the sensors, there is no need to perform frequent re-calibrations. You can fully rely on the quality of the data, as performance of the Lineas WIM sensors is not affected by changing weather conditions such as large variations of temperature or humidity, rain or sunshine.

Equipment

- 1** Lineas® WIM sensors (staggered layout) and inductive loops installed in the pavement.
- 2** WIM electronics with wireless data transfer in roadside cabinet, mounted on a pole. Power supply via wire or solar panel.

The Lineas® WIM sensors, in combination with the Kistler Data Logger, will provide you with reliable and accurate results for many years.

Kistler WIM Data Logger

The Kistler WIM Data Logger is specifically designed to process signals from the Lineas WIM sensors and can be easily integrated into your overall system. Just plug it in and your system can further process a wide range of traffic data like vehicle weight, axle loads, vehicle length, axle distances, vehicle imbalance and driving behaviour. The Kistler WIM Data Logger with the unique Lineas WIM sensors will guarantee accurate and highly reliable data.

System Design

From high-end to entry level WIM equipment, Kistler can provide specific products that allow you to customize your specific WIM System and meet your customer's needs. The Kistler WIM Data Logger receives signals from the Lineas WIM sensors and inductive loops installed in the traffic lanes. The software processes the sensor signals and calculates key vehicle information. The data can either be stored locally on the computer at the measurement site or sent directly to a central database.

Kistler can help you select the proper WIM network and specific site locations, train employees to successfully install sensors and calibrate the system.



Built for tough to deliver years of reliable traffic data in any road and weather conditions with the maintenance-free Kistler Lineas WIM sensors.



Weight enforcement

Plug and Protect.

Implementing WIM systems will allow you to detect overloaded vehicles right away in order to protect the road infrastructure and increase traffic safety. The fact is that overloaded vehicles are causing increased damage to roads and bridges and are also a danger to other road users. A consequent monitoring and enforcement of traffic violators will increase the safety and reduce unfair competition among transport companies. Moreover, less overloading on roads also means a reduction of public spending on road maintenance.

Efficient Enforcement

It is important that properly loaded vehicles are not hindered by enforcement authorities. Only overloaded trucks should be caught and issued traffic tickets. A WIM system will measure the characteristics of all passing trucks and record the data of overloaded vehicles, including their license plates. This helps you optimize the planning of overloading controls and to efficiently deploy enforcement resources. Usually a WIM system is used as a pre-selection tool to divert any overloaded vehicle to the secondary enforcement site. An accurate and reliable WIM system increases the efficiency of overloading controls by increasing the hit rate of detected overloaded trucks to more than 95 %.

Benefits

- Monitoring of overloading in truck traffic for improved planning of enforcement controls.
- Optimizing the efficiency of enforcement controls through pre-selection of overloaded trucks.
- Reducing the damage to roads and bridges.
- Reducing the costs for road maintenance by catching overloaded trucks.
- Increasing the traffic safety by decreasing the number of overloaded trucks on the street.
- Reducing unfair and illegal competition in freight transport by monitoring and penalizing overloaded trucks.

Road Safety

Overloaded trucks are more likely to be involved in an accident and cause more severe damage than legally loaded trucks. They have longer braking distances, reduced stability and reduced vehicle control, resulting in a higher risk for accidents. In case of an accident, an overloaded vehicle will have a bigger impact on other road users and will usually result in more serious damages and casualties. Experience from enforcement authorities shows that in many cases overloaded trucks also violate other traffic regulations, such as exceeding the maximum driving hours. With the Kistler WIM equipment you can detect such violators and take them off the street and thus help increase safety for all road users.

Damage to Road Infrastructure

The growing number of overloaded trucks has a major impact on the quality of the road infrastructure, resulting in serious pavement damage, cracking and increased bridge fatigue damage. The pavement damage is calculated from the sum of the axle load to the fourth-power, which means that one overloaded 5-axle truck has the same effect as 200 000 regular cars. Overloaded trucks reduce the operational life span of the road infrastructure forcing earlier and more extensive repairs and maintenance to be made, which lead to increased costs. Such trucks create traffic jams and

potentially dangerous traffic situations like aquaplaning because of pavement rutting. Kistler WIM equipment enables you to efficiently reduce overloaded traffic and therefore also substantially reduce road infrastructure damage, which results in a significant reduction of the maintenance costs.

Unfair Competition

In each country the principle of fair competition also applies to the transportation industry. Using overloaded trucks severely interferes with fair freight transport policies among the different kinds of transportation like road, rail and water, as well as among the road transportation companies. The illegal use of overloaded trucks enables companies to run fewer trips or use cheaper vehicles, leading to lower costs and higher profits. This gives such companies an unfair advantage over companies using correctly loaded trucks. WIM will help you detect such unfair business practices.

Save the Pavement.

Selective and Efficient Enforcement

The Transport Inspectorate in the Netherlands monitors and controls the 3 200 km free-way network with 20 WIM systems equipped with Kistler Lineas® WIM sensors. Each WIM system sends the data of all detected overloaded trucks to the laptop of the traffic inspector down the road who will direct the violator to the certified weighing site for a final enforcement of the overload. Many other countries in Europe, North America, Asia and the Middle East are using a similar pre-selection WIM system for efficiently enforce any overloaded vehicle without interfering the general traffic.

Enforcement Around the Clock

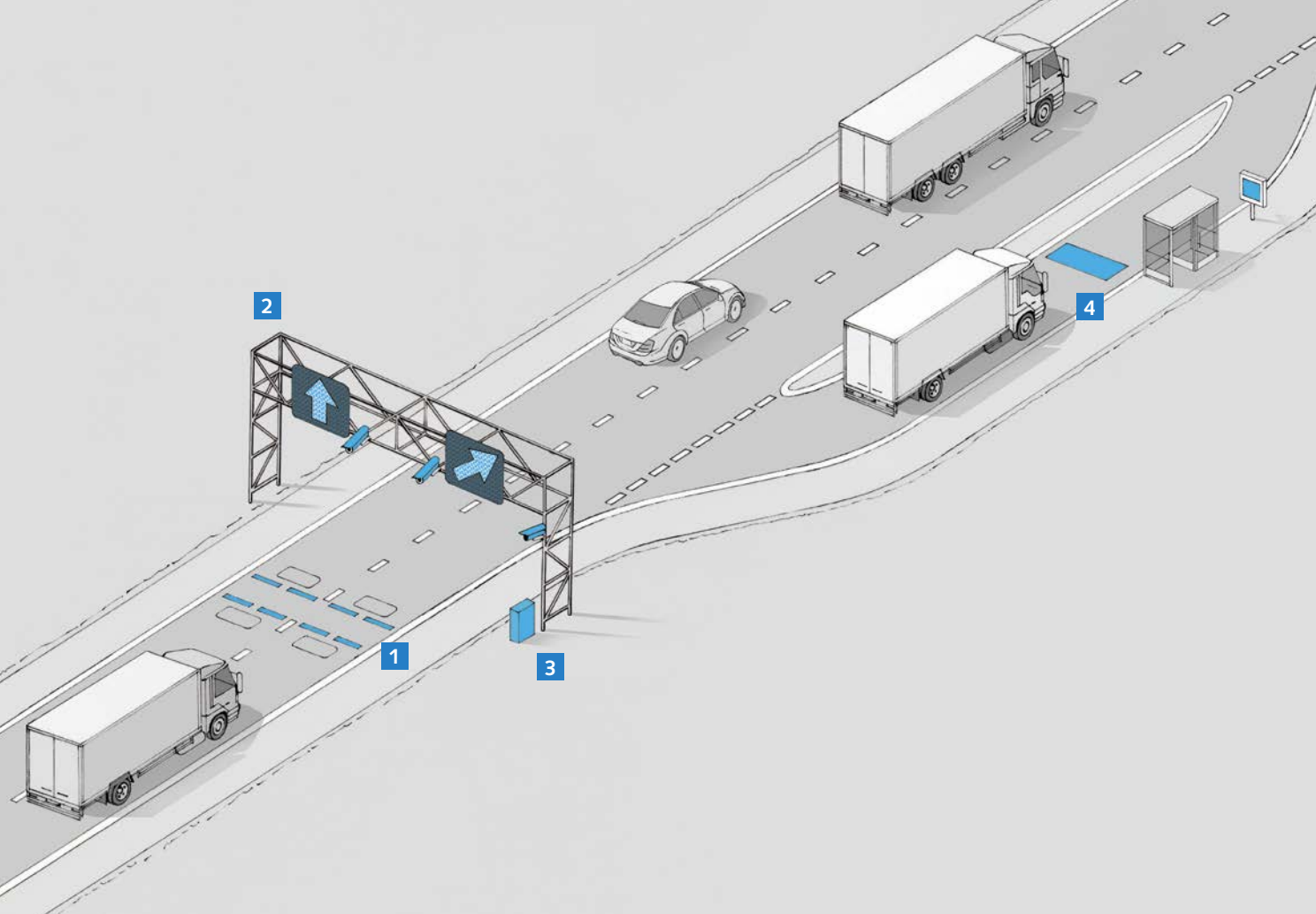
The Czech Republic Government released a new traffic law that allows the transport authority to directly enforce overloading by High Speed (HS) WIM systems. Any overloaded vehicle will be detected by this HS-WIM system with weight and license plate pictures send automatically to the enforcement office that will issue directly the penalty to the perpetrator. This fully automated 24/7 process is highly efficient, fast and with no manpower requirement. Two WIM systems based on Kistler Lineas WIM sensors installed by our local partner companies on the highway 152 near Brno are certified by the Czech Metrology Institute (CMI) and now ready to be deployed nationwide.



WIM Site for pre-selection in the Netherlands



Automatic enforcement site in the Czech Republic



WIM site for weight enforcement

Accuracy and Reliability.

Accuracy and reliability of the Kistler WIM equipment ensures you smooth operation, long-lasting performance and satisfied customers. A WIM system, connecting the Kistler Lineas® WIM sensors and inductive loops in the road, will detect all overloaded vehicles passing the control site. The enforcement authority will get real time information about the axle load and gross vehicle weight with additional options to gather data about speed, vehicle imbalance and driving behavior. Cameras will provide pictures of the vehicle and its license plate. A WIM system is used for the pre-selection of overloaded vehicles for subsequent certified weighing in a dedicated area.

Accuracy

The Lineas WIM sensors, thanks to their quartz crystal technology and in combination with advanced sensor design and high quality manufacturing process, are capable of high measurement accuracy. This is the key for correct pre-selection of overloaded trucks. The sensors have a wide measuring range and can measure light vehicles as well as heavy vehicles with the same accuracy. Even axle loads with 50 tons or more can be accurately measured. In order to avoid the costly secondary weighing process (e. g. with fixed weigh stations and manpower) certain countries plan to adapt the local regulations to enable the penalization of over-

Equipment

- 1** Lineas® WIM sensors (full layout) and inductive loops installed in each traffic lane.
- 2** Licence plate recognition cameras, overview camera and variable message signs installed on a gantry.
- 3** Roadside cabinet with WIM electronics.
- 4** Dedicated lane for certified weighing and for enforcement officer to issue traffic ticket.

loaded vehicles directly by means of a high speed WIM system. In the Czech Republic two WIM systems, based on Lineas® WIM sensors, have already been certified for this application.

Reliability

It is important for the enforcement authority to trust and feel confident regarding the WIM measurements for pre-selection of overloaded vehicles. Therefore the necessity for a highly reliable WIM system that will detect all overloaded vehicles, even under changing and harsh operational conditions, is essential. The Kistler Lineas WIM sensors are well known for their consistently high performance over time under all possible traffic and weather conditions. They don't require any frequent re-calibration and you can count on the quality of the data at all times. The road conditions must be monitored regularly, since a deterioration of the road can affect the measurements of any WIM technology.

Durability

Our Lineas WIM sensors have proven their durability in different pavements on all continents; under the harsh and extreme winter conditions in northern Europe and North America; in the hot desert conditions of the Middle East and under high humidity conditions in China and Southeast Asia. The sensors themselves are completely maintenance free and in case of pavement rutting, the sensor topcoat can be re-ground to perfectly match the profile of the road.



Detect and identify any traffic violators with the durable and accurate Kistler Lineas WIM sensors.



Toll collection

Plug and Cash.

Plug and cash with weight-related toll fees creating more revenue for financing road expenditures. The road pavement damage is generally correlated to the axle load on the road by the fourth power. Based on the 'polluter pays' principle, the fee for using a toll road should be proportional to the damage caused by the vehicle. This way the road maintenance costs will be fairly distributed and those vehicles that have caused the most damage to the road will also pay higher toll fees. The precise and flexible Kistler WIM equipment provides you with real time weight data that allows you to collect a toll fee based on the exact axle loads and gross vehicle weight with the option of collecting additional penalty fees in case of overloading.

Toll by Weight

A fair toll fee structure lets you distribute the road damage and maintenance costs according to the 'polluter pays' principle. Only a Weigh-In-Motion system measures the actual axle load of the passing vehicles, enabling you to implement a toll fee structure that differentiates vehicle size and weight class to allow for progressive increased pricing to reflect the fact that heavily loaded vehicles cause the biggest part of the road and bridge damage. Such a WIM system also allows the enforcement authority to detect toll evasion.

Benefits

- Introducing a fairer weight-related structure for toll pricing.
- Increasing revenue and recovering road maintenance costs by charging higher fees for the heavy vehicles that cause most of the damage to the toll roads.
- Refusing toll road access to overloaded vehicles.
- Flexible toll collection at low speeds in a toll plaza and at high speeds under free flow traffic conditions.

The Kistler WIM equipment, consisting of the Lineas® WIM sensors and the Kistler WIM Data Logger, can be utilized both at high speeds for free flow traffic toll collection, as well as at low speeds at toll plazas for manual or automatic toll collection.

Traditional Toll by Vehicle Class

Traditionally, the toll fee is determined by the number of axles of a vehicle and by the distance driven. The following example illustrates how the traditional toll does not take the notion of road damage into consideration (Italian toll scheme). A car with a camper with 3 axles and maximal loading of 1,8 tons (600 kg per axle) pays the same fee as a 3-axle-truck with maximal loading of 30,5 tons (7,5 tons on first axle and 11,5 tons on second and third axle), since both have 3 axles. The impact to the road damage is dramatically different. The damage of the truck (ESAL 38,144) is 100 000 times greater than the damage of the car with a camper (ESAL 0,38). With a WIM system you are able to differentiate among different vehicle weight classes.

Recovering Maintenance Costs

The costs for road maintenance, repair and renewals increase significantly because of extensive road and bridge damage caused by heavily loaded or overloaded vehicles. With an efficient tolling system you can recover these costs from the originator

by collecting a toll fee based on actual vehicle weight. You can also penalize overloaded trucks with an additional fee or even refuse toll road or bridge access. Reducing overloaded traffic will consequently result in lower maintenance costs.

Shadow Toll

Some governments contract a private company to take over full responsibility (Design, Build, Finance, Maintain or DBFM) for a certain section of the road for an extended period of time, typically 20 to 30 years. An important part of the contract is the actual development of traffic loading during the contract period. Any upward deviation from the predicted traffic volume would have serious consequences for the road maintenance, repair and renewal, resulting in higher costs. The Kistler WIM equipment is capable of measuring the actual pavement loading during the entire contractual period, in order to determine a realistic shadow toll.

Fast and Efficient.

Manual Toll on the Ambitious China Highway Network

The Chinese highway network is continuously growing with many toll roads using a toll scheme based on the actual vehicle weight and the distance driven. All traffic lanes at the toll plaza are equipped with a low-speed WIM system which are certified by the local Institutes for Metrology. Lineas WIM sensors were selected due to their high accuracy, reliability, easy installation and maintenance-free operation and are deployed in several provinces. The Guangdong province already has installed Lineas WIM sensors in several hundred lanes.



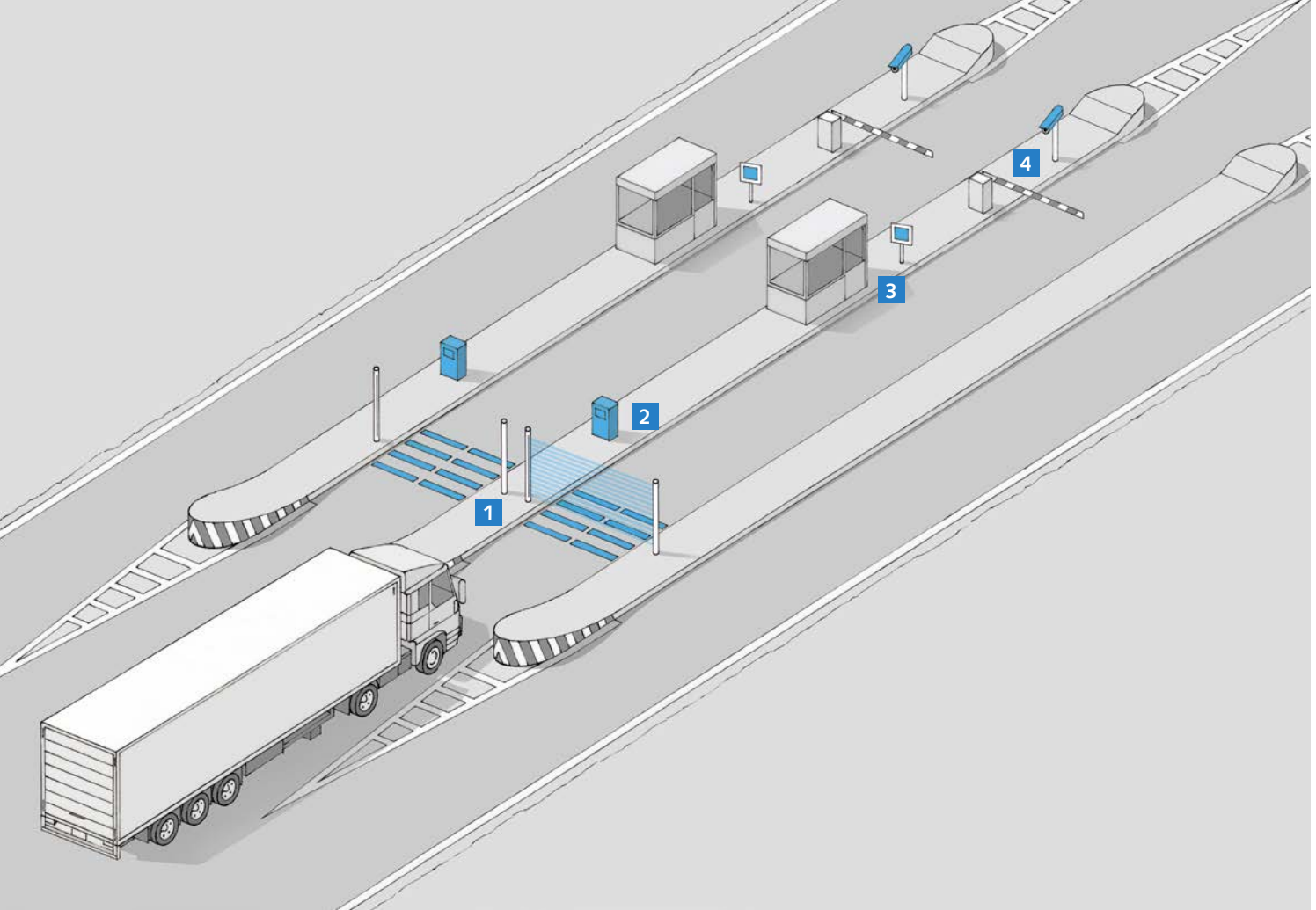
Toll plaza with Lineas WIM sensors in China

Optimizing the Performance-Related Heavy Vehicle Fee

Switzerland introduced in 2001 a new performance-related for heavy vehicles fee (LSVA) which is based on the total permissible weight and emissions level of the vehicle and also dependent on the kilometers driven. An effective control of the compliance of the trucks passing the existing system was very difficult. The Swiss Custom Administration (EZV) started to upgrade the network of 25 free flow toll gantry system with Kistler Lineas WIM sensors to compare the registered weight of each vehicle with the automatically measured vehicle weight. This powerful additional means optimizes the existing system for the Swiss custom to control the compliance of heavy traffic.



Free flow toll collection system in Switzerland



WIM site for toll collection

Flexible to Create and Easy to Integrate.

Thanks to its modularity, the Kistler WIM equipment gives you the flexibility to customize your toll system according to customer needs. It is easy to install and can be integrated in various toll collection systems, both at high speeds under free flow traffic conditions and at low speeds in a toll plaza. The Kistler WIM equipment will ensure an efficient and smooth toll collection process.

Installation

The Lineas® WIM sensors can be easily and quickly installed in each traffic lane. A well trained team will properly install the sensors with little machinery in just a few hours. The sensors are grouted into the road pavement, which minimizes lane closure to avoid interrupting traffic. At the toll plaza, a light curtain consisting of two pillars installed next to the Lineas WIM sensors, enables the system to separate vehicles. For toll collection under free flow traffic conditions, the vehicle separation is conducted using inductive loops. Both Lineas WIM sensors and light curtains are connected to the Kistler WIM Data Logger in a roadside

Equipment

- 1 Lineas WIM sensor array with light curtain (beam array) installed in each traffic lane.
- 2 Roadside cabinet with WIM electronics.
- 3 Toll booth with operator and display for weight and toll fee.
- 4 Moveable barrier and video / LPR camera.

cabinet, where the signals are processed and the data is sent to the toll system for further processing.

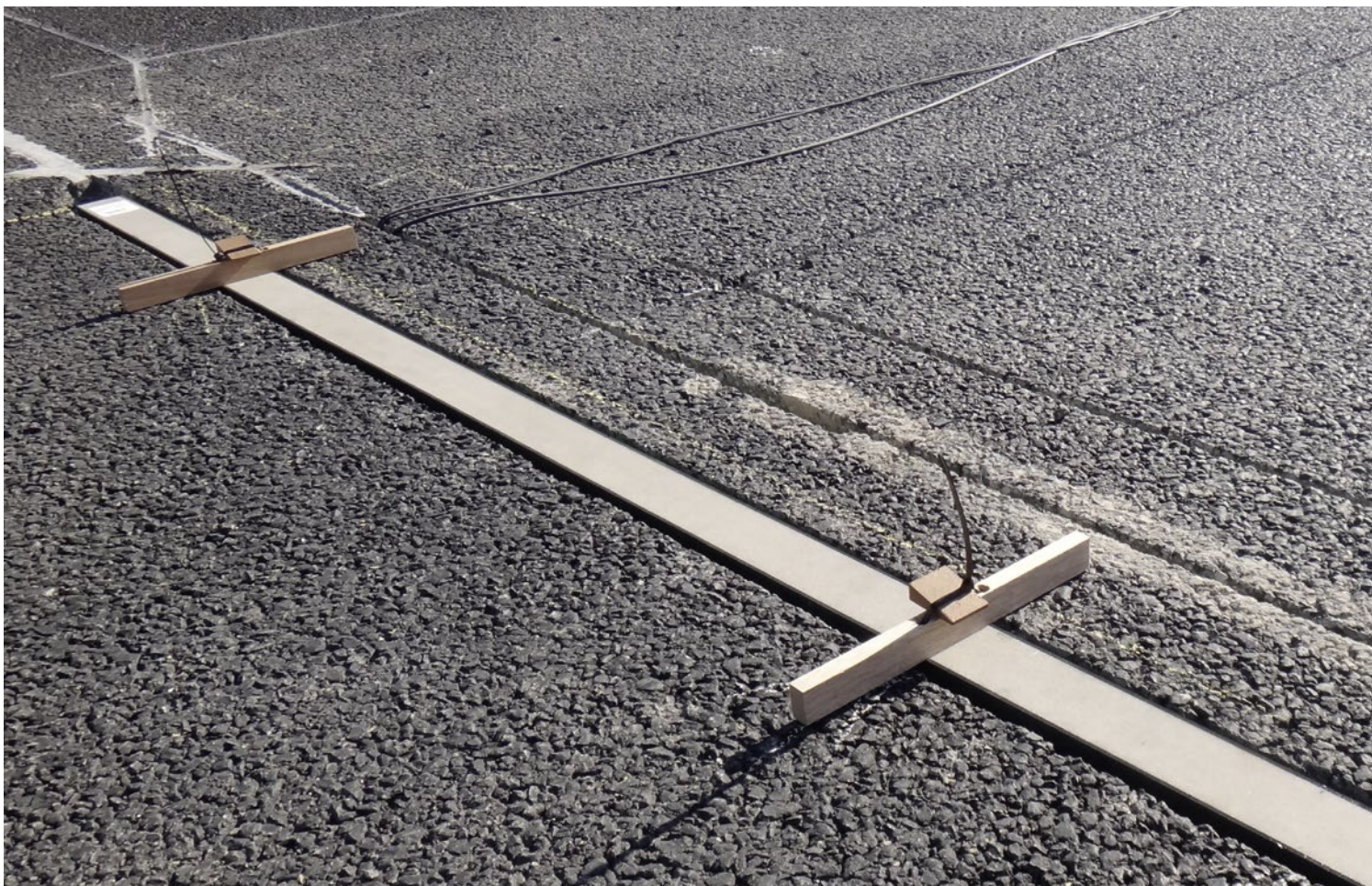
Tolling Set Up

The Kistler WIM Data Logger processes the signals from the Lineas® WIM sensors and the light curtain and provides accurate vehicle weight data. The WIM Data Logger can easily be integrated into the overall toll system provided by the system integrator. The overall toll system manages the interfaces with all other sub-systems such as cameras, licence plate recognition systems, tag readers, barriers, displays, etc.

A vehicle entering the lane will be measured and the toll fee will be calculated based on actual axle load, vehicle class and distance driven and then shown on the display. After the payment has cleared, either manually at the toll booth or electronically through the vehicle tag or transponder, the barrier will be raised.

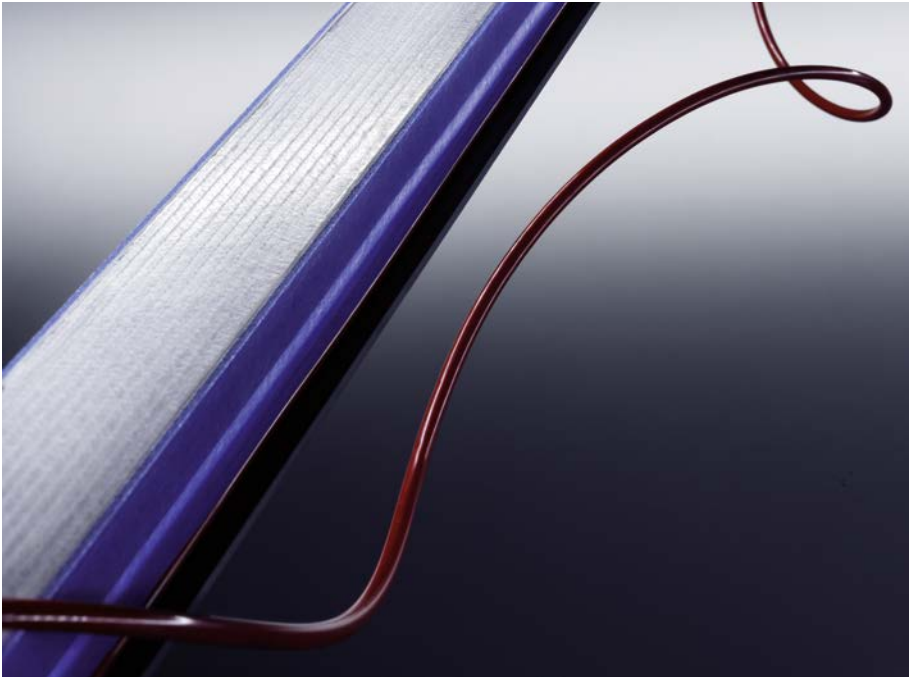
Certification

As the toll fee is issued based on the weight information, the accuracy of the WIM system must be certified by an independent and registered entity, typically a national institute for metrology. The Kistler WIM Data Logger was developed in accordance with metrological standards. The Lineas WIM sensors, thanks to their outstanding accuracy and stability over a wide range of climatic factors, also meet metrological standards.



Plug and forget. Easily install the long lasting and maintenance-free Kistler WIM sensors for a smooth and reliable tolling collection and operation.

Lineas[®] WIM Sensor.



Lineas WIM sensor with quartz crystal technology

Benefits

- Unique Quartz crystal technology.
- High measurement accuracy and long term stability.
- Wide measuring range.
- Complies to OIML standards (accuracy class 2).
- Robust design for high durability.
- Insensitive to temperature variations.
- Quick and easy installation into any type of road pavement (solid asphalt, drain asphalt or concrete).

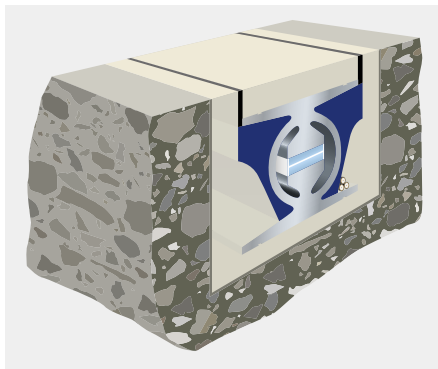
The Lineas is a rugged, reliable and maintenance-free sensor specifically designed for weigh-in-motion applications. Once installed in the pavement and connected to the Kistler WIM Data Logger it will measure the wheel and axle loads of vehicles under any speed condition.

How Does the Lineas WIM Sensor Work?

The Lineas WIM sensor is a force sensor based on unique quartz crystal technology and specially designed for measuring wheel and axle loads of road vehicles. The sensor is installed permanently into the road.

A wheel rolling over the Lineas WIM sensor applies vertical forces which are distributed through the quartz crystals in the sensor, with virtually no deformation. The quartz elements yield an electrical charge exactly proportional to the forces applied. The sensor sensitivity is virtually independent of changes in temperature, speed and time (no ageing effects). The accuracy of the measured wheel load is also not influenced by tire type or tire pressure.

To support applications with high accuracy requirements the sensors were tested and certified to comply with metrological standards. Thanks to the excellent stability of the quartz crystal technology there is no need to perform neither maintenance nor frequent recalibrations and this saves the operator time and money.



Cross-cut of installed Lineas WIM sensor

Lineas WIM Sensor Installation

The Lineas WIM sensors can be easily installed in any type of pavement, without need for heavy machinery. Thanks to its modular sensor design (length of 1,5 m, 1,75 m and 2 m) the sensors can be flexibly combined to cover any road width. The sensors are installed in a small slot in the road and fully embedded in the grout. The sensor surface has a 10 mm thick topcoat which can be re-grinded flush to the road surface in case of road rutting.

WIM Data Logger.



WIM Data Logger for vehicle weighing with Lineas® sensors

Benefits

The WIM Data Logger Type 5204A in combination with Lineas WIM sensors allows to collect accurate vehicle data.

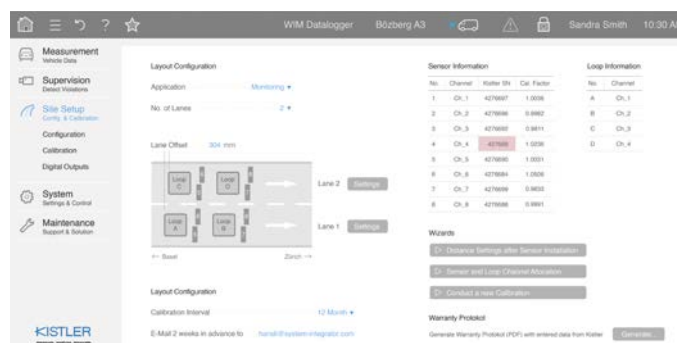
- High weighing accuracy.
- Able to monitor up to 2 traffic lanes.
- Wide speed range, from low to high speed.
- Capable of OIML certified operation.
- Compact design.
- For traffic data collection, enforcement and toll collection applications.
- Easy to integrate into overall solution.
- Quick set up thanks to modern web interface.

The WIM Data Logger is a data processing unit specifically designed to interface with Lineas WIM sensors. It allows customers to monitor traffic real time and to gather key vehicle data, such as vehicle weight and imbalance, axle loads and distances, vehicle speed and driving behavior and much more.

Designed for Accuracy and Reliability

The key is enhanced conditioning and processing of the Lineas WIM sensors signals to achieve the best weighing accuracy from low to high speeds with the highest reliability. The data logger can easily be integrated by the system integrator into its overall system for a customized solution according to the needs of the end user. The Kistler WIM Data Logger, in combination with Lineas WIM sensors, is suitable for use in applications such as traffic data collection, pre-selection for enforcement and weight-based toll collection.

The Lineas WIM sensors can be directly connected to the WIM Data Logger. Additionally, there are various digital inputs and outputs to interface peripheral devices such as loop cards, light curtains, traffic signals, camera triggers, barriers, etc. The WIM Data Logger is available in versions with 4 or 8 channels to monitor 1 or 2 traffic lane(s) and is capable of OIML certified operation.



A modern web interface enables the customer to easily set up and calibrate the WIM equipment. Vehicle data is stored locally and can either be accessed through the web interface or retrieved real time by the customer control unit.

Kistler Group
Eulachstrasse 22
8408 Winterthur
Switzerland
Tel. +41 52 224 11 11

www.kistler.com

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Europe, Asia, Americas, Australia

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