

MINISTRY OF CONSUMER AFFAIRS, FOOD AND PUBLIC DISTRIBUTION**(Department of Consumer Affairs)****NOTIFICATION**

New Delhi, the 9th September, 2016

G.S.R. 875(E).—In exercise of the powers conferred by sub-section (1) read with clauses (c), (f), (h), (i) and (s) of sub-section (2) of section 52 of the Legal Metrology Act 2009, (1 of 2010), the Central Government hereby makes the following rules further to amend the Legal Metrology (General) Rules, 2011, namely:-

1. (1) These rules may be called the Legal Metrology (General) Amendment Rules, 2016.
- (2) They shall come into force on the date of their publication in the Official Gazette.

2. In the Legal Metrology (General) Rules, 2011,-

(i) in the index of the Schedule of the Legal Metrology (General) Rules, 2011, in Seventh Schedule, after Heading E, the following heading shall be inserted, namely:--

“Heading F, Automatic instruments for weighing road vehicles in motion and measuring axle loads”;

(ii). in the “Seventh Schedule, after “Heading E” and the entries relating thereto, the following Heading and entries shall be inserted, namely:-

“Heading F**Automatic instruments for weighing road vehicles in motion and measuring axle loads****Part I
TERMINOLOGY****1. GENERAL DEFINITIONS.-****(1) Weighing instrument-**

Measuring instrument used to determine the mass of a body by using the action of gravity on the body.

The instrument may also be used to determine other mass-related quantities, magnitudes, Parameters or characteristics (e.g. axle load and axle-group load of a vehicle).

According to its method of operation, a weighing instrument is classified as an automatic or non-automatic instrument.

(2) Automatic weighing instrument-

Instrument that weighs without the intervention of an operator and that follows a predetermined program of automatic processes characteristic of the instrument.

(3) Automatic instrument for weighing road vehicles in motion-

Automatic weighing instrument, having a load receptor Para 2(3)of part I and aprons Para 2(2)(i) of this Part I, that determines the vehicle mass Para 3(1)(v) of Part I, axle loads Para

3(1)(viii) of Part I, and if applicable the axle-group loads Para 3(1)(xi) of Part I of a road vehicle while the vehicle is crossing over the load receptor of the weighing instrument.

(4) Control instrument-

Weighing instrument used to determine the static reference vehicle mass of the reference vehicles and the static single-axle loads of a two-axle rigid reference vehicle.

The control instruments used as a reference instrument during testing may be:

* seParate from the instrument being tested; or

* integral, when a static weighing mode is provided by the instrument being tested.

(5) Conventional true value (of a quantity)-

Value attributed to a particular quantity (e.g. reference vehicle mass or single-axle load of a two-axle rigid reference vehicle) and accepted, by convention, as having an uncertainty appropriate for a given purpose.

(6) Metrological authority-

Legal entity (i.e. the verification, and/or issuing authority) designated or formally accepted by the government to be responsible for ascertaining that the automatic weighing instrument satisfies all or some specific requirements of this rule.

2. CONSTRUCTION.-

(1) Controlled weighing area-

Place specified for the operation of instruments for weighing road vehicles in motion, which are installed in conformity with the requirements given in Annex B.

(2) Weigh zone-

Zone of the road comprising the load receptor with aprons in advance of and beyond each end of the load receptor in the direction of travel of the vehicle being weighed.

(i) Apron

Part of the weigh zone that is not the load receptor but which is located on either end of the load receptor and that provides a straight, approximately-level, smooth track in the direction of travel of the vehicle being weighed.

(3) Load receptor-

Part of the weigh zone which receives the wheel loads of a vehicle and which realizes a change in the balance of the instrument when a wheel load is placed upon it.

(4) Electronic instrument-

Instrument equipped with electronic devices.

(i) Electronic device

Device comprised of electronic sub-assemblies and that performs a specific function. An electronic device is usually manufactured as a seParate unit and may be capable of being independently tested.

(ii) Electronic sub-assembly

Part of an electronic device comprised of electronic components and that has a recognizable function of its own.

(iii) Electronic component

Smallest physical entity that uses electron or hole conduction in semiconductors, gases, or in a vacuum.

(5) Module-

Identifiable part of an instrument that performs a specific function or functions, and that can be separately evaluated according to the metrological and technical performance requirements. The modules of a weighing instrument are subject to specified partial error limits.

(i) Indicating device

Part of the instrument that displays the value of a weighing result in units of mass and other related values (e.g. speed).

(ii) Printing device

Means to produce hard copies of the weighing results.

(iii) Load cell

Force transducer which, after taking into account the effects of the acceleration of gravity and air buoyancy at the location of its use, measures mass by converting the measured quantity (mass) into another measured quantity (output).

(6) Software-**(i) Legally relevant software**

Program(s), data and type-specific Parameters that belong to the measuring instrument or device, and that define or fulfill functions which are subject to legal control.

Examples of legally relevant software are-

- final results of the measurement including the decimal sign and the unit;
- identification of the weighing range and the load receptor (if several load receptors have been used).

The following types of legally relevant software can be distinguished:

- type-specific; and
- device-specific.

(ii) Legally relevant Parameter

Parameter of a measuring instrument or a module subject to legal control. The following types of legally relevant Parameters can be distinguished: type-specific Parameters and device-specific Parameters.

(iii) Type-specific Parameter

Legally relevant Parameter with a value that depends on the type of instrument only. They are fixed at type approval of the instrument.

Examples of type-specific Parameters are-

- Parameters used for weight value calculation;
- stability analysis or price calculation and rounding;
- software identification.

(iv) Device-specific Parameter

Legally relevant Parameter with a value that depends on the individual instrument. Such Parameters comprise calibration Parameters (e.g. span adjustments or corrections) and configuration Parameters (e.g. maximum capacity, minimum capacity, units of measurement, etc.). They are adjustable or selectable only in a special operational mode of the instrument. They may be classified as those that should be secured (unalterable) and those that may be accessed (settable Parameters) by an authorized person.

(v) Software identification

Sequence of readable characters of software that is inextricably linked to the software (e.g. version number, checksum).

(vi) Data storage

Storage used for keeping data ready after completion of the measurement for later legally relevant purposes.

(7) Communication interface-

Electronic, optical, radio or other hardware or software interface that enables information to be automatically passed between instruments and modules.

(8) User interface-

Interface that enables information to be passed between a human user and the instrument or its hardware or software components, e.g. switch, keyboard, mouse, display, monitor, printer, touch screen, etc.

(9) Protective interface-

Interface that prevents the introduction of any data into the data processing device of the instrument which may:

- display data that are not clearly defined and that could be taken as being a measurement result;
- falsify displayed, processed or stored measurement results or primary indications;
- adjust the instrument or change any adjustment factor.

(10) Ancillary devices-

(i) Zero-setting device

Device for setting the indication to zero when there is no load on the load receptor.

(ii) Non-automatic zero-setting device

Zero-setting device that must be operated manually.

(iii) Semi-automatic zero-setting device

Zero-setting device that operates automatically following a manual command.

(iv) Automatic zero-setting device

Zero-setting device that operates automatically and without the intervention of an operator.

(v) Zero-tracking device

Device for maintaining the zero indication within certain limits automatically.

3. METROLOGICAL CHARACTERISTICS-

(1) Weighing

(i) Full-draught weighing

Determining the mass of a vehicle that is entirely supported on the load receptor.

(ii) Partial weighing

Weighing a vehicle in two or more parts successively on the same load receptor.

(iii) Weighing-in-motion

Process of determining the vehicle mass, the axle load, and if applicable, the axle-group load of a moving vehicle (i.e. a vehicle crossing over the load receptor of the weighing instrument) by measurement and analysis of the dynamic vehicle tyre forces.

(iv) Static weighing

Weighing vehicles or test loads that are stationary.

(v) Vehicle mass (VM)

Total mass of the vehicle combination including all connected components.

(vi) Axle

Axis comprising two or more wheel assemblies with centers of rotation lying approximately on a common axis extending the full width of the vehicle and oriented transversely to the nominal direction of travel of the vehicle.

(vii) Axle-group

Two or more axles included in a defined group and their respective interspaces (or axle spacing).

(viii) Axle load

Fraction of the vehicle mass that is supported via the axle on the load receptor at the time of weighing.

(ix) Single-axle load

Axle load which is not part of an axle-group load. For the purposes of this Recommendation, if no criteria for defining various axle-groups have been specified in Para 3(1)(vii) of Part I, all recorded axle loads (9) shall be considered as single-axle loads.

(x) Static reference single-axle load

Single-axle load of known conventional true value determined statically Para 6(1) of part I for a two-axle rigid vehicle.

(xi) Axle-group load

Sum of all axle loads in a defined group of axles; a fraction of the vehicle mass imposed on the axle-group at the time of weighing.

(xii) Tyre load

Portion of the vehicle mass imposed upon the tyre at the time of weighing, expressed in the units of mass.

(xiii) Dynamic vehicle tyre force

Component of the time-varying force applied perpendicularly to the road surface by the tyre(s) on a wheel of a moving vehicle. In addition to the action of gravity, this force can also include dynamic effects of other influences on the moving vehicle.

(xiv) Wheel load

Sum of the tyre loads on all tyres included in the wheel assembly on one end of an axle; a wheel assembly may have a single tyre or dual tyres.

(2) Capacity-**(i) Maximum capacity (Max)**

Maximum weighing-in-motion capacity of the load receptor without totalizing.

(ii) Minimum capacity (Min)

Value of the load below which the weighing-in-motion results before totalizing may be subject to an excessive relative error.

(iii) Weighing range

Range between the minimum and maximum capacities.

(3) Scale interval, d-

Value expressed in units of mass for weighing-in-motion that is the difference between two consecutive indicated or printed values.

(i) Scale interval for stationary load

Value, expressed in units of mass, for stationary weighing vehicles or test weights that is the difference between two consecutive indicated or printed values.

(4) Speed-**(i) Operating speed, v**

Average velocity of the vehicle being weighed as it moves over the load receptor.

(ii) Maximum operating speed, v_{\max}

Greatest velocity of a vehicle that the instrument is designed to weigh-in-motion and above which the weighing results may be subject to an excessive relative error.

(iii) Minimum operating speed, v_{\min}

Lowest velocity of a vehicle that the instrument is designed to weigh-in-motion and below which the weighing results may be subject to an excessive relative error.

(iv) Operating speed range

Set of values specified by the manufacturer between the minimum and maximum operating speeds at which a vehicle may be weighed-in-motion.

(v) Maximum transit speed

Maximum speed that a vehicle can travel on the weigh zone without producing a shift in the performance characteristics of a weighing instrument beyond those specified.

(5) Warm-up time-

Time between the moment at which power is applied to an instrument and the moment at which the instrument is capable of complying with the requirements.

(6) Durability-

Ability of an instrument to maintain its performance characteristics over a period of use.

(7) Final weight value-

Weighing value that is achieved when an automatic operation is ended and the instrument is completely at rest.

(8) Stable equilibrium-

Condition of the instrument such that the recorded weighing values show no more than two adjacent values of each weighing cycle; with one of them being the final weight value. This condition is only valid for each separate weighing cycle and not for a group of cycles.

(9) Discrimination-

Ability of an instrument to react to small variations of load. The discrimination threshold, for a given load, is the value of the smallest additional load that, when gently deposited on or removed from the load receptor, causes a perceptible change in the indication.

4. INDICATIONS AND ERRORS-**(1) Indications of an instrument-**

Value of a quantity provided by a measuring instrument.

(i) Primary indications

Indications, signals and symbols that are subject to requirements of this Rule.

(ii) Secondary indications

Indications, signals and symbols that are not primary indications.

(2) Methods of indication-**(i) Digital indication**

Indication in which the scale marks are a sequence of aligned figures that do not permit interpolation to a fraction of the scale interval.

(ii) Analog indication

Indication enabling the evaluation of the equilibrium position to a fraction of the scale interval.

(3) Reading-**(i) Reading by simple juxtaposition**

Reading of the weighing result by simple juxtaposition of consecutive figures giving the weighing result, without the need for calculation.

(ii) Overall inaccuracy of reading

Overall inaccuracy of reading of an instrument with analog indication is equal to the standard deviation of the same indication, the reading of which is carried out under normal conditions of use by several observers.

(4) Errors-**(i) Error (of indication)**

Indication of an instrument minus the (conventional) true value.

(ii) Intrinsic error

Error of an instrument determined under reference conditions.

(iii) Initial intrinsic error

Intrinsic error of an instrument as determined prior to performance tests and durability evaluations.

(iv) Maximum permissible error, MPE

Extreme values of an error permitted between the indication of a weighing instrument and the corresponding true value, as determined by reference standard mass, at zero or no load, in the reference position.

(v) Maximum permissible deviation, MPD

Maximum permissible deviation of any single-axle load, or if applicable, any axle-group load from the respective corrected mean of the single-axle load or the axle-group load.

(vi) Fault

Difference between the error of indication and the intrinsic error of a weighing instrument.

Principally, a fault is the result of an undesired change of data contained in or flowing through an electronic instrument. In this Rule a "fault" is a numerical value.

(vii) Significant fault

Fault greater than 1 d .

The following are not considered to be significant faults:

- faults that result from simultaneous and mutually independent causes in the instrument or in its checking facility;
- faults that make it impossible to perform any measurement;
- transitory faults that are momentary variations in the indications which cannot be interpreted, memorized or transmitted as a measurement result;
- faults that are so serious that they will inevitably be noticed by those interested in the measurement.

(viii) Span stability

Capability of an instrument to maintain the difference between the indication at maximum capacity and the indication at zero within specified limits over a period of use.

(ix) Rounding error

Difference between a digital measurement result (indicated or printed) and the value of

that measurement result with an analog indication.

(x) Repeatability error

Difference between the highest and lowest results of successive measurements of the same load carried out under the same conditions of measurement.

(xi) Corrected result (mean axle- and axle-group load)

Result of a measurement after algebraic correction for systematic error.

5. INFLUENCES AND REFERENCE CONDITIONS-

(1). Influence quantity-

Quantity that is not the measure and but that affects the result of the measurement.

(i) Influence factor

Influence quantity having a value within the specified rated operating conditions of the instrument.

(ii) Disturbance

Influence quantity having a value that falls within the limits specified but that falls outside the rated operating conditions of the instrument.

(2) Rated operating conditions-

Conditions of use which give the ranges of the influence quantities for which the metrological characteristics are intended to lie within the specified maximum permissible errors.

(3) Reference conditions-

Conditions of use prescribed for testing the performance of a measuring instrument or for inter-comparison of results of measurements.

6. TESTS-

(1) Static test-

Test with standard weights or a load that remains stationary on the load receptor to determine an error.

(2) In-motion test-

Test with reference vehicles that are in motion on the load receptor to determine an error or deviation.

(3) Simulation test-

Test carried out on a complete instrument or part of an instrument in which any part of the weighing operation is simulated.

(4) Performance test-

Test to verify that the equipment under test (EUT) is capable of accomplishing its specified functions.

7. VEHICLES-**(1) Vehicle-**

Loaded or unloaded road vehicle that is recognized by the instrument as a vehicle to be weighed.

(2) Rigid vehicle-

Road vehicle with a single chassis that includes neither coupling nor trailer, and that has two or more axles located along the length of the chassis that are oriented perpendicularly to the normal direction of travel of the vehicle.

(3) Reference vehicle-

Vehicles having a known conventional true value Para 1(9) of Ref. from Part I:

- mass, and single-axle load of a two-axle rigid vehicle; and
- mass of other vehicles used for in-motion tests Para 6(5) Part-I,

determined on a control instrument Para 1(8) Part-I.

8. Abbreviations and symbols-

Symbols	Meaning
I	Indication
I_n	nth indication
L	Load
ΔL	Additional load to next changeover points
P	$I + 1/2d - \Delta L =$ indication prior to rounding (digital indication)
E	$I - L$ or $P - L =$ Error
E%	$(P - L) / L\%$
E_0	Error at zero load
D	Actual scale interval
p_i	Fraction of the MPE applicable to a module of the instrument which are examined separately
MPE	Maximum permissible error
EUT	Equipment under test
Sf	Significant fault
Max	Maximum capacity of the weighing instrument
Min	Minimum capacity of the weighing instrument
U_{nom}	Nominal voltage value marked on the instrument
U_{max}	Highest value of a voltage range marked on the instrument
U_{min}	Lowest value of a voltage range marked on the instrument
V	Operating speed
V_{min}	Minimum operating speed
V_{max}	Maximum operating speed
V_{min}, V_{max}	Operating speed range

DC	Direct current
AC	Alternating current
VM	Vehicle mass
WIM	Weigh-in-motion

Part-II

Automatic instruments for weighing road vehicles in motion and measuring axle loads

1. GENERAL-

(1) Scope-

It provides standardized requirements and test procedures to evaluate the metrological and technical characteristics of such instruments in a uniform and traceable way.

(2) Application-

This rule applies to Weighing in Motion instruments:

- which are installed in a controlled weighing area Para 2(1) Part-I;
- which are used for determining and indicating the vehicle mass, the single-axle loads, and if applicable the axle-group loads of a road vehicle in motion; and
- which are installed where the vehicle speed is controlled.

This rule does not apply to instruments that:

- determine individual axle loads by multiplying a single wheel load of an axle by two; or
- are installed on-board vehicles to measure axle load.

2. METROLOGICAL REQUIREMENTS-

(1) Accuracy classes-

(i) Vehicle mass

For determining the vehicle mass, Weighing in Motion instruments are divided into six accuracy classes as shown below:

0.2 0.5 1 2 5 10

(ii) Single-axle load and axle-group load

For determining single-axle load and, if required axle-group load, instruments are divided into six accuracy classes as shown below:

A B C D E F

(iii) Relationship between accuracy classes

The relationship between the accuracy classes for single-axle load and, if required, axle-group load and the accuracy classes for vehicle mass are as specified in Table 1 below.

Table 1

Accuracy class single-axle load and axle-group load	Accuracy class for vehicle mass					
	0.2	0.5	1	2	5	10
A	✓	✓				
B	✓	✓	✓			
C		✓	✓	✓		
D			✓	✓	✓	
E				✓	✓	✓
F						✓

(2) Limits of error-**(i) Weighing-in-motion****(a) Vehicle mass**

The maximum permissible error for the vehicle mass determined by in-motion weighing, shall be one of the following values, whichever is greater:

- the value calculated according to Table 2, rounded to the nearest scale interval(d) ;
- $1 d \times$ the number of axles in the totalization in the case of initial verification,
 $2 d \times$ the number of axles in the totalization in the case of in-service inspection.

Table 2

Accuracy class for vehicle mass	Percentage of conventional value of the vehicle mass (Para 6(7) of Part-II)	
	Initial verification	In-service inspection
0.2	±0.10 %	±0.20 %
0.5	±0.25 %	±0.50 %
1	±0.50 %	±1.00 %
2	±1.00 %	±2.00 %
5	±2.50 %	±5.00 %
10	±5.00 %	±10.00 %

(b) Single-axle load and axle-group load

The limits of error applicable to single-axle loads and, if required, axle-group loads are as follows:

- For static reference single-axle loads of the two-axle rigid reference vehicle, the applicable limits of error are as specified in Para 2(2)(i)(b)(ba).of Part II
- For all other reference vehicle single-axle loads and axle-group loads, the applicable limits of error are as specified in Para 2(2)(i)(b)(bb) of Part II.

(ba) Maximum permissible error for two-axle rigid reference vehicle

For the two-axle rigid reference vehicle, the maximum difference between the indicated single-axle load for in-motion tests and the conventional true value of the static reference single-axle load shall not exceed one of the following values, whichever is the greater:

- The value from Table 3 rounded to the nearest scale interval.
- 1 d in the case of initial verification,
2 d in the case of in-service inspection.

Table 3

Accuracy class for single-axle load	Percentage of conventional true value of the static reference single-axle load	
	Initial verification	In-service inspection
A	±0.25 %	±0.50 %
B	±0.50 %	±1.00 %
C	±0.75 %	±1.50 %
D	±1.00 %	±2.00 %
E	±2.00 %	±4.00 %
F	±4.00 %	±8.00 %

(bb) Maximum Permissible Deviation (MPD) for all reference vehicle types except the two-axle rigid reference vehicle

For all reference vehicle types except the two-axle rigid reference vehicle, the maximum difference between any indicated single-axle load or, if required, any axle-group load recorded during in-motion tests and the corrected mean single-axle load Para 6(10) of Part II or the corrected mean axle-group load Para 6(11) of Part II, respectively, shall be one of the following values, whichever is the greater:

- The value from Table 4 rounded to the nearest scale interval;
- 1 $d \times n$ in the case of initial verification,
2 $d \times n$ in the case of in-service inspection,

Where n is the number of axles in the group, with $n = 1$ for single axles.

Table 4

Accuracy class for single-axle load and axle-group load	Percentage of the corrected mean single-axle load or corrected mean axle-group load	
	Initial verification	In-service inspection
A	±0.50 %	±1.00 %
B	±1.00 %	±2.00 %
C	±1.50 %	±3.00 %
D	±2.00 %	±4.00 %
E	±4.00 %	±8.00 %
F	±8.00 %	±16.00 %

(ii) Static weighing

The maximum permissible errors on static weighing for increasing or decreasing loads shall be the appropriate values in Table 5.

Table 5

Accuracy class for vehicle mass	Load, m , expressed in scale intervals	Maximum permissible errors	
		Initial verification	In-service inspection
0.2 0.5 1	$0 \leq m \leq 500$	± 0.5 d	± 1.0 d
	$500 < m \leq 2\ 000$	± 1.0 d	± 2.0 d
	$2\ 000 < m \leq 5\ 000$	± 1.5 d	± 3.0 d
2 5 10	$0 \leq m \leq 50$	± 0.5 d	± 1.0 d
	$50 < m \leq 200$	± 1.0 d	± 2.0 d
	$200 < m \leq 1\ 000$	± 1.5 d	± 3.0 d

(3) Scale interval, d -

For a particular method of weighing-in-motion and combination of load receptors, all load indicating and printing devices on an instrument shall have the same scale interval.

The relationship among the accuracy class, the value of the scale interval and the number of scale intervals for the maximum capacity of the instrument shall be as specified in Table 6.

Table 6

Accuracy class for vehicle mass	d (kg)	Minimum number of scale intervals	Maximum number of scale intervals
0.2	≤ 5	500	5 000
0.5	≤ 10		
1	≤ 20		
2	≤ 50	50	1 000
5	≤ 100		
10	≤ 200		

The scale intervals of the indicating or printing devices shall be in the form 1×10^k , 2×10^k or 5×10^k , k being a positive or negative whole number or zero.

(4) Minimum capacity-

The minimum capacity shall not be less than the load, expressed in scale intervals, specified in Table 7.

Table 7

Accuracy class for vehicle mass			Minimum capacity in scale intervals
0.2	0.5	1	50
2	5	10	10

(5). Installation and testing of instruments-

For **Weighing in Motion** instruments to be used in applications where the individual axle or axle-group loads are required, the installation and testing requirements specified in Annex B and Annex A respectively, shall be applicable. In particular, the following effects on the weighing results should be taken into account:

- Lateral forces due to interactions of the control instrument with the vehicle;
- Forces on part of the vehicle by different transient behavior and friction within the axle suspensions;
- Forces on part of the ramps if there are different levels between the control instrument and ramp that could lead to varying distribution of the axle load.

Further practical guidance on the installation and operation of these instruments is provided in Annex C.

(6) Agreement between indicating and printing devices-

For the same load, there shall be no difference between the weighing results provided by any two devices having the same scale interval.

(7) Influence quantities-

Refer to Annex A for test conditions.

(i) Temperature**(a) Temperature limits**

Weighing in motion instruments shall comply with the appropriate metrological and technical requirements at temperatures from $-10\text{ }^{\circ}\text{C}$ to $+40\text{ }^{\circ}\text{C}$:

Provided that, depending on local environmental conditions, the limits of the temperature range may differ; provided further that this range shall not be less than $30\text{ }^{\circ}\text{C}$ and shall be specified in the descriptive markings.

(b) Temperature effect on no-load indication

The indication at zero or near zero shall not vary by more than one scale interval for a difference in ambient temperature of $5\text{ }^{\circ}\text{C}$.

(ii) Power supply

An electronic instrument shall comply with the appropriate metrological and technical requirements, if the voltage supply varies from the nominal voltage, U_{nom} (if only one voltage is marked on the instrument), or from the upper and lower limits of the voltage range, $U_{\text{min}} - U_{\text{max}}$, marked on the instrument at:

- AC mains power:

Lower limit is $0.85 \times U_{\text{nom}}$ or $0.85 \times U_{\text{min}}$, upper limit is $1.10 \times U_{\text{nom}}$ or $1.10 \times U_{\text{max}}$;

- DC mains power, including rechargeable battery voltage supply if the battery can be fully (re)charged during the operation of the instrument:

Lower limit is the minimum operating voltage, upper limit is $1.20 \times U_{\text{nom}}$ or $1.20 \times U_{\text{max}}$ (for a rechargeable battery, U_{max} is the voltage of a new or fully charged battery of the type specified by the manufacturer);

- Battery power (DC), non-rechargeable batteries, and also including rechargeable batteries if (re)charging of batteries during the operation of the instrument is not possible:
Lower limit is the minimum operating voltage, upper limit is U_{nom} or U_{max} ;

- 12 V or 24 V road vehicle battery power:
Lower limit is 9 V (for a 12 V battery) or 16 V (for a 24 V battery), upper limit is 16 V (for a 12 V battery) or 32 V (for a 24 V battery).

Battery-operated and DC mains powered instruments shall either continue to function correctly or not indicate any mass or load values if the voltage is below the manufacturer's specified value, the latter being larger than or equal to the minimum operating voltage.

(8) Units of measurement-

The units of mass and load to be used on an instrument are the kilogram (kg) or the tonne (t).

(9) Scale interval for stationary load-

If the scale interval for stationary loads is not equal to the scale interval, d , it shall not be readily accessible when the instrument is in use for weighing-in-motion. In addition, if the instrument is not verified for use as a non-automatic weighing instrument (Para 5(1) (iii) of Part II), the scale interval for stationary loads shall not be readily accessible and shall only be used for static testing.

(10) Operating speed [Para 3(5)(ix)of Part II]-

Weighing in Motion instruments shall comply with the appropriate metrological and technical requirements at vehicle speeds within the operating speed range:

- given by the operating speed interlock; or
- determined during the weighing test.

Operating speed shall be indicated and/or printed only after the entire vehicle has been weighed in motion.

3. TECHNICAL REQUIREMENTS-**(1) Suitability for use-**

Weighing in Motion instruments shall be designed to suit the vehicles, site and method of operation for which they are intended.

(2) Security of operation-**(i) Fraudulent use**

Weighing in Motion instruments shall have no characteristics likely to facilitate their fraudulent use.

(ii) Accidental breakdown and maladjustment

An instrument shall be so constructed that an accidental breakdown or maladjustment of control elements likely to disturb its correct functioning cannot take place without its effect being evident.

(iii) Interlocks

Interlocks shall prevent or indicate the operation of the instrument outside the specified working conditions. Interlocks are called for:

- minimum operating voltage (Para 2(7)(ii)) Part II;
- vehicle recognition (Para 3(5)(vii)) Part II;
- wheel position on the load receptor (Para 3(5)(viii)) Part II;
- direction of travel (Para 3(5)(viii)) Part II;
- range of operating speeds (Para 3(5)(ix) of Part II).

(iv) Use as a non-automatic weighing instrument

In addition to complying with the requirements of non-automatic instruments, an instrument that can operate in a non-automatic mode shall be equipped with the means for enabling non-automatic operation that prevents both automatic operation and in-motion weighing.

(v) Automatic operation

Instruments shall be designed to provide a level of confidence that their accuracy and operation comply with the requirements for a period of at least one year of normal use. Any malfunction shall be automatically and clearly indicated (e.g. by a fault indication or by automatic switch off). The documentation supplied with the instrument (1(1) of Annex A) shall include a description of how this requirement is met.

The level of confidence shall take account of uncertainties of measurement, significant faults and failure of the instrument.

(3) Zero-setting devices-**(i) Accuracy of the zero-setting device**

Instruments shall be provided with a zero-setting device, which may be automatic or semi-automatic.

A zero-setting device shall be capable of setting zero to within $\pm 0.25 d$ and shall have a range of adjustment not exceeding 4 % of the maximum capacity. The range of adjustment of the initial zero-setting device shall not exceed 20 % of the maximum capacity.

A semi-automatic zero-setting device shall not be operable during automatic operation.

An automatic and a semi-automatic zero-setting device shall function only when the instrument is in stable equilibrium.

(ii) Zero-tracking device

A zero-tracking device shall operate only when:

- the indication is at zero;
- the instrument is in stable equilibrium;
- the corrections are not more than $0.5 d$ per second; and
- within a range of 4 % of Max around the actual zero.

(4) Use as an integral control instrument-

Weighing in Motion instruments to be used as control instruments, for the purposes of determining the vehicle mass or the static reference vehicle axle loads, shall meet the requirements of:

- Para 3(4)(i) of Part II to Para 3(4)(iv) of Part II inclusive; and
- Para 6(2)(i) of Part II

(i) Zero-setting

WIM instruments shall be capable of setting zero to within ± 0.25 of the scale interval for a stationary load (Para 2(9) of Part II).

(ii) Eccentric loading

The indications for different positions of the load shall comply with the maximum permissible errors in 2(2)(ii) Part II for initial verification for the given load.

(iii) Discrimination

An additional load that is equal to 1.4 times the scale interval for a stationary load, when gently placed on or withdrawn from each load receptor in turn when at equilibrium at any load, shall change the initial indication.

(iv) Repeatability

The difference between the results of several weighings of the same load shall not be greater than the absolute value of the maximum permissible error of the instrument for that load.

(5) Indicating, printing and data storage devices-**(i) Quality of indication**

Reading of the primary indications (see Para 4(1)(i) of Part I) shall be reliable, easy and unambiguous under conditions of normal use:

- the overall inaccuracy of reading of an analog indicating device shall not exceed $0.2 d$,
- the figures, units and designations forming the primary indications shall be of a size, shape and clarity for reading to be easy.

The indication shall be the self-indicating type and shall bear the name or symbol of the appropriate unit of mass. The scales, numbering and printing shall permit the figures which form the results to be read by simple juxtaposition (see Para 4(3)(i) of Part I).

(ii) Indication and printout for normal operation

The minimum indication or printout resulting from each normal weighing operation shall be dependent upon the application of the instrument.

For normal operation the scale interval of indications or printouts for the vehicle mass, the single-axle load or the axle-group load shall be the scale interval, d , in accordance with Para 2(3) of Part II.

The results shall bear the name or symbol of the appropriate unit of mass in accordance with Para 2(8) Part II.

For Weighing in Motion instruments to be used in applications concerned only with determining the vehicle mass, the minimum printout shall be the vehicle mass, the date and the time, and the operating speed with an associated clear warning message, if applicable. The individual axle or axle-group loads shall not be printed without an associated clear warning that these results are not verified.

For Weighing in Motion instruments to be used in applications where only individual axle loads are required, the minimum printout shall be the single-axle loads, the vehicle mass, the date and the time, and the operating speed with an associated clear warning message, if applicable. The

criteria for defining axle-groups need not be specified for the instrument. The vehicle mass and the axle-group loads shall not be printed without an associated clear warning that these results are not verified.

For Weighing in Motion instruments to be used in applications where axle-group loads are required, the minimum printout shall be the single-axle loads (when appropriate), the axle-group loads, the vehicle mass, the date and the time, and the operating speed with an associated clear warning message, if applicable. The criteria for defining axle-groups shall be specified for the instrument. The vehicle mass shall not be printed without an associated clear warning that these results are not verified.

(iii) Limits of indication

Weighing in Motion instruments shall not indicate or print the single-axle loads, axle-group loads or the vehicle mass when the single-axle load (partial weighment) is less than Min or greater than $\text{Max} + 9 \text{ } d$ without giving a clear warning on the indication and/or the printout.

(iv) Printing device

Printing shall be clear and permanent for the intended use. Printed figures shall be at least 2 mm high.

If printing takes place, the name or the symbol of the unit of measurement shall be either to the right of the value or above a column of values, or placed in accordance with national regulations.

(v) Data storage

Measurement data may be stored in a memory of the instrument (hard drive) or on external storage for subsequent indication, printing, data transfer, totalizing, etc. In this case, the stored data shall be adequately protected against intentional and unintentional changes during the transmission and/or storage process and shall contain all relevant information necessary to reconstruct an earlier measurement.

For securing stored data, the following apply:

- The appropriate requirements for securing in Para 3(6) of Part II and in Para 3(8) of Part II;
- Software transmission and downloading process shall be secured in accordance with the requirements in Para 3(6) of Part II;
- External storage device identification and security attributes shall ensure integrity and authenticity;
- Exchangeable storage media for storing measurement data need not be sealed provided that the stored data is secured by a specific checksum or key code;
- When storage capacity is exhausted, new data may replace oldest data provided that the owner of the old data has given authority to overwrite the old data.

(vi) Totalizing device

instruments may be provided with a totalizing device which operates:

- automatically, in which case the instrument shall be provided with a vehicle recognition device [Para 3(5)(vii) of Part II]; or
- semi-automatically (i.e. it operates automatically following a manual command).

(vii) Vehicle recognition device

Weighing in Motion instruments which are able to operate without the intervention of an operator shall be provided with a vehicle recognition device. The device shall detect the presence of a vehicle in the weigh zone (Para 2(2) of Part-I] and shall detect when the whole vehicle has been weighed. Weighing in Motion instruments shall not indicate or print the vehicle mass unless all of the wheels of the vehicle have been weighed.

(viii) Vehicle guide device

Weighing in Motion instruments shall not indicate or print the vehicle mass, the single-axle load, or the axle-group load if any of the wheels of that vehicle did not pass fully over the load receptor. Alternatively, a lateral guide system may be used to ensure that all the wheels of the vehicle pass fully over the load receptor.

If only one direction of travel is specified for an instrument, an error message shall be given or the instrument shall not indicate or print the vehicle mass, the single-axle load, or the axle-group load if a vehicle travels in the wrong direction. Alternatively, barriers or other traffic control methods may be used to prevent vehicles traveling in the wrong direction.

(ix) Operating speed [Para 6(13) of Part II]

The Weighing in Motion instrument shall not indicate or print the mass or axle load values for any vehicle that has traveled over the load receptor at a speed outside the specified range of operating speeds without an associated clear warning message that these results are not verified.

The operating speed shall be indicated and printed if applicable in km/h, rounded to the nearest 1 km/h, as part of every vehicle weighing record.

(6) Software-

The legally relevant software used in Weighing in Motion instruments must be present in such a form in the instrument that alteration of the software is not possible without breaking a seal, or any change in the software can be signaled automatically by means of an identification code. National legislation may specify the securing that is required.

The software documentation on the instrument shall include:

- A description of the legally relevant software;
- A description of the accuracy of the measuring algorithms (e.g. programming modes);
- A description of the user interface, menus and dialogues;
- The unambiguous software identification; e) A description of the embedded software;
- An overview of the system hardware, e.g. topology block diagram, type of computer(s), source code for software functions, etc., if not described in the operating manual;
- Means of securing software;
- The operating manual.

(i) Means of securing software

The following means of securing legally relevant software apply:

- Access shall only be allowed to authorized people, e.g. by means of a code (key-word) or of a special device (hard key, etc.); the code must be changeable;

- It shall be possible for the interventions to be memorized and it shall be possible to access and display this information; the records shall include the date and a means of identifying the authorized person making the intervention (see a) above); the traceability of the interventions shall be assured for at least the period of time in between periodical verifications depending on national regulations. Records may not be overwritten, and if the storage capacities for records are exhausted, no further intervention shall be possible without breaking a physical seal;
- Downloading of legally relevant software shall only be possible through an appropriate protective interface (Para 2(9) of Part I) connected to the instrument;
- The software shall be assigned with appropriate software identification (Para 2(6)(iv) of Part I). This software identification shall be adapted in the case of every software change that may affect the functions and accuracy of the instrument;
- Functions that are performed or initiated via a software interface shall meet the relevant requirements and conditions of Para 4(3)(v) of Part II.

(7) Installation-

(i) General

WIM instruments shall be manufactured and installed so as to minimize any adverse effects of the installation environment. The space between the weighing instrument and the ground shall allow all covered parts of the load receptor to be kept free from all debris or other matter that could affect the accuracy of the . Where particular details of installation have an effect on the weighing operation (e.g. site levels, length of aprons), these details shall be recorded in the test report.

Weighing in Motion instruments for determining vehicle mass, axle loads, and if applicable axle-group loads shall comply with the installation requirements specified in Annex B.

(ii) Drainage

If the weighing mechanism is contained in a pit, there shall be provision for drainage to ensure that no portion of the instrument becomes submerged or partially submerged in water or any other liquid.

(iii) Heating

If the operation of the weighing mechanism is installed in low temperature climate environments, there shall be provision for heating to ensure that the devices operate within the operating conditions specified by the manufacturer.

(8) Securing of components, interfaces and preset controls-

(i) General

Components, interfaces, software devices and preset controls that are not intended to be adjusted or removed by the user shall be fitted with a securing means or shall be enclosed. When enclosed, it shall be possible to seal the enclosure.

The seals should, in all cases, be easily accessible. Securing should be provided on all parts of the measuring system which cannot be materially protected in any other way against operations liable to affect the measurement accuracy.

Any device for changing the Parameters of measurement results, particularly for correction and calibration, shall be sealed.

(ii) Means of securing

Securing shall be provided by hardware, passwords or similar software means provided that:

- The requirements for securing software in Para 3(6) Part II apply;
- Transmission of legally relevant data via interfaces shall be secured against intentional, unintentional and accidental changes in accordance with the requirements of Para 4(3)(v)(b);
- The securing possibilities available in an instrument shall be such that separate securing of the settings is possible;
- Stored data shall be secured against intentional, unintentional and accidental changes in accordance with the requirements of Para 3(5)(v) of Part II.

Provided further that the Automatic instrument for weighing road vehicles in motion and measuring axle loads shall not be calibrated without receiving a one time password to be generated by the OEM's server and received on the registered mobile of the user/ service engineer/ local legal metrology officer.

(9) Descriptive markings-

Weighing in Motion instruments shall bear the following basic markings;

(i) Markings shown in full

- identification mark of the manufacturer
- identification mark of the importer (if applicable)
- type designation of the instrument
- serial number of the instrument (on each load receptor, if applicable)
- not to be used to weigh liquid products (if applicable)
- maximum transit speed km/h
- direction of weighing (if applicable)
- scale interval for stationary load (if applicable) kg or t
- power supply voltage V
- power supply frequency Hz
- temperature range (when not $-10\text{ }^{\circ}\text{C}$ to $+40\text{ }^{\circ}\text{C}$) $^{\circ}\text{C}$
- software identification (if applicable)

(ii) Markings shown in code

accuracy class vehicle mass	0.2, 0.5, 1, 2, 5 or 10
accuracy class single-axle (where applicable)	A, B, C, D, E or F
accuracy class axle-group (where applicable)	A, B, C, D, E or F
maximum capacity	Max = kg or t
minimum capacity	Min = kg or t
scale interval	d = kg or t
maximum operating speed	v_{max} = km/h
minimum operating speed	v_{min} = km/h
maximum number of axles per vehicle (where applicable)	A_{max}
type approval sign	

(iii) Supplementary markings

Depending upon the particular use of the instrument, one or more supplementary markings may be required on type approval: For example, the designation of the liquid(s) which the instrument is designed to weigh (if applicable), or where a particular instrument is verified using a limited range of vehicles (e.g. air suspension systems only, three/four axle rigid vehicles only), then this should be marked on the instrument.

(iv) Presentation of descriptive markings

Descriptive markings shall be indelible and of a size, shape and clarity that permit legibility under normal conditions of use of the instrument.

Descriptive markings may be either in the national language or in the form of adequate, internationally agreed and published pictograms or signs.

Markings shall be grouped together in a clearly visible place on the instrument, either on a descriptive plate or sticker fixed permanently near the indicating device, or on a non-removable part of the instrument itself. In case of a plate or sticker which is not destroyed when removed, a means of securing shall be provided, e.g. a non removable control mark that can be applied.

It shall be possible to seal the plate bearing the markings, unless it cannot be removed without being destroyed.

As an alternative, all applicable markings above may be shown on a programmable display which is controlled by software provided that:

- at least Max, Min and d shall be displayed as long as the instrument is switched on;
- the other markings may be shown on manual command;
- this shall be described in the type approval certificate.

In this case, means shall be provided for any access to reprogramming of the markings to be automatically and non-erasably recorded and made evident by an audit trail, e.g. by traceable access software such as an event logger providing a record of the changes or an event counter providing a non-resettable counter of any changes.

These programmable display markings need not be repeated on the data plate, if they are shown on or indicated near the display of the weighing result, with the exception of the following markings which shall be shown on the data plate:

- type and class designation of the instrument;
- name or identification mark of the manufacturer;
- type approval number;
- voltage supply;
- voltage supply frequency;
- pneumatic/ hydraulic pressure, (if applicable).

(10) Verification marks-**(i) Position**

A place shall be provided for the application of verification marks. This place shall:

- be such that the part on which the marks are located cannot be removed from the instrument without damaging the marks;
- permit the easy application of the marks without changing the metrological qualities of the instrument;
- be visible when the instrument is in service.

(ii) Mounting

Weighing in Motion instruments required to bear verification marks shall have a verification mark support located as specified above, which shall ensure the conservation of the marks as follows:

- when the mark is made with a stamp, the support may consist of a strip of lead or any other material with similar qualities inserted into a plate fixed to the instrument or a cavity bored into the instrument;
- when the mark consists of an adhesive transfer, a space shall be provided for this purpose.

4. REQUIREMENTS FOR ELECTRONIC INSTRUMENTS-

Electronic instruments shall comply with the following requirements, in addition to the applicable requirements of all other clauses.

(1) General requirements-

(i) Rated operating conditions

Electronic weighing instruments shall be designed and manufactured so that they do not exceed the maximum permissible errors under rated operating conditions.

(ii) Disturbances

Electronic weighing instruments shall be designed and manufactured so that when they are exposed to disturbances either:

- significant faults do not occur; or
- significant faults are detected and acted upon as specified in Para 4(3)(i) of Part II.

(iii) Durability

The requirements in Para 4(1)(i) of Part II and Para 4(1)(ii) of Part II shall be met durably in accordance with the intended use of the instrument.

(iv) Evaluation for compliance

A type of an electronic weighing instrument is presumed to comply with the requirements in Para 4(1)(i) of Part II, Para 4(1)(ii) of Part II and Para 4(1)(iii) of Part II if it passes the examination and tests specified in Annex A.

(2) Application-

The requirements in Para 4(1)(ii) of Part II may be applied separately to:

- each individual cause of significant fault; and/or
- each part of the electronic instrument.

The choice of whether Para 4(1)(ii) of Part II is applied is left to the manufacturer.

(3) Functional requirements-**(i) Acting upon a significant fault**

When a significant fault has been detected, the instrument shall either be made in-operative automatically, or a visual or audible indication shall be provided and shall continue until the user takes action or the fault disappears.

(ii) Switch-on procedure

Upon switch-on, a special procedure such as a display test facility which is automatically initiated at switch-on of indication (in the case of electronic instruments permanently connected to the mains at switch-on of indication) shall be performed that shows all relevant signs of the indicator in their active and non-active states sufficiently long to be checked by the operator. This is not applicable for non-segmented displays, on which failures become evident, for example screen-displays, matrix-displays, etc.

(iii) Influence factors

An electronic weighing instrument shall comply with the requirements of Para 2(7) of Part II, and in addition it shall maintain its metrological and technical characteristics at a relative humidity of 85 % at the upper limit of the temperature range of the instrument.

(iv) Warm-up time

During the warm-up time of an electronic weighing instrument, there shall be no indication or transmission of the weighing result and automatic operation shall be inhibited.

(v) Interface

An instrument may be equipped with communication interfaces Para (2(7)) of Part I enabling the coupling of the instrument to external equipment and user interfaces (Para 2(8)) of Part I permitting the exchange of information between a human user and the instrument. When an interface is used, the instrument shall continue to function correctly and its metrological functions (including all metrologically relevant Parameters and software) shall not be influenced.

(a) Interface documentation

The documentation on the instrument interfaces shall include:

- A list of all commands (e.g. menu items);
- Description of the software interface;
- A list of all commands together;
- A brief description of their meaning and their effect on the functions and data of the instrument.

(b) Securing of interfaces

Communication and user interfaces shall not allow the legally relevant software and functions of the instrument and its measurement data to be inadmissibly influenced by other interconnected instruments, or by disturbances acting on the interface.

An interface through which the functions mentioned above cannot be performed or initiated, need not be secured. Other interfaces shall be secured as follows:

- Data shall be protected (e.g. with a protective interface as defined in Para 2(9) of Part I against accidental or deliberate interference during the transfer;

- All functions in the software interface shall be subject to the requirements for securing software in Para 3(8)(ii) of Part II;
- All functions in the hardware interface shall be subject to the requirements for securing hardware in Para 3(8) of Part II;
- It shall be easily possible to verify the authenticity and integrity of data transmitted to and from the instrument;
- Functions performed or initiated by other connected instruments through the interfaces shall meet the appropriate requirements under this rule.

Other instruments required by national regulations to be connected to the interfaces of a Weighing in Motion instrument shall be secured to automatically inhibit the operation of the Weighing in Motion instrument for reasons of the non-presence or improper functioning of the required device.

5. METROLOGICAL CONTROLS-

The metrological controls of Weighing in Motion instruments shall, consist of the following:

- type approval;
- initial verification;
- subsequent verification;
- in-service inspection.

Tests should be applied uniformly by the metrological authority and should form a uniform program.

(1) Type approval-

(i) Documentation

The application for type evaluation shall include documentation which provides the following information:

- metrological characteristics of the instrument;
- a standard set of specifications for the instrument;
- a functional description of the components and devices;
- drawings, diagrams and general software information (if applicable), explaining the construction and operation;
- any document or other evidence demonstrating that the design and construction of the instrument complies with the requirements.

(ii) General requirements

Type evaluation shall be carried out on at least one, and normally not more than three, Weighing in Motion instruments that represent the definitive type. At least one of the instruments shall be completely installed at a typical site and at least one of the instruments or the major component of an instrument shall be submitted in a form suitable for simulation testing in a laboratory. The evaluation shall consist of the tests specified in Para 5(1)(iii) of Part II.

(iii) Type evaluation

The submitted documents shall be examined and tests carried out to verify that the Weighing in Motion instruments comply with the:

- metrological requirements in clause 2, particularly with reference to the appropriate limits of error when using the range of reference vehicles (Para 6(5) of Part II) and operating conditions specified by the manufacturer;

- technical requirements in clause 3;
- requirements for electronic instruments in clause 4.

The appropriate metrological authority shall:

- conduct the tests in a manner which prevents unnecessary commitment of resources;
- permit the results of these tests to be assessed for initial verification when the same instrument is involved;
- ensure that an instrument used in non-automatic (static) operation in accordance with Para 2(2)(ii) of Part II, meets the weighing performance test requirements of Non-automatic weighing instrument.

(a) In-motion tests

A complete instrument shall be tested:

- in accordance with the test methods in clause 6 of Part II, using the range of reference vehicles specified in Para 6(5) of Part II;
- under the rated operating conditions in accordance with the type specification.

(b) Evaluation of errors and deviation for automatic weighing

(ba) Vehicle mass

For determination of the vehicle mass, the error for automatic weighing shall be the indicated reference vehicle mass observed and recorded (Para 6(12) of Part II) as appropriate, minus the conventional true value of the reference vehicle mass as defined in Para 6(7) of Part II as appropriate. The maximum permissible error shall be as specified in Para 2(1)(i) of Part II for initial verification and as appropriate for the class of the instrument.

(bb) Single-axle load or axle-group load

The requirements in this subclause are only applicable to instruments to be used in applications where the single-axle load or axle-group load is required.

(bba) Single-axle load

The single-axle load errors and deviations for automatic weighing of reference vehicles shall be determined as follows:

- (bbaa) In-motion tests with the two-axle rigid reference vehicle. The error for automatic weighing shall be the indicated single-axle load observed and recorded (Para 6(9) of Part II) as appropriate, minus the conventional true value of the static reference single-axle load (Para 6.8 of Part II) as appropriate. The maximum permissible errors shall be as specified in Para 2(2)(i)(b)(ba) of Part II for initial verification and as appropriate for the accuracy class of the instrument.
- (bbab) In-motion tests with all other reference vehicle axle types. The deviation for automatic weighing shall be the indicated single-axle load observed and recorded (Para 6(9) of Part II) as appropriate, minus the corrected mean single-axle load (Para 6(11) of Part II) as appropriate. The maximum permissible deviation shall be as specified in Para 2(2)(i)(b)(bb) of Part II for initial verification and as appropriate for the accuracy class of the instrument.

(bbb) Axle-group load

For axle-group load, the deviation for automatic weighing shall be determined as follows:

(bbba) For Weighing in Motion instruments which determine and indicate the loads independent of single-axes or axle-groups by summation of individual axle load errors in accordance with regulations for axle-group load (see Para 3(1)(vii) of Part I).

(bbbb) For Weighing in Motion instruments which automatically determine and indicate single-axle loads and axle-group loads separately by the indicated axle-group load observed and recorded (Para 6(9) of Part II) as appropriate, minus the corrected mean axle-group load (Para 6(11) of Part II) as appropriate.

The maximum permissible deviation shall be as specified in Para 2(2)(i)(b)(bb) of Part II for initial verification and as appropriate for the class of the instrument, if required, with different accuracy classes for single-axle loads and axle-group loads.

(c) Simulation tests

Influence factors shall be applied during simulation tests in a manner that will reveal an alteration of the weighing result for any weighing process to which the Weighing in Motion instrument could be applied, in accordance with Para 2(7) of Part II and Para 4 of Part II.

(ca) Apportioning of errors

Where modules of an instrument or system are tested separately the following requirements apply.

The error limits applicable to a module which is examined separately are equal to a fraction, p_i , of the maximum permissible errors or the allowed variations of the indication of the complete instrument. The fractions for any module have to be taken for the same accuracy class as for the complete instrument incorporating the part.

The fractions p_j shall satisfy the following equation:

$$p_1^2 + p_2^2 + p_3^2 + \dots \leq 1$$

The fraction, p_i , shall be chosen by the manufacturer of the module and shall be verified by an appropriate test, taking into account the following conditions:

- For purely digital devices, p_j may be equal to 0;
- For weighing modules, p_j may be equal to 1;
- For all other modules (including digital load cells), p_j shall not exceed 0.8 and shall not be less than 0.3, when more than one module contributes to the effect in question.

For mechanical structures including weighbridges evidently designed and manufactured according to sound engineering practice, an overall fraction $p_j = 0.5$ may be applied without any test, e.g. when levers are made of the same material and when the chain of levers has two planes of symmetry (longitudinal and transversal).

If the metrological characteristics of the load cell or other major component have been evaluated in accordance with the requirements of non-automatic weighing instrument, that evaluation shall be used to aid type evaluation if so requested by the applicant.

(iv) Provision of means for testing

For the purposes of testing, the applicant may be required to furnish the metrological authority with the test vehicles, material, qualified personnel and a control instrument. The instrument under test may be used as the control instrument provided that it complies with the requirements in of Par 6(2)(i) of Part II.

(v) Place of testing

Weighing in Motion instruments submitted for type approval may be tested at the following places:

- on a site at which all necessary tests can be conducted and agreed upon between the metrological authority and the applicant;
- at a laboratory considered appropriate by the metrological authority;
- at any other suitable place mutually agreed upon between the metrological authority and the applicant.

(2). Initial verification-**(i) Tests**

Weighing in Motion instruments shall be tested to verify that they comply with the requirements in Para 2 of Part II (except Para 2.7 of Part II) and Para 3 of Part II for any vehicle(s) and product(s) loaded on a vehicle for which they are intended and when operated under normal conditions of use.

Tests shall be carried out by the appropriate metrological authority, in-situ, in a normal installation. The Weighing in Motion instrument shall be installed so that an automatic weighing operation will be the same for testing as it is for a normal operation.

The appropriate metrological authority shall conduct the tests in a manner that prevents an unnecessary commitment of resources. In appropriate situations and to avoid duplicating tests previously performed on the instrument for type evaluation under [Para 5(1)(iii) of Part II, the authority may use the results of observed tests for initial verification.

(a) In-motion tests

In-motion tests shall be conducted:

- in accordance with the descriptive markings [Para 3(9) of Part II];
- under the rated conditions for which the instrument is intended;
- in accordance with the test methods in rule 6, with the exception that the reference vehicles shall be the types of vehicle(s) and product(s) that the instrument is intended to weigh. However, for instruments to be used in applications where the axle load is required, the test utilizing the two-axle rigid reference vehicle must be conducted.

(b) In-motion test error evaluation**(ba) Vehicle mass**

For all reference vehicle types, the error for automatic weighing shall be as specified in [Para 5(1) (iii) (b)(ba) of Part II.

(bb) Single-axle load or axle-group load

The requirements in this subclause are only applicable to instruments to be used in applications where the single-axle load or the axle-group load is required.

(bba) Single-axle load

- a) For in-motion tests with the two-axle rigid reference vehicle, the error for automatic weighing shall be as specified in [Para 5(1)(iii)(b)(bb) (bba) (bbaa) of Part II].
- b) For in-motion tests with all other reference vehicle types, the error for automatic weighing shall be as specified in [Para 5(1)(iii)(b)(bb) (bba)(bbab) of Part II].

(bbb) Axle-group load

The error for automatic weighing shall be as specified in [Para 5(1)(iii)(b)(bb) (bbb) of Part II] for axle-group load.

(ii) Provision of means for testing

For the purposes of testing, the applicant may be required to furnish the metrological authority with the test vehicles, material, qualified personnel and a control instrument. The instrument under test may be used as the control instrument provided that it complies with the requirements in [Para 6(2)(i) of Part II].

(iii) Place of testing

Initial verification tests shall be conducted entirely at the place of installation, and during testing the instrument shall include all parts which form the assembly as intended for normal use.

(3) Subsequent metrological control-**(i) Subsequent verification**

Subsequent verification shall be carried out in accordance with the same provisions as in [Para 5(2) of Part II] for initial verification.

(ii) In-service inspection

In-service inspection shall be carried out in accordance with the same provisions as in [Para 5(2) of Part II] for initial verification, with the exception that the in-service limits of error in [Para 2(2) of Part II] shall be applied.

6 TEST METHODS-**(1) Test procedures-****(i) Vehicle mass**

For the vehicle mass a complete WIM instrument shall be tested for compliance with the requirements specified in [Para 2(1)(i) of Part II] using the range of vehicles specified in [Para 6(5) of Part II], and if applicable also the integral control instrument [Para 6(2)(i) of Part II] shall be tested.

(ii) Single-axle load and axle-group load

For single-axle loads and, if required, for axle-group loads a complete Weighing in Motion system shall be tested for compliance with the metrological requirements in:

Para 2(2)(i) (ba) of Part II using a two-axle rigid vehicle for the static reference axle load specified in Para 9(3)(i)(c) of Annex A; and

Para 2(2)(i)(b) of Part II using the range of reference vehicles specified in Para 6(5) of Part II.

(2) Control instrument-

A control instrument for determining the conventional true value of each reference vehicle mass shall be available for testing. The control instrument may either be separate or integral.

(i) Integral control instrument

The instrument under test may be used as the control instrument provided that it:

- f* has an appropriate scale interval or scale interval for stationary load (Para 2(9) of Part II); and
- f* complies with the requirements in Para 3(4) of Part II .

(ii) Separate control instrument

(a) Control instrument for full-draught vehicle weighing

A separate control instrument, capable of being used to determine the conventional true value of each reference vehicle mass by full-draught weighing when stationary, shall ensure the determination of the conventional true value of each reference vehicle's mass to an error not greater than one-third of whichever is the smaller of the appropriate MPE for in-motion tests in Para 2(1)(i) of Part II.

(iii) Control instrument for static reference single-axle load of the two-axle rigid vehicle

As appropriate, a separate or integral control instrument, capable of being used to determine the conventional true value of the static reference single-axle loads by individual axle measurement when stationary, shall be used for tests with the two-axle rigid reference vehicle.

The control instrument used for determining the static reference axle loads shall:

- f* be able to support the entire contact area of all the tyres on the individual axle being weighed;
- f* ensure the determination of the conventional true value of the static reference axle loads of the two-axle rigid reference vehicle to an error not greater than one-third of whichever is the smaller of the appropriate MPE for in-motion tests in Para 2(2)(i)(ba) of Part II.
- f* be provided with approach and exit aprons in the same plane as the load receptor which shall extend to a length sufficient to fully support the two-axle rigid vehicle being weighed. The aprons shall have no longitudinal slope and not more than 1 % of transverse slope. Where this specification cannot be achieved, alternative means may be provided to ensure that all of the wheels of the reference vehicle are within ± 3 mm of a horizontal or transversely-sloped plane passing through the load receptors during the weighing operations.

(3) Static weighing test for integral control instruments-

This test is applicable if the Weighing in Motion instrument being verified is to be used as the control instrument for measuring the static reference axle loads of the two-axle rigid vehicle.

(i) Test loads

Errors shall be determined for test loads of:

- a) minimum capacity;
- b) maximum capacity;
- c) at least two loads in between a) and b).

(ii) Distribution of test loads

Except for eccentricity tests, standard weights or masses shall be evenly distributed on the load receptor.

(iii) Eccentricity tests

Tests shall be carried out without excessive stacking or overlapping of the load on the load receptor provided that the conditions are practical and safe.

(iv) Repeatability tests

The repeatability error has to be determined with a load of about 50 % of Max which is placed 3 times on the load receptor.

(4) Verification standards-**(i) Weights**

The standard weights or standard masses used for the type examination or verification of an instrument shall principally meet the metrological requirements as specified in the rules. The error of the standard weights or masses used shall not be greater than one-third of the maximum permissible error for the load, as specified in Table 5 for initial verification.

(ii) Substitution of standard weights

The test shall be carried out only during verification and at the place of use taking Para 5(2)(ii)(b) of Annex A into account.

When testing instruments at the place of use (application), instead of standard weights any other constant load may be used, provided that standard weights of at least 50 % of Max are used. Instead of 50 % of Max, the portion of standard weights may be reduced to:

- f* 35 % of Max if the repeatability error is $\leq 0.3 d$; or
- 20 % of Max if the repeatability error is $\leq 0.2 d$.

The repeatability error (Para 6(.3)(iv) of Part II) shall be checked at a load of about the value at which the substitution is made, by placing this load three times on the load receptor. The results of the repeatability test (Para 5(2)(v) of Annex A) may be used if the test loads have a comparable mass.

If the instrument is provided with an automatic zero-setting or zero-tracking device, it may be in operation during the tests, except for the temperature test. The error at zero point is then determined according to Para. 5(1)(ii) of Annex A.

(5) Reference vehicles-

The type and number of reference vehicles to be used for testing shall represent the range of vehicles available in the appropriate Member State and for which the instrument is intended. Vehicle classification according to axle arrangement shall be accomplished using the available -system axle-count and axle spacing information. In addition to a two-axle rigid vehicle, there shall be a minimum of two other different reference vehicles. Different axle configurations, tractor/trailer configurations, tractor/trailer linkage systems and suspension systems shall be used, as appropriate.

When a particular instrument is tested using a limited range of vehicle types (e.g. air suspension systems only), this should be noted in the type approval certificate.

A minimum of two other reference vehicles shall be selected from the three listed below:

- f* one three/four-axle rigid;
- f* one four-or more axle articulated;
- f* one two/three-axle rigid vehicle and a two/three-axle draw-bar trailer.

The two-axle rigid vehicle shall be used as the reference vehicle for determining the conventional true value of static reference single-axle loads and as one of the reference vehicles for in-motion tests.

The other reference vehicles shall be selected to cover, as far as practicable, the weighing range for which the instrument is approved.

The reference vehicles shall be used for tests in the unloaded and loaded condition (Para 9(3)(i) of Annex A.)

Vehicles carrying liquid loads or other products that that may be subjected to fluctuations in their center of gravity when the vehicle moves, shall be used as reference vehicles only if the instrument will be applied subsequently for determining the mass, or the loads of single-axles and/or axle-group of such vehicles. If the **Weighing in Motion** instrument is not intended for this use, it shall bear the marking “not to be used to weigh vehicles carrying liquids or other products that may be subjected to fluctuations in their center of gravity by vehicle movement”.

If the **Weighing in Motion** instrument is intended to be used for determining the vehicle mass, the single-axle loads or the axle-group loads of vehicles with conventional steel leaf spring suspension, tests shall be carried out on vehicles with at least one such single-axle and one such axle-group suspension type. If the instrument is not intended for this use, it shall bear the marking “not to be used to weigh vehicles with conventional steel leaf spring suspension”.

(6) Number of in-motion tests

Each reference vehicle (the two-axle rigid plus two or more others) shall undertake at least five test runs at each of three different speeds as detailed Para 9(3)(ii) of Annex A when unloaded and when loaded. Thus at least 90 reference vehicle runs are required for any testing session. If appropriate, a higher number of in-motion test runs may be conducted, in accordance with national regulations.

(7) Conventional true value of the reference vehicle mass

The conventional true value of each reference vehicle mass, unloaded and loaded, shall be determined using full-draught weighing, as detailed in Para 9(3)(i) (b) of Annex A.

(8) Conventional true value of the static reference single-axle load

The conventional true value of the static reference single-axle loads for the two-axle rigid reference vehicle, unloaded and loaded, shall be determined using the method detailed in Para 9(3) (i) (c) of Annex A.

(9) Indicated single-axle load and axle-group load

The indication or printout of the single-axle load and, if required, the axle-group load following an automatic weighing operation shall be observed and recorded.

(10) Mean single-axle load and mean axle-group load

The mean single-axle load shall be the sum of the indicated or printed axle loads obtained for each single axle on the reference vehicle during an in-motion test, divided by the number of single-axle load values recorded for each respective single axle.

The mean axle-group load shall be the sum of the indicated or printed axle-group loads recorded for each defined axle-group on the reference vehicle during an in-motion test, divided by the number of load values recorded for each respective axle-group.

(11) Corrected mean of the single-axle load and the axle-group load

The corrected mean of the axle loads for each single-axle or axle-group on a reference vehicle shall be the mean (Para 6.(10) Part II) of the recorded values (Para 6.(9) Part II) for the respective single-axles and axle-groups on the reference vehicle during an in-motion test, corrected proportionally (.9.(3)(ii)(bbc) of Annex A in relation to the systematic error of the instrument used for determining the recorded values.

(12) Indicated mass of the vehicle

The vehicle mass following an automatic weighing operation shall be indicated and recorded. Where possible, the procedures in Para 3(5) of Annex A and Para 3(6)(ii) of Annex A shall be used to eliminate rounding errors included in any digital indication.

(13) Indicated operating speed

The instrument shall indicate and record the operating speed following an in-motion test (Para 3(.5)(ii of Part II)). Alternatively, the procedure given in Para9(3)(ii)(db) of Annex A shall be used to determine the operating speed and the error.

(14) Examination and tests of electronic instruments

The examination and testing of an electronic weighing instrument is intended to verify compliance with the applicable requirements and especially the requirements for electronic instruments in clause 4.

(i) Examination

An electronic weighing instrument shall be examined to obtain a general appraisal of its design and construction.

(ii) Performance tests

An electronic weighing instrument or electronic device, as appropriate, shall be tested as specified in Annex A to determine its correct operation.

Tests are to be conducted on the whole instrument except when the size and/or configuration of the instrument does not lend itself to testing as a unit. In such cases, the separate electronic devices shall be subjected to testing. It is not intended that electronic devices be further dismantled for separate testing of components. In addition, an examination shall be carried out on the fully operational weighing instrument or, if necessary, on the electronic devices in a simulated setup that sufficiently represents the weighing instrument. The equipment shall continue to function correctly as specified in Annex A.

(iii) Span stability tests

The instrument shall be subjected to span stability tests at various intervals before, during and after being subjected to performance tests.

When an instrument is subjected to the span stability test specified in Para 8 of Annex A :

- f* the maximum allowable variation in the errors of indication shall not exceed half the absolute value of the maximum permissible error in Para 2(.2)(ii of Part II) for initial verification for the test load applied on any of the n measurements.
- f* where the differences of the results indicate a trend more than half the allowable variation specified above, the test shall be continued until the trend comes to rest or reverses itself, or until the error exceeds the maximum allowable variation.

Annex A**Test procedures for automatic instruments for weighing road vehicles in motion and measuring axle-loads****1 EXAMINATION FOR TYPE APPROVAL****(1) Documentation [Para 5(1)(i) of part-II]**

Review the documentation that is submitted, including necessary photographs, drawings, diagrams, general software information, relevant technical and functional description of main components, devices, etc. to determine if it is adequate and correct. Consider the operational manual.

(2) Compare construction with documentation [Para 5(1)(i) of part-II]

Examine the various devices of the Weighing in Motion instrument to ensure compliance with the documentation.

(3) Technical requirements (Para 3 of part-II)

Examine the instrument for conformity with the technical requirements according to the checklist.

(4) Functional requirements [Para 4(3) and 4(4) of Part-II]

Examine the instrument for conformity with the functional requirements according to the checklist given in the test report forma.

2. EXAMINATION FOR INITIAL VERIFICATION**(1) Compare construction with documentation [Para 5(2) of Part-II]**

Examine the instrument for conformity with the requirements in [Para 3(9) of Part-II] for the approved type.

(2) Descriptive markings [Para 3(9) of Part-II]

Check the descriptive markings according to the checklist in the test report format.

(3) Verification marks [Para 3(9) of Part-II] and securing devices [Para 3(7) of Part-II]

Check the arrangement for verification marks and securing according to the checklist in the test report.

3. GENERAL TEST CONDITIONS

(1) Voltage supply

Power up the equipment under test (EUT) for a time period equal to or greater than the warm-up time specified by the manufacturer and maintain the EUT energized for the duration of each test.

(2) Zero-setting

Adjust the EUT as closely as practicable to zero prior to each test, and do not readjust it at any time during the test, except to reset it if a significant fault has occurred.

Certain tests require the automatic zero-setting and zero-tracking devices to be in operation (or not in operation). Where there is no specific requirement to this effect, the automatic zero-setting and zero-tracking devices shall be switched off. When this is done it shall be mentioned in the test report.

(3) Temperature

The tests shall be performed at a steady ambient temperature, usually normal room temperature unless otherwise specified. The temperature is deemed to be steady when the difference between the extreme temperatures noted during the test does not exceed one-fifth of the temperature range of the instrument without being greater than 5 °C, and the rate of change does not exceed 5 °C per hour. Note that this requirement does not apply to in-motion tests.

The handling of the instrument shall be such that no condensation of water occurs on the instrument.

(4) Recovery

After each test, allow the instrument to recover sufficiently before the following test.

(5) Indication with a scale interval not greater than 0.2 *d*

If an instrument has a device for displaying the indication with a scale interval of 0.2 *d* or less, this device may be used to calculate the error. If such a device is used, it should be noted in the test report.

(6) Control instruments and test standards

(i) Control instrument [Para 6(2) of Part-II]

Control instruments meeting the requirements of [Para 6(2) of Part -II] shall be used for weighing the vehicles. Where necessary, standard test weights meeting the requirements of [Para 6(4)(i) of Part-II] may be used to assess the rounding error.

(ii) Use of standard weights to assess rounding error

(a) General method to assess error prior to rounding

For instruments with digital indication having a scale interval *d*, changeover points may be used to interpolate between scale intervals, i.e. to determine the indication of the instrument, prior to rounding, as follows:

At a certain load, *L*, the indicated value, *I*, is noted. Additional weights, of say 0.1 *d*, are successively added until the indication of the instrument is increased unambiguously by one scale interval (*I* + *d*). The additional load, ΔL , added to the load receptor gives the indication, *P*, prior to rounding by using the following formula:

$$P = I + 0.5 d - \Delta L$$

The error prior to rounding is:

$$E = P - L = I + 0.5 d - \Delta L - L$$

Example: An instrument with a scale interval, d , of 10 kg is loaded with 1 000 kg and thereby indicates 1 000 kg. After adding successive weights of 1 kg, the indication changes from 1 000 kg to 1 010 kg at an additional load of 3 kg. Inserted in the above formula, these observations give:

$$P = (1\ 000 + 5 - 3) \text{ kg} = 1\ 002 \text{ kg}$$

Thus the true indication prior to rounding is 1 002 kg, and the error is:

$$E = (1\ 002 - 1\ 000) \text{ kg} = 2 \text{ kg}$$

(b) Correction for error at zero

Evaluate the error at zero load, E_0 , by the method of [3(6)(ii)(a) of Annex A].

Evaluate the error at load L , E , by the method of [3(6)(ii)(a) of Annex A].

The corrected error prior to rounding, E_c , is:

$$E_c = E - E_0$$

Example: If, for the example in [3(5)(ii)(a) of Annex A], the error calculated at zero load was:

$$E_0 = + 1 \text{ kg}$$

then the corrected error is:

$$E_c = + 2 - (+1) = + 1 \text{ kg}$$

4. TEST PROGRAM

(1) Type approval [Para 5(1) of Part-II]

Para 1 and 5 to 9 of Annex A shall normally be applied for type approval.

Para 5(2) of Annex A may be omitted if the instrument under test is not an integral control instrument.

The tests in Para 6 to 8 of Annex A may be performed with static load, with a vehicle movement simulator (switches) used if necessary for the calculation of the weighing results.

(2) Initial verification [Para 5(2) of Part-II]

Para 2 and Para 9 of Annex A shall be applied for initial verification tests.

If the instrument under test is to be used as an integral control instrument the tests in Para 5(2) of Annex A shall also be applied.

The test in Para 9 of Annex A shall include all dynamic in-motion effects corresponding to normal operation of the instrument.

5. PERFORMANCE TESTS DURING TYPE EVALUATION

(1) Zero-setting [Para 3(3)(i) of Part-II]

(i) Range of zero-setting

(a) Initial zero-setting

The initial zero-setting range is the sum of the positive and negative portions of the initial zero-setting range. If the load receptor cannot readily be removed, only the positive part of the initial zero-setting range need be considered.

(aa) Positive range:

With the load receptor empty, set the instrument to zero. Place a test load on the load receptor and switch the instrument off and then back on. Continue this process until, after placing a load on the load receptor and switching the instrument off and on, it does not reset to zero. The maximum load that can be re-zeroed is the positive portion of the initial zero-setting range.

(ab) Negative range:

1) Remove any load from the load receptor and set the instrument to zero. Then, if possible, remove the load receptor (platform) from the instrument. If, at this point, the instrument can be reset to zero by switching it off and back on, the mass of the non-essential components is used as the negative portion of the initial zero-setting range.

2) If the instrument cannot be reset to zero with the load receptor (platform) removed, add weights to any live part of the scale until the instrument indicates zero again.

3) Then remove the weights and, after each weight is removed, switch the instrument off and back on. The maximum load that can be removed while the instrument can still be reset to zero by switching it off and on is the negative portion of the initial zero-setting range.

4) The initial zero-setting range is the sum of the positive and negative portions.

5) Alternatively, if it is not possible to test the negative range of initial zero-setting by removing the load receptor (platform) of the instrument, then before proceeding to step 3) above, apply a test load greater than the permissible negative portion of the initial zero-setting range which can be calculated from the result of the positive range test.

6) If it is not possible to test the negative portion of the initial zero-setting range by these methods then only the positive part of the initial zero-setting range need be considered.

7) Reassemble or adjust the instrument for normal use after the above tests.

(b) Semi-automatic zero-setting

This test shall not be carried out during the span stability test.

This test is performed in the same manner as described in 5(1)(i)(a) of Annex A except that the zero-setting device is used rather than switching the instrument on and off.

(c) Automatic zero-setting

This test shall not be carried out during the span stability test.

Remove the non-essential parts of the load receptor or re-adjust the instrument as described in Para 5(1)(i)(a) of Annex A and place weights on the live part of the scale until it indicates zero.

Remove weights in small amounts and after each weight is removed allow the instrument to operate through the appropriate part of the automatic cycle so as to see if the instrument is reset to zero automatically.

The maximum load that can be removed so the instrument can still be reset to zero is the zero-setting range.

(ii) Accuracy of zero-setting

(a) Semi-automatic zero-setting

The accuracy of the zero-setting device is tested by setting the instrument to zero and then determining the additional load at which the indication changes from zero to one scale interval above zero. The error at zero is calculated according to the description in 3(6)(ii)(a) of Annex A.

(b) Automatic zero-setting or zero-tracking

The indication is brought outside of the automatic range. Then the additional load at which the indication changes from one scale interval to the next above is determined and the error is calculated according to the description in Para 3(6)(ii)(a) of Annex A. It is assumed that the error at zero load would be equal to the error at the load in question.

(2) Non-automatic tests of the integral control instrument [Para 3(4) of Part-II]

The tests in this sub-clause are to be performed on the integral control instrument in-situ at the time of type approval or verification.

(i) Zero-setting

(a) Accuracy of zero-setting [Para 3(4)(i) of Part-II]

Determination of the accuracy of zero-setting is carried out as described in Para 5(1)(ii)(a) of Annex A or Para 5(1)(ii)(b) of Annex A, as appropriate.

(ii) Determination of weighing performance

(a) Preloading

Before the first weighing test, the instrument shall be preloaded once to near Max.

(b) Static weighing test [Para 6(3) of part-II]

Apply loads from zero up to and including Max, and then remove the loads back to zero. When determining the initial intrinsic error, at least ten different load values are selected, and for other weighing tests at least five are selected. The values of the loads selected shall include Max and Min, and values at or near those at which the maximum permissible error (MPE) changes.

It should be noted that when loading or unloading weights the load must be respectively increased or decreased in a uniform progression.

The maximum permissible errors shall be the appropriate values from Para 2(2)(ii) of Part-II for initial verification.

(iii) Eccentricity test [Para 3(4)(ii) and 6(3)(iii) of Part-II]

Apply a load equal to $1/3$ Max on each half of the load receptor. On an instrument with a load receptor having n points of support with $n > 4$ the fraction $1 / (n - 1)$ of Max shall applied to each point of support.

The errors shall not exceed the appropriate maximum permissible errors from Para 2(2)(ii) of Part-II for initial verification.

(iv) Discrimination test [3(4)(iii) of Part-II]

The following tests are performed with three different loads, e.g. Min, $0.5 \times \text{Max}$, and Max.

A load plus sufficient substitution material (e.g. 10 times $0.1 d$) is placed on the load receptor. The additional material is then successively removed until the indication, I , is decreased unambiguously by one scale interval, $I - d$. Replace substitution material equivalent to $0.1 d$ and then a load equal to $1.4 d$ shall be gently placed on the load receptor and the result shall be increased by one scale interval above the initial indication, $I + d$.

(v) Repeatability test [3(4)(iv) and 6(3)(iv) of Part-II]

Two series of weighings shall be performed, one with a load of about 50 % and one with a load close to 100 % of Max. Each series shall consist of at least three weighings. Readings shall be taken when the instrument is loaded, and when the unloaded instrument has come to rest between weighings. In the case of a zero deviation between the weighings, the instrument shall be reset to zero, without determining the error at zero. The true zero position need not be determined between the weighings.

If the instrument is provided with automatic zero-setting or zero-tracking, it shall be in operation during the test.

For initial verification, one test with about 50 % of Max is sufficient with no more than three weighings.

6 ADDITIONAL FUNCTIONALITY**(1) Warm-up time test [Para 4(3)(iv) of Part-II]**

This test is to verify that metrological performance is maintained in the period immediately after switch on. The method is to check that automatic operation is inhibited until a stable indication is obtained and to verify that zero and span errors comply with the requirements during the first 30 minutes of operation.

Other test methods which verify that metrological performance is maintained during the first 30 minutes of operation may be used.

- a) Disconnect the instrument from the power supply for a period of at least 8 hours prior to the test.
- b) Reconnect the instrument and switch on while observing the indicating device.
- c) Verify that it is not possible to initiate automatic weighing or printout until the indication has stabilized or until completion of the warm-up time if it is specified by the manufacturer [Para 4(3)(iv) of Part-II]
- d) As soon as the indication of the indicating device has stabilized, set the instrument to zero if this is not done automatically.
- e) Determine the error of zero-setting by the method of 3(6)(ii)(a) of Annex A and record this error as E_{01} (error of initial zero-setting) at first and as E_0 when repeating this step.
- f) Apply a load close to Max. Determine the error by the method of 3(6)(ii)(a) of Annex A and 3(6)(ii)(a) of Annex A.
- g) Verify that:
 - the zero indication error, E_{01} , is not greater than $0.25 d$ [3(3)(i) of Part II];
 - the span error is not greater than the maximum permissible error specified in Para 2(2)(ii) of Part II for initial verification.
- h) Repeat stages e) and f) after 5, 15 and 30 minutes.
- i) After each time interval verify that:
 - the zero variation error ($E_0 - E_{01}$) is not greater than $0.25 d \times p_i$;
 - the span error is not greater than the maximum permissible error specified in Para 2(2)(ii) of Part II for initial verification.

(2) Agreement between indicating and printing devices [Para 2(6) of Part-II]

If the instrument has more than one indicating device, the indications of the various devices (both indicating and printing) are compared during the test.

(3) Operating speed [Para 3(5)(ix) of Part-II]

Verify that the automatic indication and printing of the operating speed contain a clear warning message if the speed is outside the specified range.

7. INFLUENCE FACTOR AND DISTURBANCE TESTS**(1) Test conditions**

Further guidance on the metrological performance testing requirements for influence quantities and disturbances is provided in Para no. 9(7) and Para no. 9(11) of Part-II under Seventh Schedule- Heading A- non-automatic weighing instruments.

(i) General requirements

Instruments for determining the vehicle mass, the single-axle load and/or the axle-group load shall comply with the influence factor and disturbance tests conditions and requirements specified in this Annex.

Influence factor and disturbance tests are intended to verify that instruments can perform and function as intended in the environment and under the conditions specified. Each test indicates, where appropriate, the reference condition under which the intrinsic error is determined.

It is not possible to apply these tests to an instrument that is performing an automatic operation. The instrument shall therefore be subjected to the influence factors or disturbances under static conditions or simulated operation as defined herein. The permissible effects of the influence factors or disturbances, under these conditions, are specified for each case.

When the effect of one influence factor is being evaluated, all other factors are to be held relatively constant, at a value close to normal. After each test the instrument shall be allowed to recover sufficiently before the following test.

Where parts of the instrument are examined separately, errors shall be apportioned in accordance with Para 5(1)(iii)(ca) of part-II.

The operational status of the instrument or simulator shall be recorded for each test.

When an instrument is connected in other than a normal configuration, the procedure shall be mutually agreed on by the approving authority and the applicant.

(ii) Simulator requirements**(a) General**

If a simulator is used to test a module, the repeatability and stability of the simulator should make it possible to determine the performance of the module with at least the same accuracy as when a complete instrument is tested with weights, the mpe to be considered being those applicable to the module. If a simulator is used, this shall be noted in the Test Report Format and its traceability referenced.

(b) Interfaces [Para 4(3)(v) of Part-II]

Susceptibility that would result from the use of electronic interfaces to other equipment shall be simulated in the tests. For this purpose it is sufficient to connect 3 m of interface cable terminated to simulate the interface impedance of the other equipment.

(c) Documentation

Simulators shall be defined in terms of hardware and functionality by reference to the instrument under test, and by any other documentation necessary to ensure reproducible test conditions. This information shall be attached to, or shall be traceable from, the test report.

(2) Influence factor tests [Para 2(7) of Part-II]

Summary of tests			
Test	Conditions applied	§	
Static temperatures	MPE*	7(2)(i) of Annex A	
Temperature effect on no-load indication	MPE	7(2)(ii) of Annex A	
Damp heat, steady-state	MPE	7(2)(iii) of Annex A	
AC mains voltage variations	MPE	7(2)(iv) of Annex A	
DC mains voltage variations, including rechargeable battery if the battery can be fully (re)charged during the operation of the instrument	MPE	7(2)(v) of Annex A	
Battery voltage variations (DC), including non-rechargeable, and rechargeable battery if (re)charging of the battery during the operation of the instrument is not possible	MPE	7(2)(vi) of Annex A	
Voltage variations in 12 V or 24 V road vehicle batteries	MPE	7(2)(vii) of Annex A	

* maximum permissible error

(i) Static temperatures [Para 2(7)(i)(a) of Part-II]

Static temperature tests are carried out according to Table 8.

Table 8

Environmental phenomena	Test specification
Temperature	Reference of 20 °C
	Specified high for 2 hours
	Specified low for 2 hours
	Temperature of 5 °C, if the specified low temperature is ≤ 0 °C
	Reference of 20 °C

The static temperatures test is considered as one test.

Supplementary information to the test procedures:

Object of the test:	To verify compliance with the provisions in Para 4(1)(i) of part-II under conditions of dry heat (non-condensing) and cold. The test in 7(2)(ii) of Annex A may be conducted during this test.
Preconditioning:	16 hours
Condition of the EUT:	EUT is connected to the voltage supply and “on” for a time period equal to or greater than the warm-up time specified by the manufacturer. Voltage supply is to be “on” for the duration of the test. The zero-setting and zero-tracking facilities shall be enabled as for normal operation. If the test is performed together with 7(2)(ii) of Annex A, automatic zero-setting and zero-tracking shall not be in operation.
Stabilization:	2 hours at each temperature under “free air” conditions. “Free air” conditions mean a minimum air circulation to keep the temperature at a stable level.
Temperature:	As specified in Para 2(7)(i) (a) of Part-II
Temperature sequence:	(a) At the reference temperature of 20 °C; (b) At the specified high temperature; (c) At the specified low temperature; (d) At a temperature of 5 °C, if the specified low temperature is below 10 °C; and (e) At the reference temperature.
Barometric pressure:	Changes in barometric pressure shall be taken into account.
Number of test cycles:	At least one cycle.
Test information:	Adjust the EUT as close to zero indication as practicable prior to the test (if an automatic zero-tracking device is connected, adjust it to a value near zero). The EUT shall not be readjusted at any time during the test. After stabilization at the reference temperature and again at each specified temperature, apply at least five different test loads or simulated loads and record: (a) date and time; (b) temperature; (c) relative humidity; (d) test load; (e) indications (as applicable); (f) errors; (g) functional performance.
Maximum allowable variations:	All functions shall operate as designed. All errors shall be within the maximum permissible errors specified in Para 2(2) (ii) of part-II for initial verification.

(ii) Temperature effect on the no-load indication [Para 2(7)(i)(b) of Part-II]

Currently, there are no applicable standards. This test shall be conducted as described below.

The instrument shall be set to zero and then changed to the prescribed highest and lowest temperatures as well as to 5 °C if applicable. After stabilization the error of the zero indication shall be determined.

The change in zero indication per 5 °C shall be calculated. The changes in these errors per 5 °C are calculated for any two consecutive temperatures of this test.

This test may be performed together with the temperature test in 7(2)(i) of Annex A. The errors at zero shall then be additionally determined immediately before changing to the next temperature and after the 2 hour period after the instrument has reached stability at this temperature.

If the instrument is provided with automatic zero-setting or zero-tracking, it shall not be in operation.

Condition of the EUT: EUT connected to the voltage supply and “on” for a time period equal to or greater than the warm-up time specified by the manufacturer. Voltage supply is to be “on” for the duration of the test.

(iii) Damp heat, steady state [Para 4(3)(iii) of Part-II]

Damp heat, steady state tests are carried out according to Table 9.

Table 9

Environmental phenomena	Test specification
Damp heat, steady state	Upper limit temperature and relative humidity of 85 % for 48 hours

Supplementary information to the test procedures:

Object of the test: To verify compliance with the provisions in Para 4(1)(i) of Part-II under conditions of high humidity and constant temperature.

Preconditioning: None required.

Condition of the EUT: EUT is connected to the voltage supply and “on” for a time period equal to or greater than the warm-up time specified by the manufacturer. The zero-setting and zero-tracking facilities shall be enabled as for normal operation.

The handling of the EUT shall be such that no condensation of water occurs on the EUT.

Stabilization: 3 hours at reference temperature and 50 % humidity.

2 days at the upper limit temperature as specified in Para 2(7)(i)(a) of Part-II

Temperature: Reference temperature (20 °C or the mean value of the temperature range whenever 20 °C is outside this range) and at the upper limit as specified in Para 2(7)(i)(a) of Part-II.

Temperature-humidity 48 hour sequence:

- Reference temperature of 20 °C at 50 % humidity;
- Upper limit temperature at 85 % humidity;
- Reference temperature of 20 °C at 50 % humidity.

Barometric pressure: Changes in barometric pressure shall be taken into account.

Number of test cycles:	At least one cycle.
Test information:	<p>After stabilization of the EUT at reference temperature and 50 % humidity, apply at least five different test loads or simulated loads and record:</p> <p>(a) date and time;</p> <p>(b) temperature;</p> <p>(c) relative humidity;</p> <p>(d) test load;</p> <p>(e) other indications (as applicable);</p> <p>(f) errors;</p> <p>(g) functional performance.</p> <p>Increase the temperature in the chamber to the upper limit and increase the relative humidity to 85 %. Maintain the EUT at no load for a period of 48 hours. Following the 48 hours, apply the same test loads or simulated loads and record the data as indicated above.</p> <p>Decrease the relative humidity to 50 % and decrease the temperature in the chamber to the reference temperature. After stabilization of the EUT, apply the same test loads or simulated loads and record the data as indicated above.</p> <p>Allow full recovery of the EUT before any other tests are performed.</p>
Maximum allowable variations:	All errors shall be within the maximum permissible errors specified in Para 2(2)(ii) of Part-II for initial verification.

(iv) AC mains voltage variations Para 2(7)(ii) of Part-II]

AC mains voltage supply variation tests are carried out according to Table 10.

Table 10

Environmental phenomena	Test specification	
AC mains voltage variation	U_{nom}	
	Upper limit:	$1.10 \times U_{nom}$ or $1.10 \times U_{max}$
	Lower limit:	$0.85 \times U_{nom}$ or $0.85 \times U_{min}$
	U_{nom}	

Supplementary information to the test procedures:

Object of the test:	To verify compliance with the provisions in Para 4(1)(i) of Part II under conditions of AC mains voltage variations.
Preconditioning:	None required.
Condition of the EUT:	The EUT is connected to the AC mains supply and “on” for a time period equal to or greater than the warm-up time specified by the manufacturer. Adjust the EUT as close to zero indication as practicable prior to the test and do not readjust at anytime during the test except to reset if a significant fault has been detected.
Number of test cycles:	At least one cycle.
Test information:	<p>The EUT shall be tested with a test or simulated load at or near Min and with one test load or simulated load between 50 % and the maximum capacity of the EUT.</p> <p>Stabilize the EUT at the nominal voltage and record the following data:</p> <ul style="list-style-type: none"> (a) date and time; (b) temperature; (c) relative humidity; (d) AC voltage supply; (e) test loads; (f) indications (as applicable); (g) errors; (h) functional performance. <p style="text-align: center;">Repeat the test and record the indications.</p>
Maximum allowable variations:	All functions shall operate as designed. All errors shall be within the maximum permissible errors specified in Para 2(2)(ii) of Part-II for initial verification.

(v) DC mains voltage variations [Para 2(7)(ii) of Part-II]

Instruments operating from DC mains voltage supply, including rechargeable battery if recharging of the battery during the operation of the instrument is possible, shall fulfill the tests in Para 7(2) of Annex-A, with the exception of Para 7(2)(iv) of Annex-A which is to be replaced by the test according to Table 11.

Table 11

Environmental phenomena	Test specification	
DC mains voltage variations	U_{nom}	
	Upper limit:	$1.20 \times U_{nom}$ or $1.20 \times U_{max}$
	Lower limit:	minimum operating voltage (see 7(2)(ii))
	U_{nom}	

Supplementary information to the test procedures:

Object of the test: To verify compliance with the provisions in Para 4(1)(i) of Part-II under conditions of DC mains voltage variations.

Pre-condition: None

Condition of the EUT: The EUT is connected to the DC mains voltage supply and “on” for a time period equal to or greater than the warm-up time specified by the manufacturer. Adjust the EUT as close to zero indication as practicable, prior to the test and do not readjust at any time during the test except to reset if a significant fault has been indicated.

Number of test cycles: At least one cycle.

Test information: Stabilize the EUT at the nominal voltage and record the following data at no load and with one load or simulated load:

- (a) date and time;
- (b) temperature;
- (c) relative humidity;
- (d) DC voltage supply;
- (e) test loads;
- (f) indications (as applicable);
- (g) errors;
- (h) functional performance.

Repeat the test and record the indications.

Maximum allowable variations: All functions shall operate as designed. All errors shall be within the maximum permissible errors specified in Para 2(2)(ii) of Part-II for initial verification.

(vi) Battery voltage supply (DC), not mains connected, including non-rechargeable battery voltage supply and also including rechargeable battery supply if (re)charging of battery voltage supply during the operation of the instrument is not possible [Para 2(7)(ii) of Part-II]

Battery-powered instruments shall fulfill the tests in 7(2) of Annex A, with the exception of 7(2)(iv) of Annex A and 7(2)(v) of Annex A and 7(2)(vi) of Annex A which are to be replaced by the test in Table 12.

Table 12

Environmental phenomena	Test specification	Test setup
Battery voltage variations	U_{nom}	No reference to standards for this test.
	Minimum operating voltage [see Para 2(7)(ii) of Part-II]	
	U_{nom}	

Supplementary test information:

Object of the test:	To verify compliance with the provisions in Para 4(1)(i) of Part-II under conditions of voltage variations of a fully charged battery.
Pre-condition:	None
Condition of the EUT:	The EUT is connected to the battery voltage supply and “on” for a time period equal to or greater than the warm-up time specified by the manufacturer. Adjust the EUT as close to zero indication as practicable, prior to the test and do not readjust at any time during the test except to reset if a significant fault has been indicated.
Number of test cycles:	At least one cycle.
Test information:	<p>Stabilize the EUT at the nominal voltage and record the following data at no load and with one load or simulated load:</p> <ul style="list-style-type: none"> (a) date and time; (b) temperature; (c) relative humidity; (d) battery voltage supply; (e) test loads; (f) indications (as applicable); (g) errors; (h) functional performance. <p>Reduce the voltage supply to the EUT until the instrument ceases to function properly according to the specifications and metrological requirements, and record the indications.</p>
Maximum allowable variations:	All functions shall operate as designed. All errors shall be within the maximum permissible errors specified in [Para 2(2)(ii) of Part-II] for initial verification.

(vii) Voltage variations from 12 V or 24 V road vehicle batteries [Para 2(7)(ii) of Part-II]

Road vehicle battery operated instruments shall fulfill the tests in Para 7(2) of Annex A, with the exception of Para 7(2) (iv) of Annex A which is to be replaced by the following test conducted in accordance with Table 13.

Table 13

Environmental phenomena	Test specification		
	U_{nom}	Upper limit	Lower limit
12 V or 24 V road vehicle battery voltage variation	12 V	16 V	9 V
	24 V	32 V	16 V

Supplementary information to the test procedures:

Object of the test:	To verify compliance with the provisions in Para 4(1)(i) of Part II under conditions of road vehicle battery voltage variations.
Preconditioning:	None
Condition of the EUT:	The EUT is connected to the voltage supply and “on” for a time period equal to or greater than the warm-up time specified by the manufacturer. Adjust the EUT as close to zero indication as practicable, prior to the test and do not readjust at any time during the test except to reset if a significant fault has been indicated.
Number of test cycles:	At least one cycle for each functional mode.
Test information:	<p>Stabilize the EUT at the nominal voltage and record the following data at no load and with one load or simulated load:</p> <ul style="list-style-type: none"> (a) date and time; (b) temperature; (c) relative humidity; (d) voltage supply; (e) test loads; (f) indications (as applicable); (g) errors; (h) functional performance. <p>Reduce the voltage supply to the EUT until the instrument clearly ceases to function properly according to the specifications and metrological requirements, and record the indication.</p>
Maximum allowable variations:	All functions shall operate as designed. All errors shall be within the maximum permissible errors specified in Para 2(2)(ii) of Part-II for initial verification.

(3) Disturbance Test [Para 4(1)(ii) of Part-II]

Summary of tests		
Test	Condition applied	§
AC mains voltage short time power reduction	sf*	7(3)(i) of Annex A
Electrical fast transients/burst immunity on mains supply lines and on I/O circuits and communication lines	sf	7(3)(ii) of Annex A
Electrical surges on mains supply lines and on I/O circuits and communication lines	sf	7(3)(iii) of Annex A
Electrostatic discharge	sf	7(3)(iv) of Annex A
Immunity to electromagnetic fields	sf	7(3)(v) of Annex A
Electrical transient conduction for instruments powered by 12 V or 24 V road vehicle batteries	sf	7(3)(vi) of Annex A

* value of the significant fault (Para 4(2)(vii) of Part-I)

(i) Short time power reduction

AC mains short time power reduction (voltage dips and short interruptions) tests are carried out according to Table 14.

Table 14

Environmental phenomena	Test specification		
	Test	Reduction of amplitude to	Duration / number of cycles
Voltage dips and short interruptions	Test a	0 %	0.5
	Test b	0 %	1
	Test c	40 %	10
	Test d	70 %	25/30*
	Test e	80 %	250/300*
	Short interruption	0 %	250

* These values are for 50 Hz /60 Hz, respectively

Supplementary information to the test procedures

Object of the test: To verify compliance with the provisions in Para 4(1)(ii) of Part - II under conditions of short time mains voltage interruptions and reductions while observing the weight indication of a single static load.

Preconditioning: None required.

Condition of the EUT: The EUT is connected to the voltage supply and “on” for a time period equal to or greater than the warm-up time specified by the manufacturer. Adjust the EUT as close to zero indication as practicable, prior to the test. Zero-setting functions shall not be in operation and are not to be adjusted at any time during the test except to reset if a significant fault has been indicated.

Number of test cycles: At least one cycle.

Test information: The EUT shall be tested with one small static test load.

Stabilize all factors at nominal reference conditions. Apply one load or simulated load and record:

- (a) date and time;
- (b) temperature;
- (c) relative humidity;
- (d) voltage supply;
- (e) test load;
- (f) indications (as applicable);
- (g) errors;
- (h) functional performance

In accordance with the test specification in Table 14, interrupt the voltages to the corresponding durations / number of cycles and conduct the test as detailed in Para 8(2)(i) of Part- II. During interruption observe the effect on the EUT and record as appropriate.

Maximum allowable variations:

The difference between the indication due to the disturbance and the indication without the disturbance either shall not exceed 1 *d* (Para 4(2)(vii) of Part -I), or the EUT shall detect and react to a significant fault.

(ii) Electrical fast transients/burst immunity on the mains supply lines and on the I/O circuits and communication lines

Electrical fast transients/burst immunity tests are carried out at the positive and the negative polarities for at least 1 minute at each polarity according to Tables 15 and 16.

Table 15

Environmental phenomena	Test specification
Fast transient common mode	0.5 kV (peak) 5/50 ns T_1/T_h 5 kHz rep. frequency

Table 16

Environmental phenomena	Test specification
Fast transient common mode	1 kV (peak) 5/50 ns T_1/T_h 5 kHz rep. frequency

A coupling/decoupling network shall be applied for testing AC supply ports.

Supplementary information to the test procedures

Object of the test:	To verify compliance with the provisions in Para 4(1)(ii) of Part-II under conditions where fast transients are superimposed separately on the mains voltage, and on the I/O circuits and communication lines (if any), while observing the indications for one static test load.
Preconditioning:	None required.
Condition of the EUT:	The performance of the test generator shall be verified before connecting the EUT. The EUT is connected to the voltage supply and “on” for a time period equal to or greater than the warm-up time specified by the manufacturer. Adjust the EUT as close to zero indication as practicable, prior to the test. Zero-setting functions shall not be in operation and are not to be adjusted at any time during the test except to reset if a significant fault has been indicated.
Number of test cycles:	At least one cycle.

Test information:	<p>Both positive and negative polarity of the bursts shall be applied. The duration of the test shall not be less than one minute for each amplitude and polarity. The injection network on the mains shall contain blocking filters to prevent the burst energy being dissipated in the mains. For the coupling of the bursts into the input/output and communication lines, a capacitive coupling clamp as defined in the reference standard shall be used.</p> <p>Before any test stabilize the EUT under constant environmental conditions. Apply one small static test load and record:</p> <ul style="list-style-type: none"> (a) date and time; (b) temperature; (c) relative humidity; (d) voltage supply; (e) test load; (f) indications (as applicable); (g) errors; (h) functional performance.
Maximum allowable variations:	<p>The difference between the indication due to the disturbance and the indication without the disturbance either shall not exceed 1 <i>d</i> (Para 4(2)(vii) of Part-I), or the EUT shall detect and react to a significant fault.</p>

(iii) Electrical surges on mains supply lines and on I/O circuits and communication (signal) lines

Electrical surge tests are carried out according to Table 17.

Table 17

Environmental phenomena	Test specification
Surges on mains supply lines and on I/O circuits and communication lines	<p style="text-align: center;">0.5 kV (peak) line to line 1.0 kV line to earth</p> <p>(a) 3 positive and 3 negative surges applied synchronously with AC supply voltage in angles 0°, 90°, 180° and 270°.</p> <p>(b) 3 positive and 3 negative surges applied on DC supply lines and on I/O circuits and communication lines.</p>

Supplementary information to the test procedures

Object of the test:	<p>To verify compliance with the provisions in Para 4(1)(ii) of Part-II under conditions where electrical surges are applied separately to the mains supply lines, and to the I/O circuits and communication lines (if any), while observing the indications for one static test load.</p>
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Preconditioning:	None required.
Condition of the EUT:	<p>The characteristics of the test generator shall be verified before connecting the EUT.</p> <p>The EUT is connected to the voltage supply and “on” for a time period equal to or greater than the warm-up time specified by the manufacturer. Adjust the EUT as close to zero indication as practicable, prior to the test. Zero-setting functions shall not be in operation and are not to be adjusted at any time during the test except to reset if a significant fault has been indicated.</p>
Number of test cycles:	At least one cycle.
Test information	<p>The EUT shall be tested with one small static test load.</p> <p>Before any test stabilize the EUT under constant environmental conditions. Apply one load or simulated load and record:</p> <ul style="list-style-type: none">(a) date and time;(b) temperature;(c) relative humidity;(d) voltage supply;(e) test load;(f) indications (as applicable);(g) errors;(h) functional performance.
Maximum allowable variations:	The difference between the indication due to the disturbance and the indication without the disturbance either shall not exceed 1 <i>d</i> (Para 4(2)(vii) of Part-I), or the EUT shall detect and react to a significant fault.

(iv) Electrostatic discharge

Electrostatic discharge tests are carried out according to Table 18.

Table 18

Environmental phenomena	Test specification	
Electrostatic discharge	Test voltage	Levels ⁽¹⁾
	contact discharge	6 kV
	air discharge	8 kV

Supplementary information to the test procedures

Object of the test: To verify compliance with the provisions in Para 4(1)(ii) of Part-II under conditions where electrostatic discharges are applied while observing the weight indication for one small static test load.

Preconditioning: None required.

Condition of the EUT: The performance of the test generator shall be verified before connecting the EUT.

The EUT is connected to the voltage supply and “on” for a time period equal to or greater than the warm-up time specified by the manufacturer. Adjust the EUT as close to zero indication as practicable, prior to the test. Zero-setting functions shall not be in operation and are not to be adjusted at any time during the test except to reset if a significant fault has been indicated.

Number of test cycles: At least one cycle.

Test information: Contact discharge is the preferred test method. 20 discharges (10 with positive and 10 with negative polarity) shall be applied on each accessible metal part of the enclosure. The time interval between successive discharges shall be at least 10 seconds. In the case of a non conductive enclosure, discharges shall be applied on the horizontal or vertical coupling planes as specified in the reference standard. Air discharges shall be used where contact discharges cannot be applied.

Before any test stabilize the EUT under constant environmental conditions. Apply one small static test load and record:

- (a) date and time;
- (b) temperature;
- (c) relative humidity;
- (d) voltage supply;
- (e) test load;
- (f) indications (as applicable);
- (g) errors;
- (h) functional performance.

Maximum allowable variations: The difference between the indication due to the disturbance and the indication without the disturbance either shall not exceed 1 *d* [Para 4(2)(vii) Part-I], or the EUT shall detect and react to a significant fault.

(v) Immunity to electromagnetic fields**(a) Immunity to radiated electromagnetic fields**

Radiated, radio-frequency, electromagnetic (EM) field immunity tests (radio-frequency EM fields higher than 80 MHz) are carried out according to Table 19.

Table 19

Environmental phenomena	Test specification	
Radiated electromagnetic field	Frequency ranges (MHz)	Field strength (V/m)
	80 to 2 000 ⁽¹⁾	10
	26 to 80 ⁽²⁾	
Modulation	80 % AM, 1 kHz sine wave	

Supplementary information to the test procedures

Object of the test: To verify compliance with the provisions in Para 4(1)(ii) of Part-II under conditions of specified radiated electromagnetic fields applied while observing the weight indication for one small static test load.

Preconditioning: None required.

Condition of the EUT: The performance of the test generator shall be verified before connecting the EUT.

The EUT is connected to the voltage supply and “on” for a time period equal to or greater than the warm-up time specified by the manufacturer. Adjust the EUT as close to zero indication as practicable, prior to the test. Zero-setting functions shall not be in operation and are not to be adjusted at any time during the test except to reset if a significant fault has been indicated.

Number of test cycles: At least one cycle.

Test information: The EUT shall be exposed to EM field strength as specified in Table 19. The frequency ranges to be considered are swept with the modulated carrier. The performance of the EUT shall be verified.

Before any test stabilize the EUT under constant environmental conditions. Apply one small static test load and record:

- (a) date and time;
- (b) temperature;
- (c) relative humidity;
- (d) voltage supply;
- (e) test load;
- (f) indications (as applicable);
- (g) errors;
- (h) functional performance.

Maximum allowable variations: The difference between the indication due to the disturbance and the indication without the disturbance either shall not exceed 1 d [Para 4(2)(vii) of Part-I], or the EUT shall detect and react to a significant fault.

(b) Immunity to conducted electromagnetic field tests

Conducted, radio-frequency, electromagnetic field (EM) immunity tests (radio-frequency EM fields lower than 80 MHz) are carried out in accordance to Table 20.

Table
20

Environmental phenomena	Test specification	
Conducted electromagnetic field	Frequency range MHz	RF amplitude (50 ohms) V (e.m.f)
	0.15 to 80	10 V
Modulation	80 % AM, 1 kHz sine wave	

Supplementary information to the test procedures

Object of the test: To verify compliance with the provisions in Para 4(1)(ii) of Part-II under conditions of specified conducted electromagnetic fields applied while observing the weight indication for one small static test load.

Preconditioning: None required.

Condition of the EUT: The performance of the test generator shall be verified before connecting the EUT.

The EUT is connected to the voltage supply and “on” for a time period equal to or greater than the warm-up time specified by the manufacturer. Adjust the EUT as close to zero indication as practicable, prior to the test. Zero-setting functions shall not be in operation and are not to be adjusted at any time during the test except to reset if a significant fault has been indicated.

Number of test cycles: At least one cycle.

Test information: Before any test stabilize the EUT under constant environmental conditions. Apply one small static test load and record:

- (a) date and time;
- (b) temperature;
- (c) relative humidity;
- (d) voltage supply;
- (e) test load;
- (f) indications (as applicable);
- (g) errors;
- (h) functional performance.

Maximum allowable variations: The difference between the indication due to the disturbance and the indication without the disturbance either shall not exceed 1 d [Para 4(2)(vii) of Part-I], or the EUT shall detect and react to a significant fault.

(vi) Electrical transient conduction for instruments powered by a road vehicle battery

(a) Electrical transient conduction along supply lines of 12 V or 24 V batteries

Transient immunity tests along supply lines of 12 V and 24 V vehicle batteries are carried out according to Table 21.

Table 21

Environmental phenomena	Test specification		
	Test pulse	Pulse voltage, U_s	
		$U_{nom} = 12\text{ V}$	$U_{nom} = 24\text{ V}$
Conduction along 12 V or 24 V supply lines	2a	+50 V	+50 V
	2b	+10 V	+20 V
	3a	-150 V	-200 V
	3b	+100 V	+200 V
	4	-7 V	-16 V

Supplementary information to the test procedures

Object of the test: To verify compliance with the provisions in Para 4(1)(ii) of Part-II under the following conditions while observing the weight indication for one small static test load:

- f* transients due to a sudden interruption of currents in a device connected in Parallel with the device under test due to the inductance of the wiring harness (pulse 2a);
- f* transients from DC motors acting as generators after the ignition is switched off (pulse 2b);
- f* transients on the supply lines, which occur as a result of the switching processes (pulses 3a and 3b);
- f* voltage reductions caused by energizing the starter-motor circuits of internal combustion engines (pulse 4).

Preconditioning: None

Condition of the EUT: The EUT is connected to the voltage supply and “on” for a time period equal to or greater than the warm-up time specified by the manufacturer.

Adjust the EUT as close to zero indication as practicable prior to the test. Zero-setting functions shall not be in operation and are not be adjusted at any time during the test except to reset if a significant fault has been indicated.

Stabilization: Before any test stabilize the EUT under constant environmental conditions.

Test information:	<p>The EUT is exposed to conducted disturbances (on the supply voltage by direct brief coupling on supply lines) of the strength and character as specified in Table 21. With the static load in place record:</p> <ul style="list-style-type: none"> (a) date and time; (b) temperature; (c) relative humidity; (d) voltage supply; (e) test load; (f) indications (as applicable); (g) errors; (h) functional performance. <p>Repeat the test weighing for the defined voltages and record the indications.</p>
Maximum allowable variations:	<p>The difference between the indication due to the disturbance and the indication without the disturbance either shall not exceed 1 <i>d</i> [Para 4(2)(vii) of Part-I], or the EUT shall detect and react to a significant fault.</p>

(b) Transient conduction by capacitive and inductive coupling via lines other than supply lines

Transient immunity tests via lines other than supply lines for 12 V or 24 V road vehicle batteries are carried out according to Table 22.

Table 22

Environmental phenomena	Test specification		
Electrical transient conduction via lines other than supply lines	Test pulse	Pulse voltage, U_s	
		$U_{nom} = 12 \text{ V}$	$U_{nom} = 24 \text{ V}$
	a	-60 V	-80 V
	b	+40 V	+80 V

Supplementary information to the test procedures:

Object of the test: To verify compliance with the provisions in Para 4(1)(ii) of Part-II under conditions of transients which occur on other lines as a result of the switching processes (pulses a and b), under the following conditions while observing the weight indication for one small static test load.

Preconditioning: None

Condition of the EUT:	The EUT is connected to the voltage supply and “on” for a time period equal to or greater than the warm-up time specified by the manufacturer. Adjust the EUT as close to zero indication as practicable prior to the test. Zero-setting functions shall not be in operation and are not to be adjusted at any time during the test except to reset if a significant fault has been indicated.
Stabilization:	Before any test stabilize the EUT under constant environmental conditions.
Weighing test:	<p>The EUT is exposed to conducted disturbances (bursts of voltage spikes by capacitive and inductive coupling via lines other than supply lines) of the strength and character as specified in Table 22. With the static load in place record:</p> <ol style="list-style-type: none"> a) date and time; b) temperature; c) relative humidity; d) voltage supply; e) test load; f) indications (as applicable); g) errors; h) functional performance. <p>Repeat the test weighing for the defined voltages and record the indications.</p>
Maximum allowable variations:	The difference between the indication due to the disturbance and the indication without the disturbance either shall not exceed 1 <i>d</i> , or the EUT shall detect and react to a significant fault.

A.8 Span stability test (Para 4(4)(3) of Part II)

Test	Summary of test Condition applied
Span stability	½ absolute MPE*

* Maximum permissible error on initial verification given in Para 2(2)(ii) Part-II.

Note: The maximum permissible error for the zero point shall also be taken into consideration.

Test method:	Span stability.
Object of the test:	To verify compliance with the provisions in Para 4(4)(iii) of Part-II after the EUT has been subjected to the performance tests.
Reference to standard:	No reference to international standards can be given at the present time.
Test procedure in brief:	<p>The test consists of observing the variations of the error of the EUT or simulator under sufficiently constant ambient conditions (reasonably constant conditions in a normal laboratory environment) at various intervals: before, during and after the EUT has been subjected to performance tests.</p> <p>The performance tests shall include the temperature test and, if applicable, the damp heat test. Other performance tests listed in this Annex may be performed.</p> <p>The EUT shall be disconnected twice from the mains power supply (or battery supply where fitted) for at least 8 hours during the period of the test. The number of disconnections may be increased if so specified by the manufacturer or at the discretion of the approval authority in the absence of any specification.</p> <p>In the conduct of this test, the operating instructions for the instrument as supplied by the manufacturer shall be considered.</p>
Test severity:	Test duration: 28 days or the time period necessary to conduct the performance tests, whichever is less.
Time, t , between tests (days):	$0.5 \leq t \leq 10$.
Test load:	Near maximum capacity, Max; the same test weights shall be used throughout the test.
Maximum allowable variations:	The variation in the errors of indication shall not exceed half the absolute value of the maximum permissible error in Para 2(2)(ii) of Part-II for initial verification for the test load applied on any of the n measurements.
Number of tests, n :	At least eight, except where the differences of the results indicate a trend more than half the allowable variation specified, the measurements shall be continued until the trend comes to rest or reverses itself, or until the error exceeds the maximum allowable variation.
Precondition:	None required.
Test equipment:	Verified mass standards or simulated loads.
Condition of the EUT:	<p>The EUT is connected to the voltage supply and “on” for a time period equal to or greater than the warm-up time specified by the manufacturer.</p> <p>The EUT shall be stabilized at sufficiently constant ambient conditions after switch-on for at least five hours, and at least 16 hours after the temperature and damp heat tests have been performed.</p>

- Test sequence: Stabilize all factors at sufficiently constant ambient conditions.
- Adjust the EUT as close to zero as possible.
- Automatic zero-tracking shall be made inoperative and any automatic built-in span adjustment device shall be made inoperative.
- Apply the test load (or simulated load) and determine the error.
- After the first measurement immediately repeat zeroing and loading four times to determine the average value of the error. For the subsequent measurements perform only one, unless either the result is outside the specified tolerance or the range of the five readings of the initial measurement is more than 0.1 *d*.
- Record the following data:
- (a) date and time;
 - (b) temperature;
 - (c) relative humidity;
 - (d) test load;
 - (e) indications (as applicable);
 - (f) errors;
 - (g) changes in test location,
- and apply all necessary corrections resulting from variations in temperature, etc. between the various measurements.
- Allow full recovery of the EUT before any other tests are performed.

9. PROCEDURE FOR IN-MOTION TESTS

(1) General

Note the accuracy classes required for the vehicle mass (VM) and, if required, for axle load and axle-group load.

Ensure that the desired scale interval and the maximum capacity comply with Para 2(3) of Part-II. Check that the minimum capacity complies with Para 2(4) of Part-II.

For type approval, tests shall be carried out in accordance with the requirements of this Rule, and especially the requirements in para 5(1) of Part-II and 1 of Annex A.

For initial verification, tests shall be carried out in accordance with the requirements of this Rule, and especially the requirements in para 5(2) of Part-II and 2 of Annex A.

For subsequent and in-service verification, tests shall be carried out in accordance with the requirements of this Rule, and especially the requirements in para 5(3) of Part-II.

In determining the single-axle load, and if required, the axle-group load, the conditions specified in para 2(5) of Part-II and, if appropriate the requirements of national regulations should be taken into account.

(2) Control instrument

Establish whether or not the instrument is to be used as an integral control instrument. If it is an integral control instrument then it shall comply with Para 6(2)(i) of Part-II and be tested, using the static weighing test method in Para 6(3) of Part-II, in accordance with 5(2) of Annex A.

If vehicles have to be moved over some distance from a separate control instrument to the EUT, the conditions must be closely controlled. Differences in weather conditions may cause errors which will

not be determinable and so this should be avoided where possible. Consideration shall also be given to the amount of fuel used and any possible effects that this could have on the reference values.

(3) Weighing

(i) Static weighing

If the Weighing in Motion instrument is provided with a static weighing mode, the static weighing test detailed in Para 9 (3)(i)(a) of Annex A shall be applied. When the instrument has been tested according to the test in Para 9(2) of Annex A then those results may be used.

(a) Static weighing test

Apply test loads from zero up to and including Max, then remove the test loads back to zero. Where the size of the load receptor prevents loading to Max, the reduced load should be noted. However, where a reduced load is used, it shall be at least 50 % of Max. At least ten different load values shall be selected. The values of the loads selected shall include Max and Min, and values at or near those at which the maximum permissible error changes.

It should be noted that when loading or unloading weights, the load must be respectively increased or decreased in a uniform progression.

Ensure that the error is recorded at each change in load and calculate the errors according to Para 3(6)(ii) of Annex A. Record the errors and compare them to the limits in Para 2(2)(ii) of Part-II as appropriate for initial verification or in- service inspection.

(b) Full-draught weighing of reference vehicles

For testing instruments to be used for determining the vehicle mass (VM), select the required number of reference vehicles as specified in Para 6(5) of Part-II, and conduct the following tests:

- a) The conventional true value [Para 1(9) of Part-I] of the unloaded reference vehicle mass shall be determined by full-draught weighing of the unloaded reference vehicles on the control instrument.
- b) The conventional true value [Para 1(9) of Part-I] of the loaded reference vehicle mass shall be determined by:
 - loading the unloaded reference vehicles in a) above with standard test loads;
 - or
 - full-draught weighing of the loaded reference vehicles on the control instrument.

(c) Determining static reference single-axle loads for the two-axle rigid reference vehicle

For testing instruments to be used in applications where the single-axle loads are required, the conventional true value of the static reference single-axle loads shall be determined for the two-axle rigid reference vehicle by including a minimum of two different axle loads using the following method:

- (ca) Weigh each axle of the static two-axle rigid reference vehicle in turn on the control instrument specified in Para 6(2)(ii) of Part-II and record the indicated single-axle load. After both axles have been weighed, calculate the vehicle mass by the summation of the recorded values for the two axle loads and record the VM value. This operation shall be conducted five times with the vehicle facing in the same direction, and a further five times with the vehicle facing in the opposite direction.
- (cb) For each of the above weighing operations, ensure that the vehicle is stationary, with the wheels on the axle being weighed fully supported by the load receptor, the engine switched off, the gear in neutral and the brakes released. Use wheel chocks, if necessary, to prevent vehicle motion.

- (c-1) Calculate the mean static reference single-axle load for each axle on the two-axle rigid vehicle according to the following:

$$\overline{\text{Axle}_i} = \frac{\sum_{i=1}^{10} \text{Axle}_i}{10}$$

where: i is the single-axle rank
 10 is the number of weighments of each static axle
 Axle_i is the recorded load for that axle

- (c-2) Add the two mean single-axle loads to determine the mean of the static vehicle mass:

$$\overline{\text{VM}} = \sum_{i=1}^2 \overline{\text{Axle}_i}$$

Alternatively, use the recorded values for the vehicle mass calculated after each vehicle weighment as described above and calculate the mean of the static two-axle reference vehicle mass according to the following:

$$\overline{\text{VM}} = \frac{\sum_{i=1}^{10} \text{VM}}{10}$$

- (c-3) Calculate the corrected mean single-axle loads as follows:

$$\overline{\text{CorrAxle}_i} = \overline{\text{Axle}_i} \times \frac{\text{VM}_{\text{ref}}}{\overline{\text{VM}}}$$

where: VM_{ref} is the conventional true value of each reference vehicle mass determined by full-draught weighing in Para 6(7) of Part-II.

- (c-4) For the purposes of this Rule, the conventional true value of the static reference single-axle loads [see Para 3(1)(x) of Part-I] for the two-axle rigid reference vehicle shall be the respective corrected mean single-axle load as calculated in 3) above.

- (c-5) Traceability of the conventional true value of the single-axle loads on the static reference two-axle rigid vehicle is provided by the fact that the sum of the two corrected mean static reference single-axle loads equals the conventional true value of the reference vehicle mass determined by full-draught weighing [Para 6(7) of Part-II] on a suitable control instrument [Para 6(2)(i) of Part-II]:

$$\text{VM}_{\text{ref}} = \sum_{i=1}^2 \overline{\text{CorrAxle}_i}$$

The static reference single-axle loads shall be determined with the vehicle unloaded and loaded appropriately such that the axle loads cover, as far as practicable, the weighing range of the instrument. A minimum of two different axle loads, e.g. one near Min and one near Max (respectively at the maximum permissible axle load of the two-axle rigid reference vehicle) shall be tested.

(ii) In-motion tests

Prior to any test, adjust the instrument under test in-situ and in accordance with the manufacturer's specifications.

All weighing operations shall be started with the reference vehicle positioned in advance of the approach apron at a distance sufficient for the vehicle to be traveling at a steady speed before arriving at the apron.

Test runs shall be conducted using the two-axle rigid reference vehicle plus a minimum of two other reference vehicles [Para 6(5) of Part-II] with each vehicle unloaded and loaded.

The speed of the vehicle shall be kept as constant as feasible during each in-motion test run.

For each vehicle and loading condition at least five test runs shall be performed with three test runs made over the center of the load receptor, one test run made to the left side of the load receptor, and one test run made to the right side of the load receptor.

The five test runs shall be conducted at the following speeds that are within the range of speeds for which the instrument is to be evaluated:

- (ii-a) near maximum operating speed, v_{\max} [Para 3(4)(ii) of Part-I];
- (ii-b) near minimum operating speed, v_{\min} [Para 3(4)(iii) of Part-I];
- (ii-c) near the center of the range of operating speeds [Para 3(4)(iv) of Part-I].

(a) Vehicle mass measurement

Record the vehicle masses as they are displayed or printed [Para 6(12) of Part-II by the instrument under test, and calculate the errors according to the vehicle reference weights determined in 9 (3)(i)(b) of Annex A.

No error shall exceed the applicable maximum permissible error for the specified accuracy class in Para 2(1) (i) of Part-II.

(b) Axle load measurement

The procedures in this sub-clause are only applicable to instruments to be used in applications where the single-axle load or the axle-group load is required.

(ba) In-motion test with the two-axle rigid vehicle [Para 5(1)(iii)(b)(bb)(bba)(bbaa) of Part-II]

- 1) In accordance with Para 6(6) of Part-II and Para 6(9) of Part-II record the two single-axle loads of the two-axle rigid vehicle as they are indicated or printed by the instrument under test. Calculate the difference (error) in each recorded single-axle load of the two-axle rigid vehicle and its respective static reference single- axle load 9(3)(i)(c) of Annex A.
- 2) The maximum difference (error) between any recorded single-axle load and the conventional true value of the static reference single-axle loads 9(3)(i)(c) of Annex A shall not exceed the applicable maximum permissible errors in Para 2(2)(i)(b)(ba) of Part-II for the specified accuracy class.

(bb) In-motion tests with all other reference vehicle types [Para 5(1)(iii)(b), (bb), (bba), (bbab) of Part-II]

(bb-1) As specified in Para 6(6), 6(9) of Part-II and 9(3)(ii) of Annex A, conduct the tests, record the single-axle loads and, if required, the axle-group loads of the vehicle as they are indicated or printed by the instrument under test. If no criteria for defining various axle-groups have been set by national regulations [para 3(1)(vii) of Part-I], all recorded axle loads shall be considered as single-axle loads [para 3(1)(ix) of Part-I]. For each reference vehicle (except the two-axle rigid) and its loading condition, calculate the mean single-axle loads and, if required, the mean axle-group loads of the test runs specified in 9(3)(ii) of Annex A according to the following equations:

$$\overline{\text{Axle}_i} = \frac{\sum_{i=1}^n \text{Axle}_i}{n}$$

where: i is the single-axle rank
 n is the number of test runs
 Axle_i is the recorded load for that axle

and

$$\overline{\text{Group}_i} = \frac{\sum_{i=1}^n \text{Group}_i}{n}$$

where: i is the group rank; may be zero
 n is the number of test runs
 Group_i is the recorded load for that axle-group

(bb-2) Use the values indicated or printed by the instrument under test according to 9(3)(ii-c) of Annex A and recorded as specified in Para 6(12) of Part-II for the vehicle mass and calculate the mean of the reference vehicle mass according to the following:

$$\overline{\text{VM}} = \frac{\sum_{i=1}^n \text{VM}_i}{n}$$

Alternatively, add the mean single-axle loads and axle-group loads to determine the mean of the vehicle mass:

$$\overline{\text{VM}} = \sum_{i=1}^q \overline{\text{Axle}_i} + \sum_{i=0}^g \overline{\text{Group}_i}$$

where: q is the number of single axles on the vehicle
 g is the number of axle-groups on the vehicle, which may be zero

(bb-3) Calculate the corrected mean single-axle loads and, if required, the corrected mean axle-group load(s) as follows:

$$\overline{\text{CorrAxle}_i} = \overline{\text{Axle}_i} \times \frac{\text{VM}_{\text{ref}}}{\overline{\text{VM}}} \quad \overline{\text{CorrGroup}_i} = \overline{\text{Group}_i} \times \frac{\text{VM}_{\text{ref}}}{\overline{\text{VM}}}$$

where: VM_{ref} is the conventional true value of the reference vehicle mass determined by full-draught weighing in Para 6(7) of Part-II.

(bb-4) To provide traceability, the sum of the corrected mean single-axle loads and axle-group loads for the reference vehicle should be equal to the conventional true value of the reference vehicle mass:

$$VM_{ref} = \sum_{i=1}^q \overline{CorrAxle}_i + \sum_{i=0}^g \overline{CorrGroup}_i$$

where: q is the number of single axles on the vehicle
 g is the number of axle-groups on the vehicle, which may be zero

(bb-5) Calculate the deviation of each single-axle load from the respective corrected mean single-axle load and, if required, the deviation of each axle-group load from the respective (if more than one axle-group) corrected mean axle-group load:

$$DevAxle_i = Axle_i - \overline{CorrAxle}_i$$

$$DevGroup_i = Group_i - \overline{CorrGroup}_i$$

(bb-6) No deviation shall exceed the appropriate maximum permissible deviation as specified in Para 2(2)(i)(b)(bb) of Part-II for the applicable accuracy class.

(bb-7) For future reference only (to quantify any difference in the fraction of the vehicle mass carried on each of the two-axle rigid reference vehicle's single axles when determined by static 9(3)(i)(c-4) of Annex A and by in-motion [9(3)(ii)(b)(bb-3) of Annex A] weighing, also perform the calculations above [(bb-1)- (bb-5)] for all test runs of the two-axle rigid reference vehicle, unloaded and loaded. Include these results in the test report so that this data will not be lost. These results shall not be used in lieu of those from 9(3)(ii)(a) of Annex A for evaluating the instrument being tested.

(d) Operating speed measurement Para 2(10) of Part-II

(da) Test of operating speed interlock Para 6(3) of Annex A

To test the functioning of the operating speed interlock, test runs with one of the reference vehicles shall be made at speeds outside the range of operating speeds:

(daa) at a speed of at least 5 % in excess of the maximum operating speed, v_{max} ;

(dab) at a speed of at least 5 % below the minimum operating speed, v_{min} (if applicable).

The instrument shall detect the above conditions and not indicate or print any mass or load values unless there is a clear warning message on the indication and/or the printout [3(5)(ix) of Part-II].

(db) Test of operating speed Para 3(5)(ix) of Part-II

To determine and test the operating speed during an in-motion test, conduct six test runs of the unloaded two-axle rigid reference vehicle over the lateral center of the load receptor at constant speed. Three runs shall be near maximum operating speed, v_{max} , and three additional runs shall be just above minimum operating speed, v_{min} .

The reference value (conventional true value) for speed to be used in calculating the error in the indicated operating speed for each test run shall be the quotient of the measured axle spacing (to the nearest 10 mm) of the static two-axle rigid reference vehicle divided by the measured time interval (to the nearest millisecond) between arrival at a defined location (e.g. the leading edge) on the load receptor by the front and the rear axle of the moving two-axle rigid reference vehicle.

No error in the indicated operating speed shall exceed 1 km/h.

(e) Test of vehicle recognition device interlock Para 3(5)(vii) of Part-II

The correct function of the device shall be tested by the following test procedure if:

- (a) the Weighing in Motion instrument automatically determine axle-group loads; or
- (b) a maximum number of axles per vehicle is given on the plate; or
- (c) the length of the weigh zone is given on the plate.

Connect two of the reference vehicles together with a suitable towing device (strap or chain) to form a combination vehicle that has an overall length greater than the minimum, or otherwise specified (B.4), apron length. Have the front vehicle tow the connected rear vehicle (with driver onboard) over the full length of the weigh zone at a speed near the maximum operating speed, v_{\max} , with the instrument operating in automatic mode.

The instrument shall:

- (a) determine the correct axle-group loads or detect a failure;
- (b) detect the exceeding of the maximum number of axles;
- (c) detect the fact that all of the wheels of the vehicle being weighed were not within the weigh zone throughout the weighing operation and not indicate or print any mass or load values unless there is a clear warning message on the indication and/or the printout.

Annex B

Practical instructions for the installation of automatic instruments for weighing road vehicles in motion and measuring axle loads

1. Installation and operation

The installation requirements are subject to change, in recognition of future technical developments.

2. Weigh zone

The weigh zone Para 2(2) of Part-I shall comprise a load receptor with an apron on both ends.

3. Apron construction

The aprons Para 2(2)(i) of Part-I in advance of and beyond the load receptor shall consist of a stable, load bearing structure made of concrete or an equally durable material resting on a suitable foundation to provide a straight, smooth, approximately-level plane surface to support all tyres of a vehicle simultaneously as the vehicle approaches and passes over the load receptor.

Note: Annex C gives an example of an apron specification which may be used to construct aprons which have been shown to respect the conditions in this Annex. This example should be considered when specifying aprons.

4. Apron geometry

Each of these aprons shall have a minimum length of 16 m. However, prior to beginning any test, the Member State in which this Rule is being used may specify a different apron length (shorter or longer) which is deemed adequate to fully support simultaneously all wheels of the longest vehicle type that will be weighed by the instrument to be tested [Para 3(5)(vii) of Part-II] as it approaches and passes over the load receptor. A reasonably smooth and level road surface shall be provided in advance of the approach apron of sufficient length and width for the test vehicle to reach a steady test speed before arriving at the apron.

The aprons shall be permitted to have a transverse slope, not exceeding 1 %, for drainage purposes. To minimize load transfer between axles of the vehicle, the aprons shall have no longitudinal slope. The load receptor shall be mounted in the same plane as the aprons.

If no lateral guide system is used [Para 3(5)(viii) of Part-II], the aprons shall have sufficient width throughout their length to extend transversely a minimum of 300 mm beyond each lateral edge of the load receptor and the width of the load receptor shall be clearly marked over the whole length of the aprons.

The apron (and load receptor) shall have sufficient width to fully support the widest vehicle that will be weighed by the instrument.

Annex C

General guidelines for the installation and operation of automatic instruments for weighing road vehicles in motion and measuring axle loads

1. Apron characteristics

To achieve the necessary levels of accuracy (with the exception of WIM instruments for full-draught weighing) the minimum requirements for the apron smoothness should include the following:

- (a) for 8 m in advance of and beyond the load receptor, the apron surface should be within a tolerance of ± 3 mm from the level or transversely-sloped plane that includes the load receptor; and
- (b) the surface of the apron outside the 8 m length of apron beyond the load receptor should be within a tolerance of ± 6 mm from the level or transversely-sloped plane that includes the load receptor.

2. Apron compliance checks

Compliance with the apron geometry and characteristics specified above and in Annex B should be determined by a suitably qualified person at a specified period (e.g. if concrete is used, 30 days after apron construction is complete, to allow for the adverse effects of shrinkage in the concrete during curing) and before the site is first used.

A level datum should be taken at a suitable point within the apron minimum area (i.e. the "16 m area") and its position marked on the drawing in the test report format. Its position should be determined by taking elevations using a precise level and staff, and choosing the point which minimizes the extent of any remedial work having regard to the requirements specified above.

A 400 mm \times 400 mm (nominal) grid of level control points should be marked out durably on the aprons for 8 m either side of the load receptor(s). A 1 m \times 1 m (nominal) grid of level control points should be marked out on the remainder of the aprons. Setting out lines for the control points should be shown on the drawing in the test report format. Elevations should be taken on all those points using the precise level and staff.

If concrete is used, a simple stability check should be undertaken to monitor any changes in apron elevation under an axle load. A loaded two-axle vehicle, with a rear axle loading as near to the maximum capacity of the Weighing in motion instrument as feasible, should pass at a low speed along the approximate lateral center of the concrete aprons. Elevations should be taken at the corners of each slab making up the apron at each transverse joint to ensure that as the vehicle crosses the joint, no movement in elevation is outside the tolerances specified in Para 1 of Annex C.

3. Routine durability checks

Surface level compliance checks should be repeated using the same level control points at time intervals specified by national legislation.

Note: There are a number of factors (e.g. level of usage, construction of aprons, etc.) which should be taken into consideration when specifying the time interval between compliance checks.

4. Spilt material and ice

Care should be taken in the design and operation of the installation to ensure that, as far as possible, a build-up of spilt material and ice on the weigh zone of the instrument either does not occur, or is removed regularly.

5. Overhead structures

Load receptors should not be installed beneath a loading or conveying mechanism from which loose material might fall.

6. Tare weighing

The time between tare weighing and gross weighing operations associated with a particular load should be minimal.

7. Notice of speed restrictions

There should be means to ensure that all drivers of vehicles that cross the load receptor are aware of the minimum and maximum operating speeds at which they can proceed.”

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P. V. RAMA SASTRY, Jt. Secy.

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