



**Enhance safety –
and cut
maintenance costs**

Railway vibration measurement

Vibration sensors for the design, commissioning and monitoring of trains, tramways and subways



High-speed trains under test at China's Academy of Railway Sciences

Reliable vibration measurement solutions

New trends are emerging in the railway sector. First and foremost, the focus is on safety. Next in line: cutting costs. Preventive maintenance allows early detection of bogie failures – and that means major savings. Last but not least: compliance with manuals, contracts and regulations is increasing the need for mandatory testing.

Vibration measurement is now being used more widely in response to these trends. Kistler sensor technology can serve different purposes: permanently installed systems support preventive maintenance and enhance safety, while temporary systems (installed for shorter or longer periods) assist with vehicle design and commissioning.

From Modal Analysis in Design to Derailment Detection

Kistler accelerometers are used to meet a variety of requirements. Acceleration sensors are deployed in many diverse applications, including modal analysis, vibration testing, passenger comfort and durability testing, derailment detection, wear and defect detection, and preventive track maintenance.

Benefits

- High precision and reliability for enhanced safety
- Improved network availability thanks to early defects detection
- Cost reduction thanks to preventive maintenance
- Comprehensive monitoring of vehicle parameters
- Automatic detection of rail defects

Two technologies – multiple applications

Kistler has a long track record of manufacturing piezoelectric and MEMS capacitive sensors for highly demanding applications in the aerospace and automotive industries, among others. In the railway sector too, there are many challenging applications that call for our expertise to ensure that your projects succeed.

Kistler offers MEMS capacitive solutions for lower-frequency monitoring requirements, and piezoelectric solutions for higher-frequency applications: whatever your requirements, you can depend on Kistler for outstanding reliability, accuracy and stability.

Modal Analysis and High-Frequency Vibration Investigations

Kistler offers the lightweight Ceramic Annular Shear sensor featuring ultra-low noise levels, as well as piezoelectric accelerometers based on the PiezoStar® seismic element for high thermal stability. For more information, consult our brochures and catalogues at www.kistler.com/t&m/acceleration.

Passenger Comfort, Preventive Maintenance and Durability

In these applications, lower frequencies are required and Kistler's K-Beam® MEMS capacitive sensors are optimally suited. Rugged, stable, and easy to mount, DC MEMS accelerometers are suitable for both short- and long-term monitoring applications.

K-Beam® and PiezoStar® are registered trademarks of Kistler Holding AG.



Usage of single axis Type 8316A for preventive maintenance on tramways



Kistler sensor installation at the Chinese Academy of Railway Sciences (CARS) for comfort and durability testing of high-speed trains

Preventive Maintenance for Trains

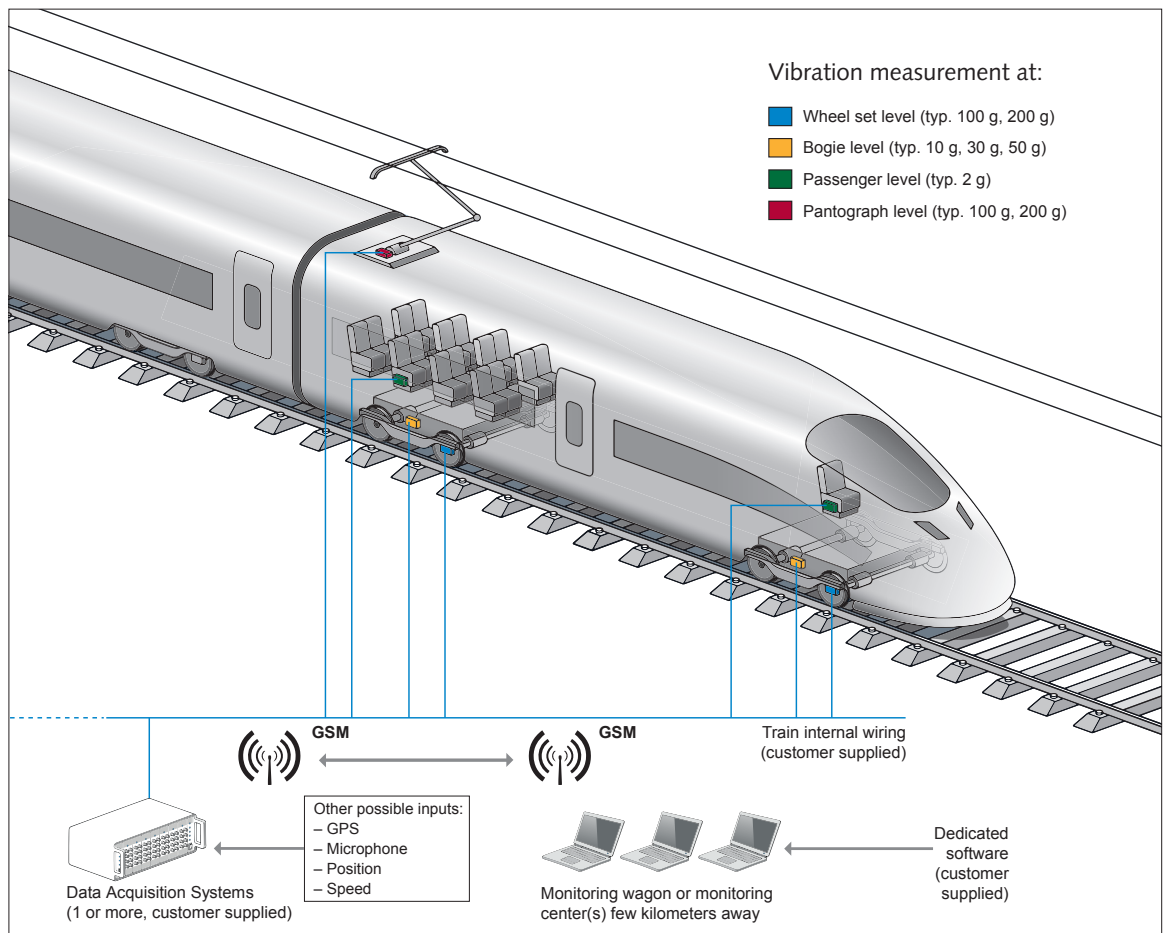
Rolling vibrations are monitored to detect any deterioration of bogie performance prior to a serious condition. This is also the case for bearing wear, wheel wear/imbalance, dampers/suspension fatigue as well as abnormal vibrations or displacement levels around the pantograph.

Ride Comfort Monitoring (Example: Vibrations in Cabin/Seats)

Vibration measurements serve many purposes: they are used for optimization in the development phase, for validation during commissioning, and at regular intervals to assess train or track conditions.

Preventive Maintenance for Infrastructure

Vibration measurements can help to detect problems in the rails such as dislocations, breaks, chipping, squats or track waves. They support preventive maintenance and can help prevent derailments. Kistler's Rail WIM (Weigh-In-Motion) line also includes products to measure track loads. Please refer to our website for more information on this specific application: www.kistler.com/wim.



Typical vibration measurement setup in high-speed train applications with Kistler K-Beam sensors

Kistler MEMS sensor family

High-precision accelerometers are crucial in every avenue of the dynamic test environment. Kistler's MEMS capacitive sensors will consistently endure the most demanding applications while providing reliable results.

Excellent Thermal Stability and Shock Resistance

Kistler MEMS sensors for vibration measurement are stable in environmental conditions with changing temperatures. They feature a temperature output for additional compensation, and they have excellent shock resistance in case of high impacts (metal-to-metal impacts).

Wide g Range

The range extends from 2 g for passenger-level vibration monitoring to 200 g for wheelset monitoring.

Low Noise

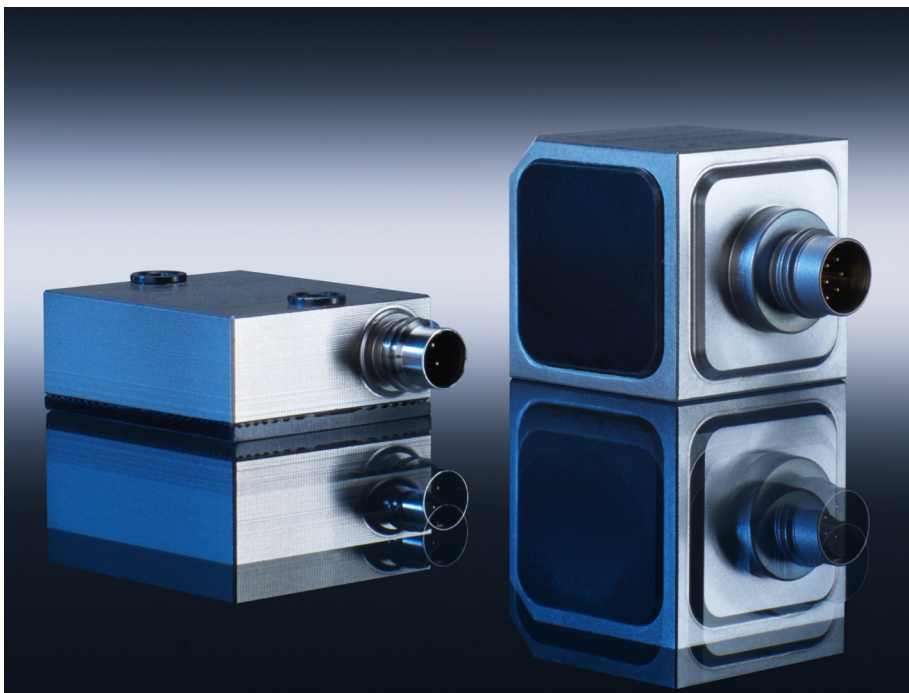
Kistler MEMS sensors operate with low noise levels. An optional differential output compensates potential noise originating from the train wiring itself (common mode rejection).

Custom Adaptation to Train Wiring

Low-smoke and halogen-free cable solutions or adaptation boxes are available for direct mounting on the train's existing wiring. Sensors can be located remotely from the power supply.

Key Features at a Glance

- From DC up to 1 500 Hz
- From 2 to 200 g
- Reliable, accurate measurement of low-frequency vibrations down to DC (tilt)
- High temperature stability and shock resistance, suitable for all environments
- Exceptional modularity in electrical signal output and cable configurations



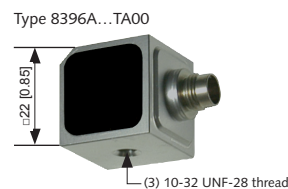
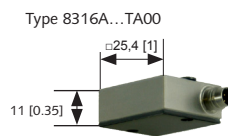
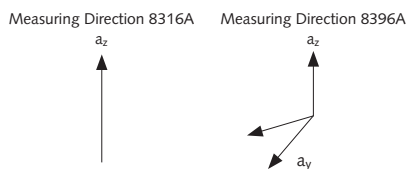
Kistler MEMS capacitive family: single-axis sensor Type 8316A and triaxial sensor Type 8396A

Kistler K-Beam: variable-capacitance MEMS sensors

Our single-axis Type 8316A and triaxial 8396 accelerometers offer temperature stability between -55 and $125\text{ }^{\circ}\text{C}$ [$-65 \dots 260\text{ }^{\circ}\text{F}$] together with a outstanding 0.1% FSO amplitude non-linearity. Combined with low noise levels, these characteristics ensure accurate measurement of low-frequency events from DC up to the $1\,000\text{ Hz}$ bandwidth.

Available in six measuring ranges (from 2 to 200 g), these sensors incorporate a sensing element with gas damping and internal over-range stops. Various output, housing and cable options are available to accommodate most applications.

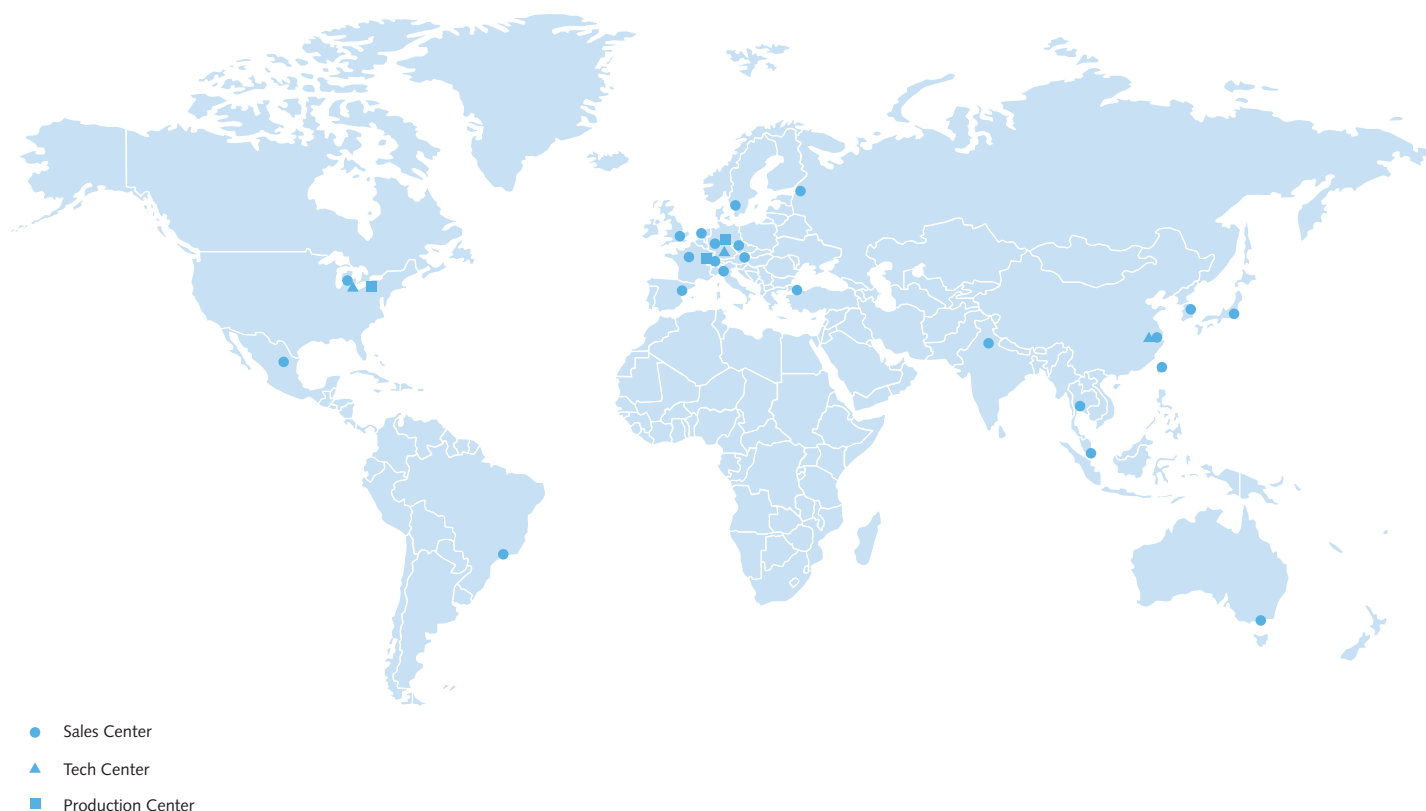
For more information on these sensors and our piezoelectric sensors, please consult our website at www.kistler.com/t&m/acceleration.



Type 8316... and 8396...							
Technical Data	Type	...A2D0...	...A010...	...A030...	...A050...	...A100...	...A200...
Range	g	±2	±10	±30	±50	±100	±200
Sensitivity, ±5 % (±4 V FSO version)	mV/g	2 000	400	133,3	80	40	20
(2,5 ±2 V FSO version)	mV/g	1 000	200	66,6	40	20	10
(±8 V FSO differential vers.)	mV/g	4 000	800	266,6	160	80	40
Zero g output (±4 V FSO version)	mV	0 ±60					
(2,5 ±2 V FSO version)	mV	2 500 ±60					
(±8 V FSO differential vers.)	mV	0 ±120					
Frequency response, ±5 %	Hz	0 ... 250	0...1000	0...1500	0... 1500	0...1500	0...1500
Resonance frequency mounted (nom.)	kHz	>1,2	>3,2	>4,2	> 5.8	>8.5	>11
Non-linearity	%FSO	+/-0.3					
Resolution/threshold	mg _{rms}	0,10	0,50	1,47	2,45	4,90	9,80
Transverse sensitivity	%	1					
Shock half sine	g _{pk}	6 000 (200 μs)					
Temp. coeff. bias	mg/°C [mg/°F]	±0,1 [±0.06]	±0,5 [±0.3]	±1,5 [±0.8]	±2,5 [±1.6]	±5 [±2.8]	±10 [±5.5]
Temp. coeff. sensitivity	ppm/°C [ppm/°F]	±100 [±55]					
Operating temp. range	°C [°F]	-55 ... 125 [-65 ... 260]					
Phase shift max., @ 100 Hz	°	20	10				
Current nom.	mA	8316A: 4 / 8396A: 12					
Voltage	VDC	6 ... 50					
Connector	type	8316A: 4 pin pos. / 8396A: 9 pin pos					
Housing/base	material	Titanium / Anodized Aluminium					
Sealing	type	Hermetic					
Mass	grams	8316A...TA00: 15 / 8396A...TA00: 30					
Ground isolated		8316A: yes / 8396A: yes on aluminum anodized adhesive mount surface or with accessory					

All values are given as follow: metric [imperial]

Your partner for innovation



Kistler aims to offer all customers personal and professional support. 30 Sales Centers around the globe and an extensive network of local distributors keep us close to our customers. Our experts are always happy to offer help and advice.

Our local Sales Centers and Sales Offices offer expert advice and practical assistance with technical implementation. For standardized calibration services, repairs to/with original parts and product modifications, please contact your regional Tech Center.

To help you make the most effective use of Kistler measurement technologies, Kistler offers tailor-made training for all its products and systems – either at your own premises or at one of our Sales Centers.

Simply go to www.kistler.com/t&m/acceleration, select your country and you'll see the sales representative who can help you. Contact us today – we're here to help!

Kistler Services at a Glance

- Advice on products
- Regular calibration
- Customized solutions (engineering)
- Training
- On-site support
- Application consultancy

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