

WEIGHING OPERATIONS WITH PORTABLE WHEEL LOAD SCALES



Force measurement technology
made in Germany



WEIGHING MEANS STAYING ON THE SAFE SIDE



Safety is paramount in road and air traffic, which is why particular attention is paid during the design and development phase of motor vehicles, automotive components and aircraft to their weight and achieving an optimum distribution of weight. Overloaded vehicles or vehicles laden incorrectly also represent an increased safety risk, which is why both manufacturers and supervisory authorities count on our portable wheel load scales for the uncomplicated and precise determination of vehicle loads. For greater safety – on land and in the air.

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FORCE MEASUREMENT TECHNOLOGY MADE IN GERMANY

HKM-Messtechnik is a medium-sized, family managed enterprise which, since it was established in 1988, has become a leading name in the area of force measurement technology. From transducers and signal processing to signal evaluation and visualisation, we are a one-stop solution provider for the development, design and manufacture of force measurement systems. And we do this exclusively in Germany. Only here we can find the optimum framework conditions and qualified personnel with the skills to provide you with individual support.

For road vehicles, aircraft and mobile plants

Portable HKM wheel load scales are versatile solutions, flexible in their use and configuration, flat, accurate and reliable. Regardless of whether you drive a motorcycle, car or semi-trailer truck, we have the right wheel load scale for almost every vehicle. Different load ranges also make their use in the aviation industry possible for everything from ultralight to wide-body aircraft. They also provide a valuable service when it comes to determining the support load for mobile plant and machinery. The design, number and combination of wheel load scales and the type of display is always selected to meet your individual requirements.

Determining the load and centre of gravity during the design phase

Weight distribution plays a major role in the design and development of motor vehicles and automotive components. In addition to making a decisive contribution to driving behaviour, it also influences fuel consumption, emissions and load capacity specifications. HKM wheel load scales provide a valuable service in this respect.

When it comes to aircraft, the mass and balance calculation is an important design and conceptual criterion. In the context of the type certification and approval of aircraft, the weight and centre of gravity of the unloaded aeroplane are determined by weighing. The precision and reliability of our portable wheel load scales are also highly valued here all over the world.

Weight determination and load distribution

In addition to the overall load of an aircraft, truck or car/caravan combination, the distribution of load is also a decisive factor. Driving or flight behaviour is dangerously altered by uneven loading. The potential for accidents to occur is increased by the shifting of cargo during transportation. If weighing a vehicle detects an unfavourable or impermissible distribution of weight, the load needs to be appropriately redistributed or reloaded onto a suitable vehicle. HKM wheel load scales are an exceptionally reliable measurement instrument for checking load distribution.

Wheel load scales with factory calibration and official verification

Whether with factory calibration or official verification, there is no difference in our wheel load scales when it comes to precision and reliability. Factory calibrated scales are the right choice for the majority of uses. They are tested using a reference weight (the so-called national standard) and meet the required standards of accuracy. We offer you regular inspections and an in-house recalibration service so that you can be sure of being on the safe side at all times. Where official requirements need to be met, use of verified HKM wheel load scales is necessary. These are inspected by the official office of weights and measures and receive an official verification certificate.

Main areas of use for HKM wheel load scales

- » Automotive development and production and vehicle upgrading (superstructures)
 - › Optimising of overall weight and weight distribution
 - › Preparation for vehicle registration
 - › Optimising of fuel consumption
 - › Determining of tipping points for cranes and vehicles with long booms (e.g. concrete pumps)
- » Loading inspection of vehicles
 - › Determining the overall weight
 - › Load distribution on axles and on the left and right vehicle side
 - › Checking of permissible overall and axle loads of heavy load transports with a special permit
- » Determining the centre of gravity of aircraft or containers
- » Use in motor racing
 - › Observance of relevant racing class specifications
 - › Vehicle optimising with regard to the racing circuit or driver

MOBILE VEHICLE WEIGHING WITH HKM WHEEL LOAD SCALES

A variety of measuring methods are employed to determine the weight of a vehicle. They differ in terms of the effort and accuracy involved. Complete vehicle weighing operations are possible with a single wheel load scale. Several scales combined to form a single system simplify measurement and enhance the accuracy of the recorded values.

Vehicle weighing in a single operation

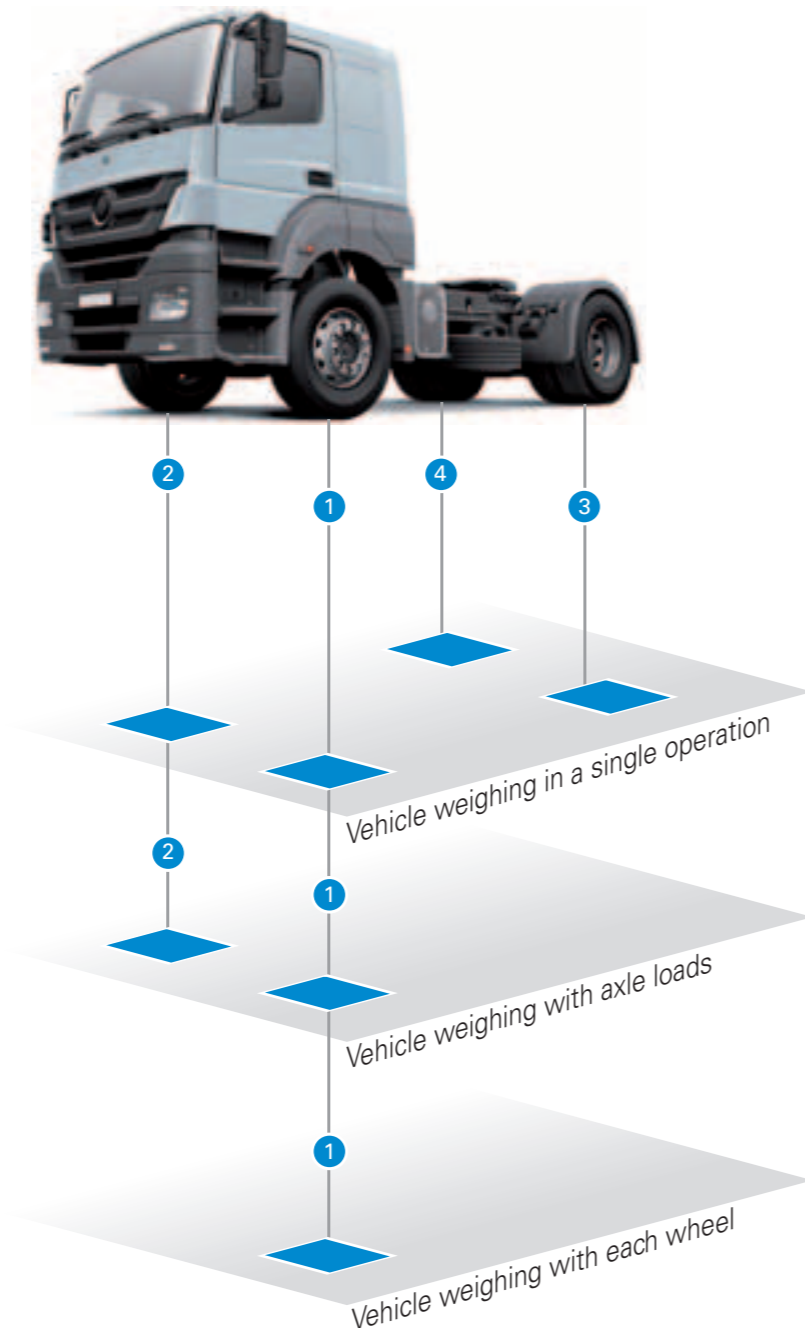
The most accurate and quickest measuring results are achieved by weighing the entire vehicle in a single operation. This involves weighing the vehicle simultaneously at all wheels, a procedure that requires the use of one HKM wheel load scale for each wheel.

Vehicle weighing with axle loads

The overall load can also be calculated from the sum of the axle loads. It is imperative that two wheel load scales be used for this purpose. The necessary height compensation between the wheels on the scales and the remaining wheels can be achieved with the aid of compensation plates or wheel load scales set into the ground.

Vehicle weighing with each wheel

It is possible to weigh an entire vehicle with just one portable wheel load scale. The effort involved here is considerably greater, as each wheel load needs to be measured separately. Additionally, the measuring accuracy achieved is lowest where this method is used. In common with weighing using axle loads, the height difference between the wheels needs to be compensated for.

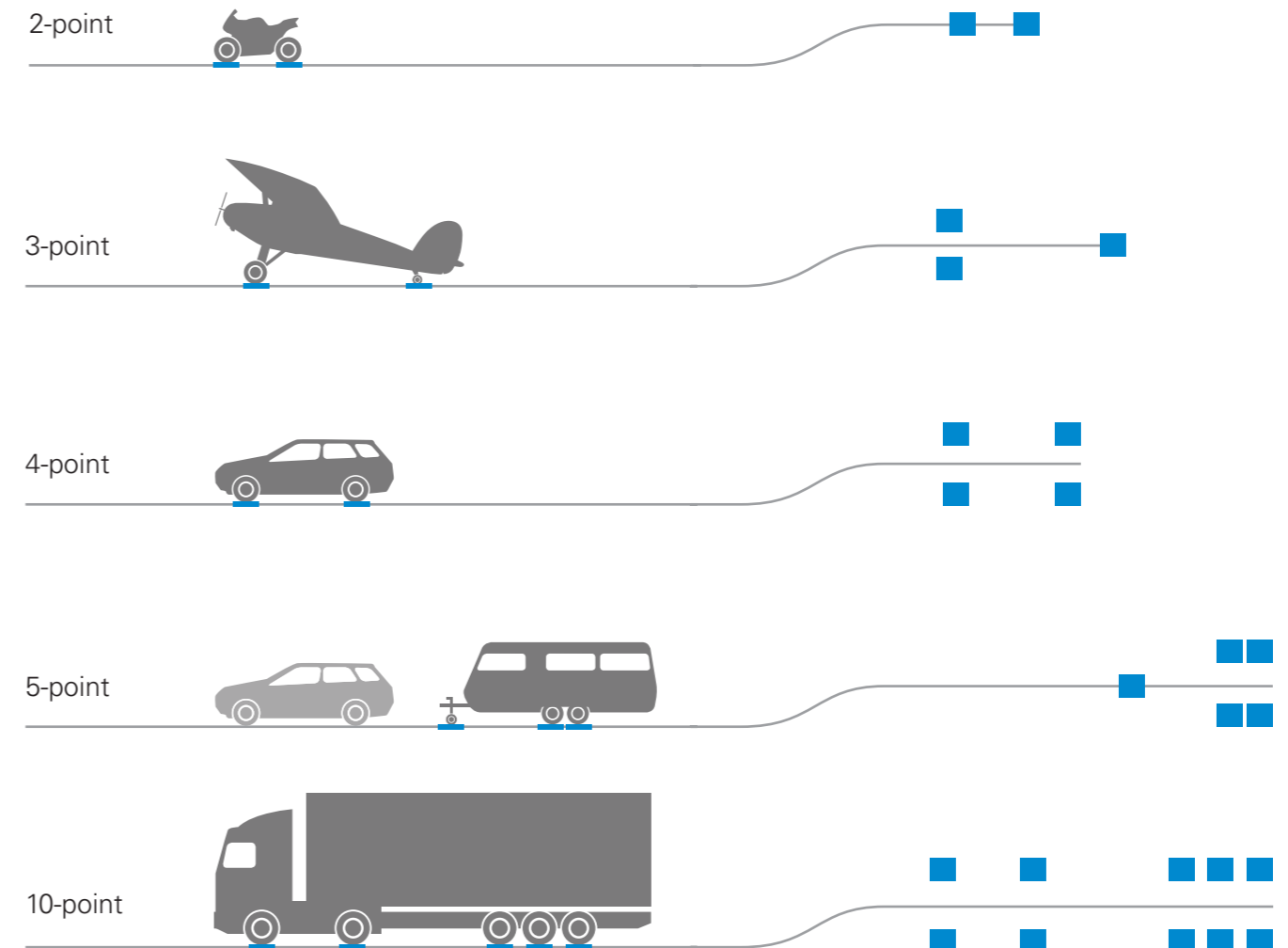


From 2 to 20 – a clever combination for optimum measuring results

Portability and flexibility are the most noteworthy characteristics of HKM wheel load scales. A variety of configurations can be achieved through the combination of up to twenty individual scales. Representations of different scale configurations are depicted in the diagram. In addition to individual wheel or axle

loads, complete vehicle loads, centres of gravity and load distributions can also be determined. Scales in different load ranges can be operated together to facilitate the optimum adaptation of a wheel load scale system of this nature to suit requirements. This can be particularly exploited if the anticipated wheel loads of

a vehicle differ in terms of greatness. The support load on the drawbar of a caravan is, for example, considerably less than the load on the central axle. More detailed information on the different load ranges of our wheel load scales can be found on pages 12 and 16.



The weighing operation – step by step to the right result

Vehicles can be weighed easily, quickly and speedily with portable HKM wheel load scales. The diagram provides a step by step explanation of the weighing operation, from positioning of wheel load scales and driving on to them to the actual weighing of the vehicle. A prerequisite in each case is a suitable measuring station. Certain ambient conditions need to be met if correct results are to be achieved. Please refer to pages 18/19 for more detailed information in this respect.



Positioning the wheel load scales

The flat design of our wheel load scales makes them ideal for driving on to. This is made even easier with the aid of optionally available ramps. Positioning is also conceivably easier, with each wheel load scale – with or without a ramp – being positioned centrally in front of the wheel. The same applies to the height compensation plates needed under certain circumstances.

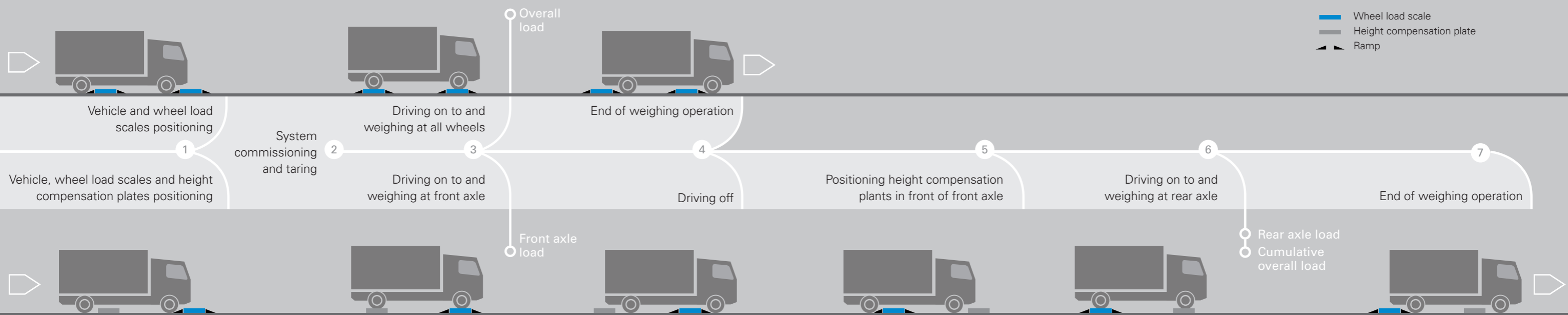
Driving on to the wheel load scale

Following correct positioning of the wheel load scales, the vehicle should then be driven slowly and carefully on to them. Abrupt steering and braking manoeuvres should be avoided as, in the worst case, the bearings in the wheel load scales could be damaged. All the brakes on the vehicle should be released during the weighing operation.

Optimum wheel position

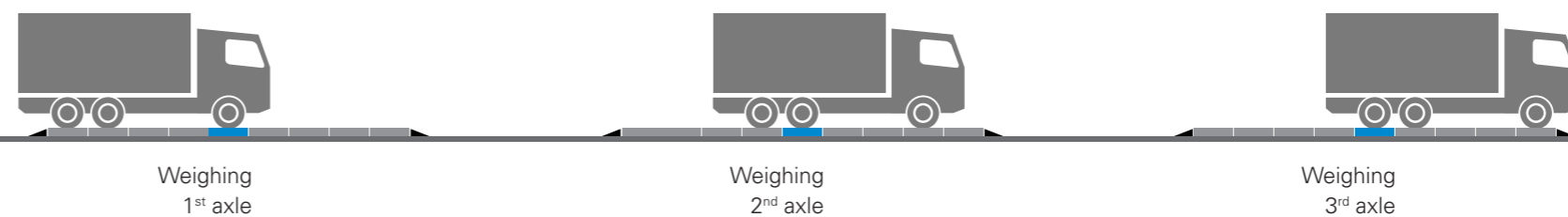
The position of the vehicle on the wheel load scales decisively influences the accuracy of the measurement. After driving on to the scales, the wheels should be ideally straight in the direction of travel and centred on the wheel load scales. A slight lateral protrusion is acceptable and does not impact on the weighing result.

Vehicle weighing in a single operation



Vehicle weighing with axle loads

Axle load weighing of multi-axle vehicles





THE FLEXIBLE ALL-ROUNDER – FACTORY CALIBRATED WHEEL LOAD SCALES



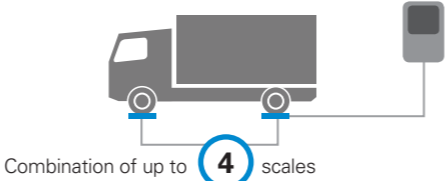
THE FLEXIBLE ALL-ROUNDER – FACTORY CALIBRATED WHEEL LOAD SCALES

HKM wheel load scales are calibrated ex works, thus ensuring the highest level of accuracy. This means that they are immediately ready for use wherever they are needed. But wherever measuring is realised, it is also important that the result is clearly visible. We have developed a variety of display and evaluation options for this purpose.

Data evaluation on hand-held terminal

If no more than 4 wheel load scales are operated together in a system, measuring results (wheel, axle and overall load) can be evaluated and displayed on an HKM hand-held terminal. The individual

scales are linked together by cable, with the transmission route to the hand-held terminal also being established by cable. This system operates independently and does not require a computer or laptop.

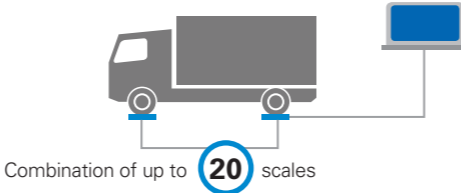


Combination of up to 4 scales

Data evaluation on the PC, data transmission via cable

We have developed a special software for more comprehensive weighing tasks. This means that measured values from up to 20 individual wheel load scales can be recorded simultaneously. Transmission is realised via a cable link to a PC or

laptop. Data for the wheel load, axle load, right and left vehicle side and the overall load is displayed with the aid of our wheel load scale software. It can be evaluated, stored, printed and processed.

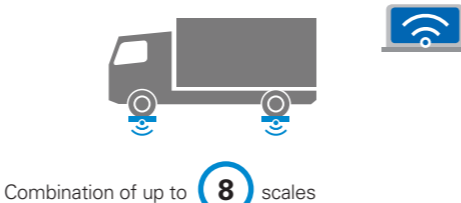


Combination of up to 20 scales

Data evaluation on the PC, data transmission via radio

Use of cables is not always possible or even desirable, therefore we have developed a special radio module for some wheel load scales. Integrated batteries provide the required energy. Each wheel

load scale is equipped with a radio module that transmits the measured values directly to a USB radio receiver on the PC. Further evaluation is realised using the HKM software.



Combination of up to 8 scales



Factory calibration – our service for your safety

Factory calibration checks whether the deviation between the verified reference weight (the so-called standard) and the displayed measured value lies within the prescribed tolerance range. The associated calibration certificate is included with the wheel load scale as verification of this inspection. Our wheel load scales do not require any maintenance. To ensure your safety and the traceability of measuring results, we recommend an inspection and recalibration at intervals of one to two years on our test rig.



Factory calibrated wheel load scales

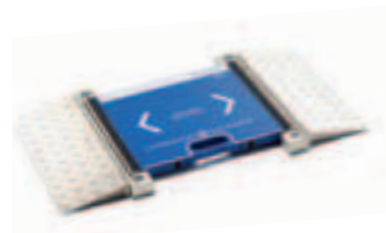
RW 2.0



The cost-effective wheel load scale for small load ranges

Small, light and highly accurate. Weighing in at only 6.5 kg, the RW 2.0 is the fly-weight among HKM wheel load scales. Its high degree of measuring accuracy makes it ideal for use on two-wheeled vehicles and light cars, particularly in motor racing. It also demonstrates its strengths when weighing gliders and ultralight aircraft. Measured values are displayed on an HKM hand-held terminal or PC, with data being transmitted exclusively via cable. Radio transmission of measurement data is not possible.

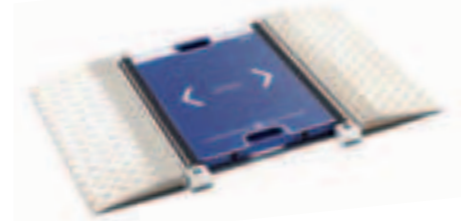
RW 8.1



The all-rounder for practically every weighing operation

The RW 8.1 combines an extremely high level of measuring accuracy with a broad spectrum of load ranges. This makes it an all-rounder among HKM wheel load scales. It is used in a broad range of car and van weighing applications and for sports aircraft and business jets. It is also the first choice when it comes to determining the support loads of, for example, cranes. Cable and radio connections are available for data transmission.

RW 9.1



Wheel load scale with large support surface for heavy loads

For anybody who needs to move heavy loads. The RW 9.1 is the largest wheel load scale in the HKM range. With an impressive 600 x 400 mm, it offers the largest weighing surface and can support loads of up to 10,000 kg. This is why it is used for weighing heavy trucks and heavy-duty vehicles with pneumatic tyres, but it is also employed to determine loads in the case of commercial and transport aircraft. Measurement data can also be transmitted by cable or radio.

Designs	RW 2.0	RW 8.1	RW 9.1
Nominal load range [kg]	100/500	1,000/2,000/8,000	10,000
Weighing surface (W x L) [mm]	420 x 430	382 x 400	600 x 400
Aircraft			
Gliders / UL aircraft	●	●	●
Business and sports aircraft	●	●	●
Commercial and transport aircraft	●	●	●
Two-wheelers			
Motorcycles	●	●	●
Cars			
Light cars	●	●	●
Cars	●	●	●
Motor racing	●	●	●
Trucks			
Vans and light trucks	●	●	●
Heavy trucks	●	●	●
Heavy-duty and special vehicles	●	●	●
Agricultural and forestry vehicles			
Tractor units	●	●	●
Trailers	●	●	●
Cranes (support load determination)	●	●	●

● Main areas of use ● Suitable areas of use



Overview of accessories for our factory calibrated wheel load scales

Designs	RW 2.0	RW 8.1	RW 9.1
Ramps recommended	●	●	●
Height compensation plates (W x L x H) [mm]	○	● 500 x 500 x 40	● 750 x 600 x 45

Wheel load scales with data transmission via cable			
Signal evaluation	Hand-held terminal optionally with printer (display for up to 4 wheel load scales)	●	●
	Wheel load scale software for PC (evaluation for up to 20 wheel load scales)	●	●
Power supply, 12 V (plug-in power supply or mobile battery pack)		●	●
1x connection cable per wheel load scale		●	●
1x dummy plug per system		●	●
Converter box with USB connection cable (for software only)		●	●
Carrying case, for up to 4 scales + terminal	○	●	○

Wheel load scales with radio data transmission			
Wheel load scale software for PC (evaluation for up to 8 wheel load scales with radio transmitter module)	○	●	●
Radio transmitter module: RFT 5.0, 1x per wheel load scale	○	●	●
Radio receiver: RFR 3.0, 1x per system	○	●	●
Plug-in charger power supply, for RFT 5.0	○	●	●
Carrying case, for up to 6 scales with RFT 5.0	○	●	○

● requirement | ● optionally available | ○ not available



SIGNED AND SEALED: OFFICIALLY VERIFIED WHEEL LOAD SCALES

Special tasks demand special measures. Use of verified measuring instruments, to give an example. Verified portable HKM wheel load scales are immediately recognisable. They are equipped ex works with a display module to meet statutory regulations. This turns them completely into independent scales. The force transducer, measurement amplifier and display form a single unit. Integrated rechargeable batteries ensure maximum flexibility, completely independent of a mains power supply.

You can use our portable and verified wheel load scales to weigh the most varied vehicles, speedily and with great precision. The scales are inspected and verified in the accuracy class III pursuant to DIN EN 45 501 and approved for commercial and official weighing operations. Verified wheel load scales are always to be found where official

measuring results are required. They are equally indispensable during weight and load inspections in road traffic and during vehicle development and production. Technical testing institutes trust in the reliability of HKM wheel load scales, and they are also to be found in use in agriculture and forestry, on building sites and in waste management.

Reading data on the display module



The measuring result of each individual wheel load can be read on the display module. Adding the individual wheel loads to obtain axle and vehicle loads is a task for the user. There are no inter-

faces to a printer or PC. The integrated tilt sensor registers the degree of slope on the measuring station. The scale only permits weighing if this slope is within the stipulated tolerance range.

What does verified mean?

Official verification is the inspection of a measuring instrument in accordance with measurement and calibration legislation. In contrast to calibration, official verification is a sovereign task in the Federal Republic of Germany and is realised exclusively by official measurement and calibration offices and state-approved testing bodies. The inspection determines whether statutory

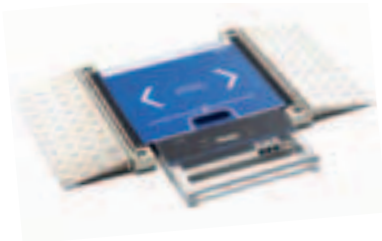
calibration regulations are observed, particularly error limits. The meeting of requirements is certified with a verification marking. This initial verification is valid from then on until the end of the following year. Following this, annual verification is necessary, and we will be more than happy to take care of this on your behalf at the measurement and calibration office.



We have the right wheel load scale for practically every purpose. When it comes to the question of whether a factory calibrated model can adequately realise the required task, or whether the use of an officially verified wheel load scale is mandatory, we will be happy to provide you with the answer.

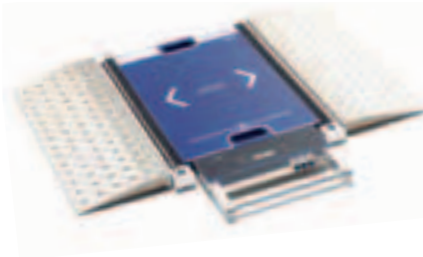
Officially verified wheel load scales

RWA 8.1.0 E RWA 9.1.0 E



Verified all-round wheel load scale for numerous load ranges

The RWA 8.1.0 E combines maximum measuring accuracy with a broad spectrum of load ranges. This makes it an all-rounder among verified HKM wheel load scales. It is used for weighing cars and trucks and for determining support loads. The wheel load scale is operated using the control and display module (see right side).



Verified wheel load scale for heavy loads

With a nominal load of 10,000 kg, the RWA 9.1.0 E covers the upper load range. In addition to heavy trucks, it is used mainly for weighing heavy-duty and special vehicles with pneumatic tyres. Twin tyres can also be accommodated on its 600 mm wide weighing surface. The control and display module is identical to that of the 8.1.0 E.



RWA series control and display module

The wheel load scale is easy to operate, as control is realised with three buttons. The wheel load weighed is displayed on the central backlit LCD display, and 5 LEDs also provide information on different scale operating conditions. The integrated batteries can be recharged via a connection socket.

Designs	RWA 8.1.0 E	RWA 9.1.0 E
Nominal load range [kg]	500 / 1,000 / 2,000 / 8,000	10,000
Weighing surface (W x L) [mm]	382 x 400	600 x 400
Cars	■	
Camper, Caravans	■	
Trucks		
Vans and light trucks	■	
Heavy trucks		■
Heavy-duty and special vehicles		■
Agricultural and forestry vehicles		
Tractor units	■	■
Trailers	■	■
Cranes (support load determination)	■	■

■ Main areas of use ■ Suitable areas of use

Overview of accessories for our officially verified wheel load scales

Designs	RWA 8.1.0 E	RWA 9.1.0 E
Ramps recommended	⊙	⊙
Height compensation plates (W x L x H) [mm]	⊙ 500 x 500 x 40	⊙ 750 x 600 x 45
Power supply, 12 V (plug-in power supply)	●	●

● requirement | ⊙ optionally available | ⊘ not available

RWA 8.1.0 E and RWA 9.1.0 E as a factory calibrated design

Both our scales with the display module are also available on request as factory calibrated RWA 8.1.0 and RWA 9.1.0 designs. Two scales of the same type can be operated via an optional connection cable as an axle load scale within the range not requiring official verification.



FOR UNIMPAIRED MEASURING RESULTS

Portable wheel load scales are extremely flexible and can be used practically anywhere and at any time. External influences, such as the quality of the ground or climatic factors, impair the accuracy of measuring results. Certain conditions therefore need to be fulfilled in order to guarantee the familiar precision of our products.

Condition of the ground

The ideal ground for use of our portable wheel load scales is firm, dry and absolutely level. Concreted or asphalted ground is best if correct weighing is to be achieved. Unsurfaced paths or sites and surfaces consisting of sand, gravel or snow are unsuitable and lead to erroneous measurements or even failure of the scale.

In addition, the measuring station should be level and adequately dimensioned to accommodate the size of the vehicle.

Climatic influences: Wind, temperature, damp

Climatic conditions influence the weighing results where HKM wheel load scales are used outdoors. External factors such as wind, extreme temperatures or severe precipitation can considerably impair measuring accuracy or make weighing impossible.

Small and light aircraft in particular are extremely sensitive to wind. It is recommended that weighing be realised in an enclosed hall or hanger to achieve precise load measurements. Also vehicles which, due to their structural design, react severely to wind influences can only be weighed with the required accuracy in areas protected against the wind.

The documented accuracy of all HKM wheel load scales relates to use within a defined temperature range. This usually lies between -10°C and $+40^{\circ}\text{C}$. Exact measurements are no longer possible if the ambient temperature deviates from this standard range.

Our portable wheel load scales are well protected against damp and precipitation. They can be used in light rain without any problem. However, the scales should not be immersed completely in water. Muddy or snow-covered surfaces are not suitable.

Impact of tilting on the measurement

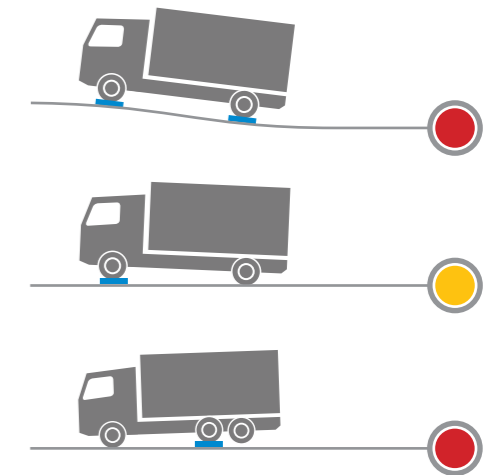
In addition to meeting certain requirements with regard to ground conditions, the measuring station should also be free of any slope. An uneven or precipitous weighing station is only suitable for correct weighing within a narrowly defined tolerance range. The same applies to the slope of a vehicle when driving on to the wheel load scales. Our height compensation plates can be used to achieve the correction of the slope necessary to obtain an accurate measuring result.

Impact of sloping ground and vehicle

Even asphalted and concreted outdoor sites and roads are usually never completely level. Portable HKM wheel load scales can be operated up to a slope of 1.4° in a longitudinal and transverse direction without negatively impacting the documented accuracy. A weighing site with a greater gradient is unsuitable for a measurement. A laser rangefinder with an integrated inclinometer is ideal for checking the slope.

The slope of the vehicle should also not exceed the limit values. Driving on to individual scales on one side shifts the

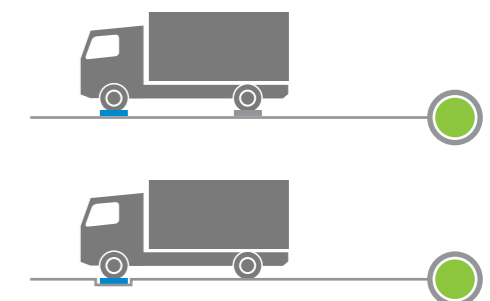
centre of gravity of the vehicle and, consequently, leads to inaccurate weighing results. The height difference needs to be compensated for where fewer wheel load scales are available than the vehicle has wheels. Appropriate compensation plates are included in our range for this purpose. In particular, this height compensation is essential in the case of vehicles with axles practically next to each other or the undercarriage of aircraft.



Height compensation plates and sunk wheel load scales

Height compensation plates are used during wheel load and axle load weighing to compensate for the height difference between the wheel load scales and ground. They replace missing wheel load scales, ensuring that all wheels are simultaneously at the same height level.

Scales can be set into the ground as an alternative to using height compensation plates. This also achieves a uniform height level. A water drain should be provided to protect the wheel load scales.



Weighing vehicles with a liquid load

The weighing of liquid loads represents a special case. In contrast to solid loads, transports with liquid substances are more susceptible to measuring errors.

The motion of the vehicle when driving on to the wheel load scales creates waves in the liquid. Reliable weighing is only possible after these have settled.



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sumbul, Richard Lightscapes



HKM-Messtechnik GmbH
Ziegelhofstraße 228
79110 Freiburg
Germany

Phone +49 761 89 607-0
Telefax +49 761 89 607-66
info@hkm-messtechnik.de
www.hkm-messtechnik.com

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