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P U B L I C D E C R E E

As the authority with substantive and territorial jurisdiction in the matter of laying down metrological and technical requirements for legal measuring instruments and laying down the methods for type approval and verification of legal measuring instruments under § 14(1) of Act No 505/1990 on metrology, as amended (hereinafter the 'Metrology Act'), and in accordance with the provisions of § 172 et seq. of Act No 500/2004, the Code of Administrative Procedure (hereinafter the 'CAP'), the Czech Metrology Institute (hereinafter the 'CMI') commenced ex officio proceedings on 1. 8. 2023 pursuant to § 46 of the CAP, and, based on supporting documents, issues this:

I.

MEASURE OF A GENERAL NATURE

number: 0111-OOP-C010-24

stipulating metrological and technical requirements for specified measuring instruments, including test methods for type approval and verification of specified measuring instruments:

'high-speed weigh-in-motion road vehicle scales'

1 Basic definitions

For the purposes of this measure of a general nature, terms and definitions of the VIM[1)] and the following shall apply:

1.1 High-speed weigh-in-motion road vehicle scales (hereinafter '**scales**'**):** automatic scales that measure dynamic forces on the tyre of a moving vehicle and detect its presence on a load cell according to time and calculate the values of the total vehicle mass and axle load or group of axles, or other vehicle parameters required by a special regulation, directly while the vehicle is in motion and on its route and for which the requirements of special legislation apply[2)]

1.2 load cell: a sensor of the dynamic force exerted by a vehicle tyre on the road

1.3 weighing in entirety: determining the mass of a vehicle that is entirely on the load plate

1.4 static weighing: weighing the entire vehicle, load on axles or test load that is static without movement

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[1)1)] International Vocabulary of Metrology – Basic and general concepts and associated terms (VIM).

[2)2)] For example, Act No 13/1997 *on roads*as amended.

1.5 weigh-in-motion: a process that uses measurement and analysis of dynamic forces on vehicle tires to determine the overall load exerted by a moving vehicle and the portions of this load that are transferred by the wheels or axles of this vehicle

1.6 vehicle mass: the entire mass of vehicle trailers including all connected parts and cargo/payload

1.7 axle: an axle containing two or more wheel assemblies spanning the entire width of the vehicle

1.8 axle group: a group of two or more axles on the same vehicle, defined by the total number of axles whose centre points are separated by less than a value specified by special legislation[3)]

1.9 axle load: the portion of vehicle mass that is exerted via the axle on the load cell during weighing

1.10 axle group load: total load on all axles that are part of an axle group

1.11 dynamic force on a tyre: a force component changing over time applied perpendicular to the road surface by the tire on a moving vehicle; in addition to the force of gravity, this force can also include other dynamic effects on the moving vehicle

1.12 weighing range: the range between the minimum and maximum value of a measured variable magnitude, where scales function within the scope of given specifications

1.13 scale interval, *d*: the difference between two consecutive indicated or printed mass values during weigh-in-motion, expressed in units of mass

1.14 operating speed, *v*: the average speed of a moving vehicle as it passes over a load cell, if it is to be weighed

1.14.1 maximum operating speed, v_{max}: the maximum vehicle speed for which a scale is designed for weigh-in-motion, and above which it is not guaranteed that the maximum permissible error will not be exceeded

1.14.2 minimum operating speed, v_{min}: the minimum vehicle speed for which a scale is designed for weigh-in-motion, and below which it is not guaranteed that the maximum permissible error will not be exceeded

1.14.3 operating speed range: the speed interval specified by the manufacturer between the minimum and maximum operating speeds for which the vehicle may be weighed in motion

1.15 maximum weighing limit (*Max*): the maximum weight the load cell can measure during weigh-in-motion

1.16 minimum weighing limit (*Min*): the load value below which weigh-in-motion results can be subject to excessive relative error

1.17 reference scales: scales used for the static determination of the mass of a reference vehicle and the load on individual axles of the reference vehicle

1.18 vehicle: a road vehicle, under load or not, that is recognized by scales as a vehicle that is to be weighed

1.18.1 rigid vehicle: a two-track road vehicle with a single chassis, not including any trailer or semi-trailer, and with two or more axles located along the length of the chassis

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[3)] Decree No 209/2018 *weights, dimensions and connectivity of vehicles*as amended.

1.18.2 reference vehicle: a vehicle having a known conventional mass determined by reference scales (both total mass and axle load are considered)

1.19 software subject to metrological verification of measuring instruments: program(s), data and specific parameters of scale types that belong to a measuring instrument or equipment, and that define or perform functions that are subject to metrological verification of measuring instruments

1.19.1 software parameter subject to metrological verification of measuring instruments: a parameter of software of a measuring instrument or one of its modules that is subject to metrological verification of measuring instruments

1.19.2 software identification: a sequence of legible characters that is a permanent part of the software (e.g. version number, checksum)

1.20 simulated functional test: a test performed on complete scales or parts thereof, where each part of the weighing operation is simulated

1.21 weighing zone: a road section consisting of built-in load cells and required minimum lengths of road sections ahead and behind the load cells

1.22 vehicle recognition equipment: equipment that detects the presence of a vehicle in the weighing section and whether or when the entire vehicle has been weighed. The equipment must, by the nature of the information obtained (together with optical vehicle identification equipment) provide the prerequisites for subsequent categorisation of vehicles pursuant to special legislation[3)]

1.23 v**ehicle speed measurement equipment:** equipment that measures the speed of the weighed vehicle for the purpose of determining whether the operating speed limit values for which the scales have been designed or verified have not been exceeded

1.24 indicator: an electronic device displaying the weighing results in units of mass and other information, if applicable

1.25 printer: a device designed to make printed copies of weighing results and other information

1.26 recording equipment: equipment that records and stores measurement data

1.27 optical vehicle identification equipment: equipment intended for the unambiguous identification of vehicles that during weighing have been assessed as exceeding stipulated mass parameters

1.28 auxiliary equipment: other equipment connected or connectible to the scales via manufacturer-specified interfaces that cannot affect the metrological characteristics of the system

2 Metrological requirements

During verification, measuring instruments are subject to the metrological requirements applicable at the time they were placed on the market or into circulation.

2.1 Rated operating conditions

2.1.1 Operating temperature range

Scales must meet metrological requirements at temperatures from -20 °C to +40 °C.

The load cells used and the other sensors situated in the road must fulfil metrological characteristics at temperatures of at least -20 °C to + 60 °C.

For the purpose of type approval, the manufacturer may specify another (greater) operating temperature range.

2.1.2 Operating speed

Scales must meet applicable metrological requirements at vehicle speeds within the stipulated range of operating speeds. If the actual speed of a vehicle is outside the range of the scales' operating speeds during weighing, the scales must (see 3.4):

- either automatically block the release of the measurement result, or
- indicate or print out the value of the measured actual vehicle speed, and at the same time indicate or print out a clear warning that the measurement is outside the scales' operating speed range.

The operating speed must be indicated and/or printed out only after the entire vehicle has been weighed in motion.

Within the operating speed range specified in the measuring instrument type approval certificate, the error indicated in the indicated operating speed must not exceed 2 km/h.

2.2 Weighing range

The manufacturer of the scales specifies the weighing range, which is given by the values *Max* and *Min* , for purposes of type approval and subsequent use.

The manufacturer must specify the manner in which the scales react when the *Max* weighing range value is exceeded and how they indicate this condition.

2.3 Maximum permissible errors during verification

2.3.1 Vehicle mass

The maximum permissible error for vehicle mass determined by weighing in motion is 5 %.

2.3.2 Axle load

The maximum permissible error for axle load determined by weighing in motion is 11 %.

2.4 Maximum permissible errors in traffic

2.4.1 Vehicle mass

The maximum permissible error for vehicle mass determined by weigh-in-motion in traffic is 7 %.

The parameter referred to in Article 3.15.2(e) must not exceed 1.5 times the stipulated value when using the measuring instrument.

2.4.2 Axle load

The maximum permissible error for axle load determined by weigh-in-motion in traffic is 15 %.

The parameter referred to in Article 3.15.2(e) must not exceed 1.5 times the stipulated value when using the measuring instrument.

2.5 Units of measurement

The units of mass and load used in the equipment are the kilogram (kg) or tonne (t).

2.6 Scale interval

The scale interval must not exceed the values given in Table 2.

Table 2 – Scale interval

Axle load	20 kg
Vehicle mass	50 kg

The scale interval of indicator, recording or printing equipments shall be in the form of 1×10^k, 2×10^k or 5×10^k, where k is a positive or negative integer or zero.

3 Technical requirements

During verification, measuring instruments are subject to the technical requirements that were applicable when they were placed on the market or into circulation.

3.1 In general

Scales are an automatic measuring system consisting of the following parts:

- load cells installed on the road;
- vehicle recognition equipment;
- vehicle speed measuring equipment;
- indication equipment;
- printing equipment;
- recording equipment;
- equipment for the optical identification of vehicles;
- auxiliary equipment;

that as a whole is capable of measuring dynamic forces on tyres and detecting the presence of a moving vehicle on the load cell time, and of calculating total vehicle mass and axle or axle load values, speed, plus other vehicle parameters required by special legislation[3)] (e.g. axle separation, vehicle type).

The scales must be designed so that they are suitable for as great a range of vehicle types utilised for regular road use as possible.

The scales must be laid out and built in such a way that when they are correctly installed and used in their intended environment, they maintain their metrological parameters to the extent specified by this legislation for at least the period for which their verification is valid.

3.2 Load cell

A load cell installed in the roadway must detect the presence of a moving vehicle and record the dynamic forces on the tyres.

3.3 Vehicle recognition equipment

Scales are intended for operator-free operation, and thus must have vehicle recognition equipment. The equipment must detect the presence of a vehicle in the weighing zone and must ascertain when the entire vehicle was weighed. Given the nature of the information obtained, the equipment must permit the subsequent categorisation of vehicles in accordance with special legislation[4)].

The scales must not indicate, record or print out the mass of the vehicle if all of the vehicle's wheels were not weighed.

[4)] Decree No 153/2023 *on vehicle roadworthiness approval and technical conditions of vehicle operation on roads*.

3.4 Vehicle speed measuring equipment

The speed of a vehicle during weighing must be indicated, and if appropriate recorded and printed out as part of the vehicle weighing record, in km/h, after being rounded to the nearest whole number.

The scales must not indicate, record or print out the mass or axle or axle group values for any vehicle that has passed over the load cell at a speed outside the specified range of operating speeds without an accompanying clear warning signal that these results are not verified.

3.5 Indication equipment

3.5.1 Indication during normal operation

Displayed mass and load values must be indicated precisely and unambiguously, and must not lead to errors.

Scales are intended for indication of the following values:

- measured values of the total mass, including the unit of measurement;
- measured values of axle or axle group load, including the unit of measurement;
- the maximum permissible total mass value, including the unit of measurement;
- the maximum permissible axle or axle group load, including the unit of measurement;
- the speed of the vehicle being weighed;
- the time (the date, hour, minute and second the measurement was performed), if appropriate.

If scales in a corresponding application are not intended and approved for total mass or axle or axle group load, the scales can indicate this value for information only, clearly marked that this indication is not in the verified range of measurement.

3.5.2 Limit indication values

Scales may indicate, record or print out data on measurement of axle load, axle group load or vehicle mass, if single-axle load (partial weighing) is lower than *Min* or greater than *Max* only if the indication and/or printed output is accompanied by a clear warning of this problem.

3.6 Printing equipment

3.6.1 Print output during normal operation

The printed results must be correct, appropriately identified and unambiguous. Printing must be clear, legible, indelible and permanent.

The contents of the printed output are based on the values for which the scales are intended, as follows:

- the measured value of the total mass, including the unit of measurement;
- the measured value of the axle load(s), including the unit of measurement;
- the maximum permissible total mass value, including the unit of measurement;
- the maximum permissible axle or axle group load, including the unit of measurement;
- time (resolution to the second) and date (day, month, year);
- the speed of the vehicle being weighed;
- the type of scales (e.g., an abbreviation).

If scales in a corresponding application are not intended and approved for total mass or axle or axle group load, the scales can indicate this value for information only, clearly marked that this indication is not in the verified range of measurement.

3.6.2 Agreement between indication and printing equipment

For the same load, there must not be any difference between the indicated and printed weighing result, if the indication and printing equipment have the same scale interval.

3.7 Recording equipment

3.7.1 Scope of recorded data

The recording equipment must record and store all relevant measurement data. The minimum scope of data recorded and stored by this equipment is the same as the contents of printed output pursuant to article 3.6.1.

3.7.2 Data memory

Data may be stored in the scales' memory (e.g. on a hard disk) or in external storage for subsequent operations (indication, printing, transmission, summation, etc.). Stored data must be reasonably protected against intentional and unintentional changes during the transmission and/or storage process, and must contain all relevant information needed to reconstruct past measurements.

The following requirements apply to the security of stored data:

a) relevant security requirements in Article 3.14;

b) the software transmission and download process must be secured in accordance with requirements in Article 3.14;

c) external memory identification and security attributes must ensure integrity and authenticity;

d) exchangeable storage media for storing measurement data need not be sealed, providing that stored data is secured by a specific checksum or key code;

e) if the memory capacity is exhausted, data may be overwritten by new data using a code key or in another way compatible with the above requirements.

3.8 Optical vehicle identification equipment

Scales must be equipped with a device pursuant to Article 3.8.1 or 3.8.2 for the unambiguous identification of those vehicles that during weighing were found to exceed specified mass parameters. This identification must meet security, integrity and authenticity requirements.

3.8.1 Imaging unit

Scales may be equipped with a digital camera that captures the weighing situation with dependable identification of the weighed vehicle, which is displayed on a connected remote display along with the following values measured by the scales:

- measured values of total mass, including the unit of measurement;
- measured values of axle or axle group load, including the unit of measurement.

3.8.2 Image recording unit

Scales must be equipped with an image recording unit that must capture the situation during weighing, ensuring identification of the vehicle being weighed.

An image-recording unit working in automatic mode may enable the setting of a limit mass for image recording.

The situation on the scales is recorded by a digital camera, which outputs individual digital images or video sequences stored in digital memory.

The following must be displayed on individual images or in video sequences in the data display field:

- measured values of total mass, including the unit of measurement;

- measured value of axle load, including the unit of measurement;
- time (resolution to the second) and date (day, month, year);
- the type of scales (e.g., an abbreviation).

If the above data is displayed only on the main image, the other images must be marked with a unique identifier that ensures the integrity, authenticity and unambiguous identification of the images and associated data. The image identifier must be generated using a cryptographically strong algorithm or digital signature and shall contain information on the exact time the image was taken and the equipment that carried out the weighing and its geolocation.

For digital images, image information and information regarding measured values must be inseparably joined into one data file. This information must also be integrated into the pixel structure of the digital image. To ensure integrity, the digital image data file must have a digital mark (signature). The origin (authenticity) of the entire digital image data file must be uniquely identifiable (e.g. the ID number of the scales).

Video sequences to be archived must have their integrity (integrity) and origin (authenticity) ensured in order to avoid undue changes in the content of images and measured data or incorrect assignments.

3.9 Auxiliary equipment

Any external equipment connected to the scales via an appropriate interface must not have a negative influence on their metrological parameters.

3.10 Resistance to external influences

Disruptive external influences on the scales must not lead to measurement errors that would exceed the scales' greatest permissible error according to Articles 2.3.1 or 2.3.2.

3.10.1 Physical durability

The design of the scales and materials used must guarantee sufficient rigidity, stability and resistance to mechanical vibrations and shocks. The manufacturer must specify the physical conditions in which the scales should be used. For the load cell, a physical environment class with high or very high level of vibrations and shocks applies, designated as M3 pursuant to special legislation[5)].

3.10.2 Weather resistance

In its off state, a load cell installed in a roadway must be able to withstand temperatures between -40 °C and 70 °C without damage, and after returning to its operating temperature range, must function within the range of maximum permissible error.

To ensure correct measurement in relation to ambient temperature and the scales' operating temperature range, the scales must have a temperature measurement device. The scales must be capable of automatically recognizing a temperature outside the operating temperature range and displaying a suitable warning. Any weighing taking place at that moment must be terminated and the scales must block further weighing or switch themselves off.

The scales must not be sensitive to ambient relative humidity.

3.10.3 Resistance to dust and water

Those portions of the scales that are subject to the effects of weather must have at least an IP 67 housing to provide protection from dust and temporary immersion in water, and other parts at least IP 54.

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5) Government Regulation No 120/2016 *on conformity assessment of measuring instruments when made available on the market*, as amended, implementing Directive 2014/32/EU of the European Parliament and of the Council of 26 February 2016 *on the harmonisation of the laws of the Member States relating to the making available on the market of measuring instruments*.

3.10.4 Electromagnetic compatibility (EMC)

The scales must not be influenced by electrical or electromagnetic interference, or must react to it in a defined manner (e.g. reporting an error, blocking measurement, etc.). They must also not radiate any unwanted electromagnetic fields.

During laboratory EMC tests, the scales or parts thereof must exhibit normal function and the results of simulated functional tests must be within the limits of greatest permissible error pursuant to Articles 2.3.1 or 2.3.2.

3.11 Power

Scales powered from the electrical grid must meet metrological requirements under normal voltage fluctuation conditions. If voltage declines below the minimum operating voltage, the scales must be blocked from working or their activity outside specified operating conditions must be clearly indicated, for example by a suitable warning.

3.12 Measuring instrument security and fraud protection

Scales must not have characteristics that would facilitate fraudulent use, and there must be a minimum of ways in which they can be unintentionally improperly used. Components that are not intended to be disassembled or adjusted by the user must be protected from such activity.

3.13 Software

3.13.1 Software subject to metrological verification of measuring instruments

The software used in scales must be presented in such a form that software cannot be changed without damaging a seal, or each change in software can be automatically recorded and its nature specified with the use of an ID code.

The software documentation for scales must include:

a) a description of the software subject to metrological verification of measuring instruments;

b) a description of measurement algorithm accuracy (e.g. programming modes);

c) a description of the user interface, menus and dialogues;

d) unique identification of the software;

e) a description of included software (e.g. operating environment);

f) a hardware system overview, e.g. a topological block diagram, type of computer(s), source code for software functions, etc., if not described in the user manual;

g) software security resources;

h) a user manual.

3.13.2 Software security resources

Resources for securing software subject to metrological verification of measuring instruments are as follows:

a) only authorized individuals may be given access, for example using codes (passwords) or a special device (hardware key, etc.); codes must be changeable;

b) the measuring instrument's memory must store all accesses, listing the date of the access, identification of the authorized individual performing the access, and the type of access;

c) memory capacity must be sufficient for at least 2 years of expected accesses; if memory capacity for access record storage is exhausted, no automatic erasure of any stored records can take place;

d) it must be possible to recall relevant access records to the full extent of information recorded;

e) it must not be possible to erase access records without removing a physical seal;

f) downloading of software subject to metrological verification must be possible only via an appropriate secure interface connected to the scales;

g) the software must include identification of its version, which must change if any software version changes occur;

h) functions that are performed or launched via a software interface must meet the terms and conditions of this legislation.

3.14 Hardware and software security

3.14.1 In general

All scale equipment including software, which is intentionally to be prevented from disconnection or removal by a user or other individual, must be equipped with a housing or other suitable means of security. It must be possible to seal housings after their closure; sealing points must be easy to access in all instances. All parts of the measuring system that cannot be protected by housings must be equipped with sufficiently effective means of preventing operations that tend to influence measuring accuracy.

Each piece of scale equipment that could influence measuring results, especially equipment for calibration and adjustment of scales or for correction of measured values, must be sealed.

3.14.2 Means of security

Security must consist of sealed housings, encryption, passwords or similar software means in such as way that:

a) the software security requirements in Article 3.13.2 apply;

b) transmission of measurement results data via an interface must be protected from intentional, unintentional and random changes;

c) the scales must be secured in such a way to make it possible to secure scale settings separately;

d) stored data must be protected from intentional, unintentional and random changes.

3.15 Installation of scales

3.15.1 In general

Scales must be installed to minimise any adverse effects of the installation environment on measuring accuracy and related data. The scales shall preferably be installed outside areas where frequent acceleration or deceleration could occur and must not be installed in sections where the number of lanes changes.

All installation requirements that have an effect on the weighing operation must be stipulated in sufficient detail. The manufacturer of the scales shall, if necessary in relation to the basic requirements of Articles 3.15.2 and 3.15.3 and to ensure correct weighing of vehicles, stipulate more detailed specifications for installation requirements. Those closer requirements shall be included in the measuring instrument type approval certificate.

Where relevant, other conditions or recommendations for the installation of scales providing conditions for ensuring adequate long-term stability of their metrological characteristics (e.g. more detailed requirements for the qualitative characteristics of the road within the weighing zone) shall be indicated by the manufacturer in the technical documentation of the specified measuring instrument or in the installation or operating instructions of the given type of scales.

3.15.2 Roadway geometry

The section of roadway at least 75 m in front of and 25 m past the load cell must meet the following requirements:

a) the road gradient must be ≤ 1 %;

b) the road's cross slope must be ≤ 3 %;

c) the radius of curvature of the road's longitudinal axis must be ≥ 1000 m;

d) the road must be free of irregularities causing local gradient changes;

e) the depth of ruts must not be greater than 4 mm.

For the purpose of type approval, other criteria for roadway geometry specified under points (a) to (c) specified by the manufacturer are also permitted if the applicant for type-approval demonstrates by means of sufficiently representative evidence (in particular the results of tests of installed weights of a given or structurally related type) that, even under these conditions, the scales meet the other requirements pursuant to this measure, in particular the requirements for the maximum permissible errors pursuant to Article 2.3 or 2.4 (see Article 5.4.6.3). The different conditions must be specified in the type approval certificate.

3.15.3 Roadway characteristics

The roadway in the load cell installation location must meet the following requirements:

- below the roadway's top layer, there must be a standard substrate without reinforced locations (e.g. without special facilities such as service shafts, etc.);
- load cells must be installed in homogeneous layers where the surface is undamaged;
- along the entire span of load cells, the roadway must be homogeneous across each traffic lane and without masonry joints;
- the scales' load cells must not be installed in locations where undesirable dynamic effects could occur.

4 Measuring instrument markings

During verification, measuring instruments are subject to the marking requirements that were applicable when they were placed on the market or into circulation.

4.1 Markings on measuring instruments

Scales must bear the following markings:

- the manufacturer’s identification mark;
- identification of the type of scales;
- the serial number of the scales;
- if scales are not suited or intended for weighing vehicles that have specific characteristics (e.g. axle suspension design, number of axles) or transporting loads with specific characteristics (e.g. liquids), they must be marked with a notice or this restriction on suitability for weighing with a clear specification of the type and scope of this restriction (if relevant for the scales in question);
- the direction of weighing (if applicable for the scales);
- power supply voltage, in V;
- power supply frequency, in Hz;

- operating temperature range (if different from the minimum requirements pursuant to Article 2.1.1), in °C;
- identification of the software (if appropriate);

and the following information on metrological parameters:

- upper weighing limit *Max* =....., in kg or t;
- lower weighing limit *Min* =....., in kg or t;
- scale interval *d* =....., in kg or t;
- maximum operating speed v_{max} =....., in km/h;
- minimum operating speed v_{min} =....., in km/h;
- maximum number of axles per vehicle (if applicable) A_{max};
- type approval mark in accordance with national requirements.

4.2 Presentation of markings

The markings pursuant to Article 4.1 must be legible, unambiguous and intelligible and indelible under the scales' normal conditions of use.

These markings may be either in the Czech language or in the form of adequate internationally agreed and published symbols or signs.

Markings must be grouped together in a clearly visible place on the scales on the indicating device in its immediate vicinity or on an easily accessible, clearly visible non-removable part of the scales. If the markings are not a fixed part of a non-removable part of the scales, they must be secured with an official mark.

4.3 Official marks

Scales and components thereof must permit the placement of an official mark or marks so that:

- scale components on which marks are placed cannot be removed from the scales without damaging the marks;
- the marks can be placed without changing the metrological characteristics of the scales;
- they are visible on the scales during normal installation.

5 Measuring instrument type approval

The following are performed during type approval:

- external inspection;
- tests of the scales' resistance to disruptive environmental effects;
- functional weigh-in-motion tests on location during road traffic.

5.1 External inspection

During an external inspection of scales, the following are assessed:

a) that prescribed technical documentation is complete, including a user manual;

b) that metrological and technical characteristics specified by the manufacturer in documentation comply with the requirements of this legislation specified in chapter 2 and 3;

c) that functional wholes are complete and comply with prescribed technical documentation;

d) that the scales' software version agrees with the version specified by the manufacturer.

5.2 Simulated functional tests in the laboratory

Simulated functional tests are performed when assessing resistance to the influence of the external environment according to 5.3, on complete scales unless the size and/or configuration of the scales makes it impossible to test them in their complete form. In such cases, testing is allowed with a load signal generator taking the place of load cells.

The metrological body approving measuring device types can accept a manufacturer's proposal to modify the method and manner in which simulated functional tests are performed, if suitable with regards to the specifics of the technology and design of the scales' measurement chain.

5.3 Tests of resistance to the influence of the external environment

5.3.1 Tests of resistance of scales to physical effects

5.3.1.1 Test of the resistance of scales to random vibrations

Resistance to random physical vibrations is tested on scales in their on state by applying vibrations with the following parameters:

- frequency range: 10 Hz to 150 Hz;
- overall effective acceleration level: 7 m/s^2,
- spectral density of acceleration 10 Hz to 20 Hz: 1 m^2/s^3;
- spectral density of acceleration 20 Hz to 150 Hz: -3 dB/octave;

in all three axes, always for 2 minutes.

During this test the tested scales must remain functional, and during the subsequent simulated functional test, measurement error must not exceed the maximum permissible error listed in Article 2.3.1 or 2.3.2.

5.3.1.2 Impact resistance test

Impact resistance is tested with the scales switched on, by applying repeated impacts with the following parameters:

- peak acceleration: 100 m/s^2;
- duration of rated impulse: 16 ms;
- corresponding change in velocity; 1 m/s;
- number of impacts in each direction: 1000 ± 10.

During this test the tested scales must remain functional, and during the subsequent simulated functional test, measurement error must not exceed the maximum permissible error listed in Article 2.3.1 or 2.3.2.

5.3.2 Weather resistance tests

5.3.2.1 Test of resistance to limit temperatures

Resistance to limit ambient temperatures pursuant to Article 3.10.2 is tested with the scales switched off:

a) with dry heat at 70 °C for 2 h;

b) with cold at -40 °C for 2 h.

Following this test, the scales must not exhibit any damage, and during the following simulated functional test, measurement error must not exceed the maximum permissible error listed in Article 2.3.1 or 2.3.2.

5.3.2.2 Resistance to operating temperatures

Resistance to operating ambient temperatures pursuant to Article 2.1.1 is tested with the scales switched on:

a) with dry heat at the upper limit of the ambient operating temperature range for 2 h;

b) with cold at the lower limit of the ambient operating temperature range for 2 h.

During this test the scales must function normally, and the error during a simulated functional test must not exceed the maximum permissible error listed in Article 2.3.1 or 2.3.2.

5.3.2.3 Resistance to air humidity

Resistance to air humidity pursuant to Article 2.2 is tested with the scales switched on with two 24-hour cycles of moist heat with a maximum temperature of 40 °C.

During this test the tested scales must remain functional, and during the subsequent simulated functional test, measurement error must not exceed the maximum permissible error listed in Article 2.3.1 or 2.3.2.

5.3.2.4 Dust and water resistance

Dust and water resistance pursuant to Article 3.10.3 is tested in the off state on those parts of the scales that are exposed to the effects of weather.

Following this test, the scales must not exhibit any damage, and during the following simulated functional test, measurement error must not exceed the maximum permissible error listed in Article 2.3.1 or 2.3.2.

5.3.3 Electromagnetic compatibility (EMC) tests

5.3.3.1 Immunity to conducted disturbances induced by radio-frequency fields

Immunity to conducted disturbances induced by high-frequency fields is tested with the scales switched on, over a 150 kHz to 80 MHz frequency range with a test field amplitude of 10 V. The interference is applied to signal cabling longer than 3 m, at all DC power inputs and outputs, at all AC power inputs and outputs, and at all functional ground connections.

During a simulated functional test under the given test conditions, measurement error must not exceed the maximum permissible error listed in Article 2.3.1 or 2.3.2., or the system must detect a serious error and react to it.

5.3.3.2 Immunity to radiated radio-frequency electromagnetic fields

Immunity to radiated high-frequency electromagnetic fields is tested with the scales switched on, in the 80 MHz to 2 GHz frequency range with test field intensity amplitude of 10 V/m and 80% amplitude modulation with a 1 kHz sinus wave. The interference is applied to all sides of the scales' housing.

During a simulated functional test under the given test conditions, measurement error must not exceed the maximum permissible error listed in Article 2.3.1 or 2.3.2., or the system must detect a serious error and react to it.

5.3.3.3 Immunity to electrostatic discharge

Immunity to electrostatic discharge is tested with the scales switched on, preferably with a contact discharge of 6 kV or with an 8 kV air discharge. Discharges are applied to the scales' housing and to coupling plates near the scales.

During a simulated functional test under the given test conditions, measurement error must not exceed the maximum permissible error listed in Article 2.3.1 or 2.3.2., or the system must detect a serious error and react to it.

5.3.3.4 Immunity to electrical fast transient/burst disturbances

Immunity to electrical fast transients/bursts is tested with the scales switched on at a no-load test voltage of ± 1 kV in positive and negative polarity for at least 1 minute in each polarity on power and signal terminals with a repeat frequency of 5 kHz. The interference is applied to signal cabling longer than 3 m, at all AC power inputs and outputs, and at all functional ground connections longer than 3 m.

During a simulated functional test under the given test conditions, measurement error must not exceed the maximum permissible error listed in Article 2.3.1 or 2.3.2., or the system must detect a serious error and react to it.

5.3.3.5 Immunity to surges

Immunity to surges is tested with the scales switched on by applying a surge of:

- ± 1 kV line to ground; to signal lines longer than 30 m;
- ± 0.5 kV line to line and a symmetrical test voltage of ± 0,5 kV on DC power lines longer than 10 m.

Interference is applied to signal lines longer than 30 m or to lines partly or entirely installed outdoors, regardless of their length.

During a simulated functional test under the given test conditions, measurement error must not exceed the maximum permissible error listed in Article 2.3.1 or 2.3.2., or the system must detect a serious error and react to it.

5.3.3.6 Immunity to power-frequency magnetic fields

Immunity to 50 Hz magnetic fields is tested with the scales switched on with a continuous magnetic field of intensity 30 A/m on the equipment housing.

During a simulated functional test under the given test conditions, measurement error must not exceed the maximum permissible error listed in Article 2.3.1 or 2.3.2., or the system must detect a serious error and react to it.

5.3.3.7 Immunity to AC mains voltage dips

Immunity to short AC mains voltage dips, short interruptions and slow voltage variations is tested with the scales switched on at all AC power inputs with a supply current of < 16 A by applying a voltage reduction:

- of 40 % of U_N for 10 AC voltage cycles;
- of 70 % of U_N for 25 AC voltage cycles;
- of 80 % of U_N for 250 AC voltage cycles;

where U_N is the nominal value of AC mains voltage.

During a simulated functional test under the given test conditions, measurement error must not exceed the maximum permissible error listed in Article 2.3.1 or 2.3.2., or the system must detect a serious error and react to it.

5.3.4 Test of immunity to supply voltage limit values

Immunity to supply voltage limit values is tested with electronic devices switched on. For AC, its limits are given as U_{nom} — 15 % and U_{nom} + 10 %, where U_{nom} is the rated supply voltage.

During a simulated functional test under the given test conditions, measurement error must not exceed the maximum permissible error listed in Article 2.3.1 or 2.3.2., or the system must detect a serious error and react to it.

5.4 Weigh-in-motion accuracy road tests

5.4.1 In general

Complete scales installed pursuant to Article 3.15 are subjected to weigh-in-motion accuracy tests.

5.4.2 Test equipment

5.4.2.1 Reference vehicles

The reference vehicles used in weigh-in-motion tests must represent the range of use of the scales specified by their manufacturer for the purpose of type approval. Reference vehicles are intended to represent different vehicle designs, axle configurations, connection and suspension systems.

At least the following reference vehicles shall be used:

- a rigid two-axle vehicle;
- a rigid three-axle or four-axle truck;
- a tractor with a semi-trailer with a minimum of three axles;
- a rigid truck with a trailer with two or three axles.

If the scales are to be used to determine vehicle mass or single-axle or axle group loads for vehicles transporting loads whose centre of gravity can shift during vehicle motion, reference vehicles must include those carrying loads in the form of liquids or other products that can change the position of their centre of gravity during vehicle motion.

5.4.2.2 Reference vehicle loading

The combination of the reference vehicles used and their chosen load must represent the measuring range of the instruments specified by their manufacturer for the purpose of type approval.

Vehicle loads shall be selected in such a way that the maximum permitted values of the total mass of the vehicles and the maximum permitted values of the axle(s) are not exceeded, pursuant to a special legislation[3)].

5.4.2.3 Reference scales

During testing, standalone reference scales must be available to determine the conventional true mass value of each vehicle and the reference single-axle or axle group load.

5.4.2.3.1 Reference scales for measuring reference vehicle mass

To determine the conventional overall mass value of reference vehicles, preference is given to stand-alone reference scales that can determine the conventional mass value of each reference vehicle by weighing it all at once with an error less than or equal to one third of the applicable MPE for weigh-in-motion pursuant to Article 2.3.1.

5.4.2.3.2 Reference scales for measuring reference axle load of a reference vehicle

To determine the conventional axle load, stand-alone portable reference scales for weighing Class III or IV vehicles are used, or low-speed scales of accuracy class 1 or better.

5.4.3 Test conditions

Tests are performed under operating conditions stipulated by the manufacturer of the scales in question.

5.4.4 Determining reference values for reference vehicles

5.4.4.1 Conventional true value of the reference vehicle mass

The conventional true mass value for each reference vehicle, unloaded and loaded, must be determined by static full-draught weighing on reference scales (see Article 5.4.2.3.1).

5.4.4.2 Conventional true value of the axle load of a reference vehicle

Reference scales are used to determine conventional axle load values for an unloaded and loaded reference vehicle (see Article 5.4.2.3.2).

The reference scales are used to sequentially determine the load on each axle of the reference vehicle, with at least three to five test runs in both directions. The mean reference axle load is calculated as the arithmetic average of recorded values.

To correct for the influence of the method used, the total vehicle mass is calculated by axles as the sum of mean load values on individual axles VM.

The corrected mean reference load value per axle is then:

$$CorrAxle_i = Axle_i \times \frac{VM_{ref}}{VM} \tag{1}$$

where: VM_{ref} is the conventional value of each reference vehicle mass determined by full-draught weighing pursuant to Article 6.2.2.1.

To verify that reference axle loads are correct, the following must apply:

$$VM_{ref} = \sum_{i-1}^{2} \overline{CorrAxle_i}$$

The corrected mean load value (see above) is used as the conventional per-axle load of the reference vehicle.

5.4.5 Verification of scales installation at the weighing location

Road geometry is checked pursuant to Article 3.15.2, and must meet all criteria.

5.4.6 Weigh-in-motion reference vehicle tests

5.4.6.1 Test runs

Each reference vehicle must perform at least ten test runs at each of the three following speeds:

a) near the maximum operating speed, v_{max};

b) near the minimum operating speed, v_{min};

c) near the middle of the operating speed range;

(each reference vehicle must thus perform a total of 30 test runs).

For every ten test runs at a given test speed, the vehicle must be positioned above the centre of the load cell six times, twice on the left and twice on the right side of the load cell.

5.4.6.2 Test run speed

Vehicle speed must be kept as constant as possible during each test run. The scales must indicate and record the speed of the tested vehicle as it passes over the load cells.

5.4.6.3 Weigh-in-motion accuracy test

During weigh-in-motion accuracy tests, all test runs are performed pursuant to 5.4.6.1 using reference vehicles pursuant to 5.4.2.1. The values of all vehicle mass indications and all axle load indications are recorded. For each recorded value (total vehicle mass, axle or axle group load), the relative error δ is calculated in percent:

$$\delta = \frac{C - R}{R} \times 100 \tag{2}$$

where: C is the value measured by the scales;

R is the corresponding reference value measured by the reference scales.

The number of relative errors δ that exceed the stipulated maximum permissible error pursuant to Article 2.3.2 for each quantity is determined, and this number is expressed as the relative number of values for each quantity as follows:

$$P_{de} = \frac{n}{N} \times 100 \tag{3}$$

where: N is the number of calculated differences exceeding the maximum permissible error;

N is the total number of recorded values for the given quantity.

The number of relative errors exceeding the maximum permissible error P_{de} must not be greater than 5 %, and these errors must not be greater than the maximum permissible error for traffic (see Article 2.4.2).

5.4.7 Operating speed tests

5.4.7.1 Operating speed blocking test

During the operating speed blocking test, a test run by one reference vehicle must take place at a speed outside the operating speed range, as follows:

a) at a speed at least 5 % higher than the maximum operating speed, v_{max};

b) at a speed at least 5 % lower than the minimum operating speed, v_{min}, (if the scales can be used for this).

The scales must detect the above conditions and must react in accordance with Article 3.4.

For safety reasons, the maximum and minimum operating speeds may be temporarily changed for the purpose of demonstrating correct speed limiter operation.

5.4.7.2 Operating speed test

To determine and test operating speed during a weigh-in-motion test, six test runs shall take place with an unloaded two-axle rigid reference vehicle across load receptors at a constant speed. Three runs must take place near the maximum operating speed v_{max}, and three additional runs must take place at exactly the listed minimum operating speed v_{min}.

A reference speedometer shall be used to determine the reference speed. For each speed measurement, the error of the indicated operating speed shall be calculated. The indicated operating speed error must not exceed the error given in Article 2.1.2.

6 Initial verification

6.1 In general

The following is performed during initial verification of scales:

a) a visual inspection;

b) functional weigh-in-motion tests in road traffic;

c) operating speed tests.

6.2 Visual inspection

The following is assessed during a visual inspection of scales submitted for verification:

a) conformance of the scales with the approved type;

b) completeness and condition of the scales' functional wholes;

c) that the software version an approved one.

6.3 Functional weigh-in-motion tests in road traffic

6.3.1 Reference vehicles and their loading

During weigh-in-motion functional tests in road traffic, reference vehicles and their loading must, for purposes of initial verification, represent the measuring range and range of application specified by the type approval certificate or the limited measuring range of the instrument and the range of use specified by their user for the specific installation site.

Vehicle loads shall be selected in such a way that the maximum permitted values of the total mass of the vehicles and the maximum permitted values of the axle(s) are not exceeded, pursuant to a special legislation[3)].

At least the following reference vehicles shall be used:

- a rigid two-axle vehicle;
- a rigid three-axle or four-axle truck;
- a tractor with a semi-trailer with at least three axles or a rigid truck with a trailer with two or three axles.

Only reference vehicles carrying loads in the form of stable loads whose centre of gravity cannot change its position when the vehicle is moving shall be used for verification.

6.3.2 Test runs

Each reference vehicle must perform at least ten test runs at the site where the scales are installed, in each lane, at each of the two following speeds:

a) near the maximum operating speed, v_{max};

b) near the minimum operating speed, v_{min}.

For every ten test runs at a given test speed, the vehicle must be positioned above the centre of the load cell six times, twice on the left and twice on the right side of the load cell.

Vehicle speed must be kept as constant as possible during each test run.

6.3.3 Weigh-in-motion accuracy tests in road traffic

When testing accuracy by weigh-in-motion in road traffic, the test runs pursuant to Article 6.3.2 shall be carried with reference vehicles pursuant to Article 6.3.1. The values of all vehicle mass indications and all axle load indications are recorded. The test shall be evaluated in accordance with Article 5.4.6.3.

6.4 Operating speed tests

During initial verification, operating speed tests pursuant to Article 5.4.7. are performed.

7 Subsequent verification

During verification, measuring instruments are subject to the requirements that were applicable when they were placed on the market or into circulation.

7.1 In general

During subsequent verification of scales, the following are performed:

a) a visual inspection;

b) functional weigh-in-motion tests in road traffic;

c) operating speed tests.

7.2 Visual inspection

Visual inspection during subsequent verification proceeds in accordance with Article 6.2.

7.3 Functional weigh-in-motion tests in road traffic

Functional weigh-in-motion tests in road traffic are performed at the site where the scales are installed pursuant to Article 6.3.

7.4 Operating speed tests

The operating speed tests shall be carried out pursuant to Article 5.4.7. Compliance with the requirements of Article 5.4.7.2 may be demonstrated as part of the test pursuant to Article 5.4.7.1.

8 Shortened test

If legislation[6)] stipulates the performance of short tests confirming the validity of the verification at the time of use of the measuring instrument, the accuracy of the scales shall be tested by means of weigh-in-motion in road traffic at the site where the scales are installed pursuant to Article 6.3, and the scope of the test is focused on evaluating the total mass under one load of the reference vehicle used, where the number of runs must not be less than eight.

The greatest permissible errors shall be the greatest operating errors in traffic pursuant to Article 2.4.

9 Measuring instrument examination

When examining measuring instruments pursuant to § 11a of the Metrology Act at the request of a person who may be affected by an incorrect measurement, proceed according to Chapter 7. The test is always performed if it is technically possible.

The greatest permissible errors shall be the greatest operating errors in traffic pursuant to Article 2.4.

10 Notified standards

For the purposes of specifying the metrological and technical requirements for measuring instruments and specifying the testing methods for their type approval and verification arising from this General Measure, the CMI shall notify Czech technical standards, other technical standards or technical documents of international or foreign organisations, or other technical documents containing more detailed technical requirements (hereinafter ‘notified standards’). The CMI shall publish a list of these notified standards attached to the relevant measures, together with the general measure, in a manner accessible to the public (at www.cmi.cz).

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6) Decree No 345/2002 stipulating measuring instruments for mandatory verification and measuring instruments subject to type approval.

Compliance with notified standards or parts thereof is considered, to the extent and under the conditions laid down in the general measure, as compliance with those requirements laid down in this measure to which these standards or parts thereof apply.

Compliance with a notified standard is one of the ways to demonstrate compliance. These requirements may also be met by using another technical solution guaranteeing an equivalent or higher level of protection of legitimate interests.

II.

G R O U N D S

The CMI has issued this General Measure laying down metrological and technical requirements for specified measuring instruments and tests for the type approval and verification of these specified measuring instrument in accordance with § 14(1)(j) of the Metrology Act to implement § 6(1), § 9(1) and § 9(9) of the Metrology Act.

Decree No 345/2002 stipulating measuring instruments for mandatory verification and measuring instruments subject to type approval, as amended, classifies high-speed weigh-in-motion road vehicle scales as measuring instruments subject to type approval and mandatory verification under item 2.1.3(c) in the Annex 'List of Specified Measuring Device Types'.

As such, the CMI has issued this Measure of a General Nature to implement § 6(1), § 9(1), § 9(9), and § 11a(3) of the Metrology Act for this specific type of measuring instrument, 'high-speed weigh-in-motion road vehicle scales', laying down metrological and technical requirements for high-speed weigh-in-motion road vehicle scales and tests for the type approval and verification of these specified measuring instruments.

This legislation (Measure of a General Nature) was notified in accordance with Directive (EU) 2015/1535 of the European Parliament and of the Council of 9 September 2015 laying down a procedure for the provision of information in the field of technical regulations and of rules on Information Society services.

III.

I N S T R U C T I O N S

In accordance with § 173(2) CAP, no remedy may be submitted against a measure of a general nature.

In accordance with the provisions of § 172(5) CAP, no appeal or remonstrance may be filed against the decision on objections.

Compliance of a general measure with legal regulations may be assessed in a review procedure pursuant to § 94 to § 96 CAP. A party to the proceedings may initiate review proceedings to be conducted by the administrative authority that issued the measure of a general nature. If the administrative authority finds no reason to commence the review proceedings, it shall communicate and provide grounds for this within 30 days. Pursuant to Article 174(2) CAP a ruling on the commencement of review proceedings can be issued within three years of the effective date of the measure of a general nature.

IV.

REPEALING PROVISIONS

Measure of a General Nature number: 0111-OOP-C010-15, laying down the metrological and technical requirements for specified measuring instruments, including testing methods for verification of the following specified measuring instruments: ‘high-speed weigh-in-motion road vehicle scales’ is repealed.

V.
EFFECTIVE DATE

This measure of a general nature takes effect on the fifteenth day after it is posted on the official bulletin board (§ 24d of the Metrology Act).

doc. RNDr. Jiří Tesař, Ph.D. v. r.

Director General

Checked by: Mgr. Tomáš Hendrych

Posted on: 13. 2. 2024

Signature of the authorised person confirming posting: Mgr. Tomáš Hendrych m.p.

Effective date: 28. 2. 2024

Signature of the authorised person indicating efficacy: Mgr. Tomáš Hendrych m.p.