National Institute of Metrology

Type evaluation tests of non-automatic weighing instruments

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For Initial Verification

For electronic NAWI, before any tests, make sure that the warm up for hour an hour for Class II, III and Class IIII, For Class I, you may following the instruction what is suggested by the manufacture. Usually that will be one hour or more.

Maximum effect of zero-setting device

The effect of any zero-setting device shall not alter the maximum weighing capacity of the instrument.

The overall effect of zero-setting and zero-tracking devices shall be not more than 4 %,

and of the initial zero-setting device not more than 20 %, of the maximum capacity.

This does not affect an instrument of class IIII, except if it is used for commercial transactions.

For Initial Verification

For the weighing test of multi-interval instrument.

Class III MAX_1=3 kg e_1=1g MAX_2=6 kg e_2=2g
When you load 3kg on the load receptor, what should you use to determin the error at that load?
1/10 e_1 or 1/10 e_2 ?
It depends on the indication when the 3kg is loaded.
The Indication is 2.999 kg, then 1/10 e_1 should be used.
The indication is 3.000 kg, then 1/10e_2 should be used.

If seals is broken for the calibration of the span of NAWI, then after the verification, you may apply a verification mark and a seal.

Class of Non automatic weighing instrument

3.1.2 Verification scale interval

The verification scale interval for different types of instruments is given in Table 2.

Table 2

Type of instrument	Verification scale interval
Graduated, without auxiliary indicating device	$e = d$
Graduated, with auxiliary indicating device	e is chosen by the manufacturer according to the requirements in 3.2 and 3.4.2
Non-graduated	e is chosen by the manufacturer according to the requirements in 3.2

3.2 Classification

The verification scale inter
relation to the accuracy clas

3.4.2 Verification scale interval

The verification scale interval, e, is determined by the expression:

$$d < e \leq 10\,d \text{ (see Tables 5a and 5b)}$$

$$e = 10^k \text{ kg}$$

k being a positive or negative whole number, or zero.

Accuracy class	Verific scale inte			
Special (I)	0.001 g			
High (II)	0.001 g ≤ e 0.1 g			
Medium (III)	0.1 g ≤ e ≤ 2 g 5 g ≤ e	100 500	10 000 10 000	20 e 20 e
Ordinary (IIII)	5 g ≤ e	100	1 000	10 e

3.4.2 Verification scale interval

The verification scale interval, e, is determined by the expression:

$$d < e \leq 10\ d \text{ (see Tables 5a and 5b)}$$

$$e = 10^k \text{ kg}$$

k being a positive or negative whole number, or zero.

For a self- or semi-self-indicating instrument, see 4.2.2.1.

Table 5a – Example values of e, calculated following this rule

d =	0.1 g	0.2 g	0.5 g
e =	1 g	1 g	1 g
e =	10 d	5 d	2 d

This requirement does not apply to an instrument of class I with $d < 1$ mg, where $e = 1$ mg, as shown in the following Table.

Table 5b – Example values of e where $d < 1$ mg

d =	0.01 mg	0.02 mg	0.05 mg	< 0.01 mg
e =	1 mg	1 mg	1 mg	1 mg
e =	100 d	50 d	20 d	> 100 d

3.4 Auxiliary indicating devices

3.4.1 Type and application

Only instruments of classes I and II may be fitted with an auxiliary indicating device, which shall be:

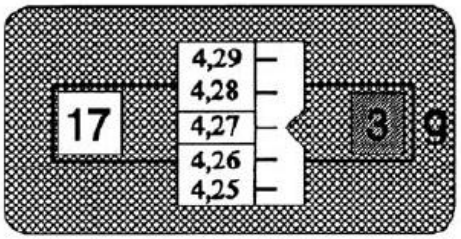
- a device with a rider;
- a device for interpolation of reading;
- a complementary displaying device (see Figure 4); or
- an indicating device with a differentiated scale division (see Figure 5).

These devices are permitted only to the right of the decimal sign.

A multi-interval instrument shall not be fitted with an auxiliary indicating device.

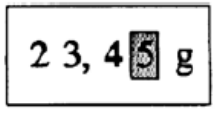
Note: Extended displaying devices (see T.2.6 and 4.4.3) are not regarded as auxiliary indicating devices.

Figure 4 – Example of a complementary displaying device

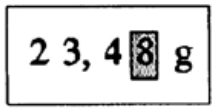


indication: 174.273 g
last figure: 3
d = 1 mg
e = 10 mg

Figure 5 – Examples of indicating devices each with a differentiated scale division



last differentiated figure: 5
d = 0.01 g or 0.05 g
e = 0.1 g



last differentiated figure: 8
d = 0.01 g or 0.02 g
e = 0.1 g

Next section

1. Brief Introduction of weighing instruments
2. Overview of R 76
3. **Type Evaluation Tests according R76**

Type Evaluation Tests (Annex A R76)

Weighing Performance Test
Eccentricity
Discrimination and Sensitivity
Repeatability
Time dependence
Stability of equilibrium
Tilting
Tare
Warm-up test
Voltage various
Temperature test
Temperature effect on no-load indication
Endurance

Type Evaluation Tests (Annex B R76)

Short time power reduction
Electrical bursts: (a) Power supply lines (b) I/O circuits and communication lines
Electrical discharge:(a) Direct application (b) Indirect application
Surge
Immunity to radiated electromagnetic fields
Damp heat, steady state
Span stability test

Additional tests for electronic instruments (Mandatory)

How to do the tests in type evaluation?

- Complete instrument
- Module

General information concerning the type

Application no.: ……
Type designation: ……
Manufacturer: ……
Applicant: ……
Instrument category: ……

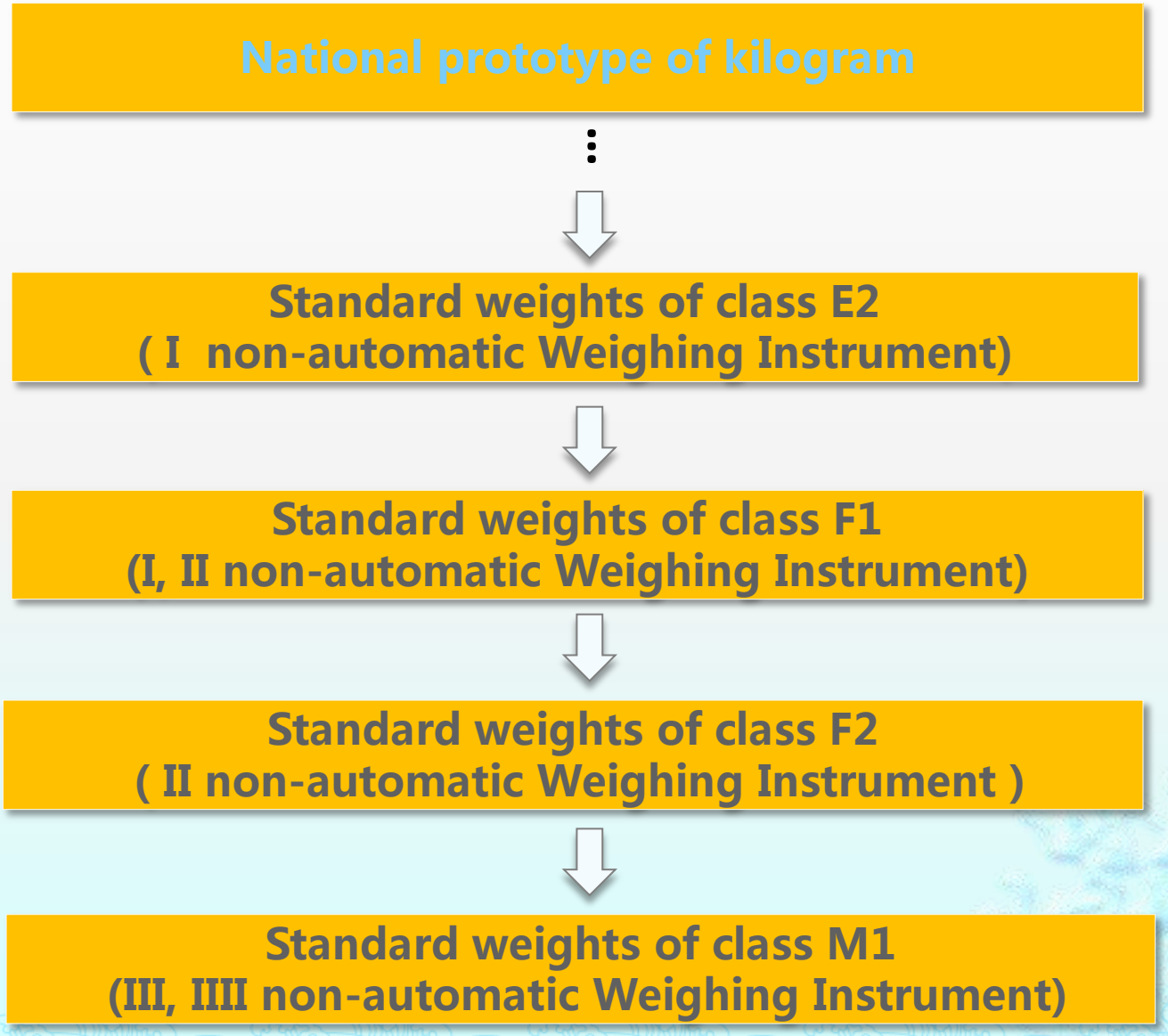
☐ Complete instrument ☐ Module[1] with error fraction p_i = ☐

Accuracy class[2]: ☐ (I) ☐ (II) ☐ (III) ☐ (IIII)

☐ Self-indicating ☐ Semi-self-indicating ☐ Non-self-indicating

Hierarchy for Verification of Mass and Weighing Metrology

OIML R111



How to do the tests in type evaluation?

- **3.10.4.1 Selection of EUTs**
- The selection of EUTs to be tested shall be such that their number is minimized but nevertheless sufficiently representative (see example in acceptable solution of 3.10.4.6).
- Approval of the most sensitive EUTs implies approval of the variants with lower characteristics. Therefore, when a choice exists, the EUTs with the highest metrological characteristics shall be selected for test.

- **3.10.4.2 Variants within a family to be tested**
  - For any family, at least the variant with the highest number of verification scale intervals (*n*) and the variant with the smallest verification scale interval, *e*, shall be selected as EUTs. Further EUTs may be required according to 3.10.4.6.
  - If a variant has both characteristics, one EUT may be sufficient.

- **3.10.4.3 Variants acceptable without testing**
  - Variants other than the EUTs can be accepted without testing, if one of the following bulleted provisions is fulfilled (for comparable metrological characteristics):
  - Their capacities, Max, fall between two tested capacities. The ratio between the tested capacities shall not exceed 10; or
  - All of the following conditions a), b), and c) are fulfilled:
    - a) $n \leq n_{test}$
    - b) $e \geq e_{test}$
    - c) $Max \leq 5 \times Max_{test} \times (n_{test} / n)$
  - Note: **Max_{test}, n_{test}, and e_{test}** are the characteristics of the EUT.

- **3.10.4.4 Accuracy class**
  - If an EUT of a family has been tested completely for one accuracy class, it is sufficient for an EUT of a lower class if only partial tests are carried out that are not yet covered.
- **3.10.4.5 Other features to be considered**
  - All metrologically relevant features and functions have to be tested at least once in an EUT as far as applicable and as many as possible in the same EUT.
  - For example, it is not acceptable to test the temperature effect on no-load indication on one EUT and the combined effect (see Table 7) on a different one.

- Variations in metrologically relevant features and functions such as different:
  - housings;
  - load receptors;
  - temperature and humidity ranges;
  - instrument functions;
  - indications; etc.
- may require additional partial testing of those factors which are influenced by that feature. These additional tests should preferably be carried out on the same EUT, but if this is not possible, tests on one or more additional EUTs may be performed under the responsibility of the testing authority.

- **3.10.4.6 Summary of relevant metrological characteristics**
- **The EUTs must cover:**
  - highest number of verification scale intervals, nmax;

	Variant	Max	*e*	*d*	*n*	EUT
Family 1 Accuracy class II Temperature range: 10 °C / 30 °C	*1.1*	200 g	0.01 g	0.001 g	20 000	
	1.2	400 g	0.01 g	0.001 g	40 000	X
	1.3	2000 g	0.05 g	0.05 g	40 000	
Family 2 Accuracy class III Temperature range: – 10 °C / 40 °C	*2.1*	1.5 kg	0.5 g	0.5 g	3 000	X
	2.2	3 kg	1 g	1 g	3 000	
	2.3	5 kg	2 g	2 g	2 500	
	2.4	15 kg	5 g	5 g	3 000	X
	2.5	60 kg	20 g	20 g	3 000	

- **3.10.4.6 Summary of relevant metrological characteristics**
- **The EUTs must cover:**
  - lowest verification scale interval, e_{min};

	Variant	Max	*e*	*d*	*n*	EUT
Family 1 Accuracy class II Temperature range: 10 °C / 30 °C	*1.1*	200 g	0.01 g	0.001 g	20 000	
	1.2	400 g	0.01 g	0.001 g	40 000	X
	1.3	2000 g	0.05 g	0.05 g	40 000	
Family 2 Accuracy class III Temperature range: – 10 °C / 40 °C	*2.1*	1.5 kg	0.5 g	0.5 g	3 000	X
	2.2	3 kg	1 g	1 g	3 000	
	2.3	5 kg	2 g	2 g	2 500	
	2.4	15 kg	5 g	5 g	3 000	X
	2.5	60 kg	20 g	20 g	3 000	

- **3.10.4.6 Summary of relevant metrological characteristics**
- **The EUTs must cover:**
  - lowest input signal, μV/e (when using analog strain gauge load cells);

	Variant	Max	*e*	*d*	*n*	EUT
Family 1 Accuracy class II Temperature range: 10 °C / 30 °C	*1.1*	200 g	0.01 g	0.001 g	20 000	
	1.2	400 g	0.01 g	0.001 g	40 000	X
	1.3	2000 g	0.05 g	0.05 g	40 000	
Family 2 Accuracy class III Temperature range: – 10 °C / 40 °C	*2.1*	1.5 kg	0.5 g	0.5 g	3 000	X
	2.2	3 kg	1 g	1 g	3 000	
	2.3	5 kg	2 g	2 g	2 500	
	2.4	15 kg	5 g	5 g	3 000	X
	2.5	60 kg	20 g	20 g	3 000	

- **3.10.4.6 Summary of relevant metrological characteristics**
- **The EUTs must cover:**
  - all accuracy classes;

	Variant	Max	*e*	*d*	*n*	EUT
Family 1 Accuracy class II Temperature range: 10 °C / 30 °C	*1.1*	200 g	0.01 g	0.001 g	20 000	
	1.2	400 g	0.01 g	0.001 g	40 000	X
	1.3	2000 g	0.05 g	0.05 g	40 000	
Family 2 Accuracy class III Temperature range: – 10 °C / 40 °C	*2.1*	1.5 kg	0.5 g	0.5 g	3 000	X
	2.2	3 kg	1 g	1 g	3 000	
	2.3	5 kg	2 g	2 g	2 500	
	2.4	15 kg	5 g	5 g	3 000	X
	2.5	60 kg	20 g	20 g	3 000	

- **3.10.4.6 Summary of relevant metrological characteristics**
- **The EUTs must cover:**
  - all temperature ranges;

	Variant	Max	*e*	*d*	*n*	EUT
Family 1 Accuracy class II Temperature range: 10 °C / 30 °C	*1.1*	200 g	0.01 g	0.001 g	20 000	
	1.2	400 g	0.01 g	0.001 g	40 000	X
	1.3	2000 g	0.05 g	0.05 g	40 000	
Family 2 Accuracy class III Temperature range: – 10 °C / 40 °C	*2.1*	1.5 kg	0.5 g	0.5 g	3 000	X
	2.2	3 kg	1 g	1 g	3 000	
	2.3	5 kg	2 g	2 g	2 500	
	2.4	15 kg	5 g	5 g	3 000	X
	2.5	60 kg	20 g	20 g	3 000	

- **3.10.4.6 Summary of relevant metrological characteristics**
- **The EUTs must cover:**
  - single range, multiple range or multi-interval instrument;

序号	型号	最大称量 Max	最小称量 Min	检定分度值 *e*	实际分度值 *d*	准确度等级	外形
1	Type 1	2.1 g	0.01 mg	1 mg	0.1 μg	I	1
2	Type 2	6.1 g	0.1 mg	1 mg	1 μg	I	1
3	Type 3	1.1/2.1/	0.1 mg	1 mg	μg	I	1
4	Type 4	60/120 g	1 mg	1 mg	0.01/0.1 mg	I	2
5	Type 5	220 g	1 mg	1 mg	0.01 mg	I	2
6	Type 6	60/120/220 g	1 mg	1 mg	0.01/0.02/0.05 mg	I	2
7	Type 7	120 g	10 mg	1 mg	0.1 mg	I	2
8	Type 8	220 g	10 mg	1 mg	0.1 mg	I	2
9	Type 9	320 g	10 mg	1 mg	0.1 mg	I	2
10	Type 10	80/160/	10 mg	1 mg	0.1/0.2/0.5 mg	I	2
11	Type 11	520 g	10 mg	1 mg	0.1 mg	I	2

- **3.10.4.6 Summary of relevant metrological characteristics**
- **The EUTs must cover:**
  - maximum size of load receptor, if significant;
  - metrologically relevant features (see 3.10.4.5);
    - Other features to be considered applicable and as many as possible
    - maximum number of instrument functions;
    - maximum number of indications;
    - maximum number of peripheral devices connected;
    - maximum number of implemented digital devices;
    - maximum number of analog and digital interfaces;
    - several load receptors, if connectable to the indicator; and
    - different types of power supply (mains and/or batteries).

How to do the tests in type evaluation?

- Weighing Performance Test
- **A.4.4.1 Weighing test**
  - Apply test loads from zero up to and including Max, and similarly remove the test loads back to zero. When determining the initial intrinsic error, at least 10 different test loads shall be selected, and for other weighing tests at least 5 shall be selected. The test loads selected shall include Max and Min (Min only if Min $\geq$ 100 mg) and values at or near those at which the maximum permissible error (mpe) changes.

- During type examination it should be noted that when loading or unloading weights the load shall be progressively increased or progressively decreased.
- It is recommended to apply the same procedure as far as possible during initial verification (8.3) and subsequent metrological control (8.4).
- 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 A.4.2.3.2.

- **A.4.4.2 Supplementary weighing test (4.5.1)**
  - For instruments with an initial zero-setting device with a range greater than 20 % of Max, a supplementary weighing test shall be performed using the upper limit of the range as zero point.
- **A.4.4.3 Evaluation of error (A.4.1.6)**
  - $P = I + \frac{1}{2}\, e - \Delta L$
  - $E = P - L = I + \frac{1}{2}\, e - \Delta L - L$
  - $E_c = E - E_0 \leq mpe$

Weighing Performance Test

- For example:
  - An NAWI with
    - Max=6200 g
    - e=1 g
    - d= 0.1 g
    - Class II

- test loads for determining the initial intrinsic error should be:
- 1 g, 5 g, 100 g, 200 g, 500 g, 1000 g, 2000 g 5000 g, 6000 g, 6200 g

10e

5000 e

Min

Max

Weighing Performance Test

- For example:
  - An NAWI with
    - Max=6200 g
    - e=1 g
    - d= 1 g
    - Class II

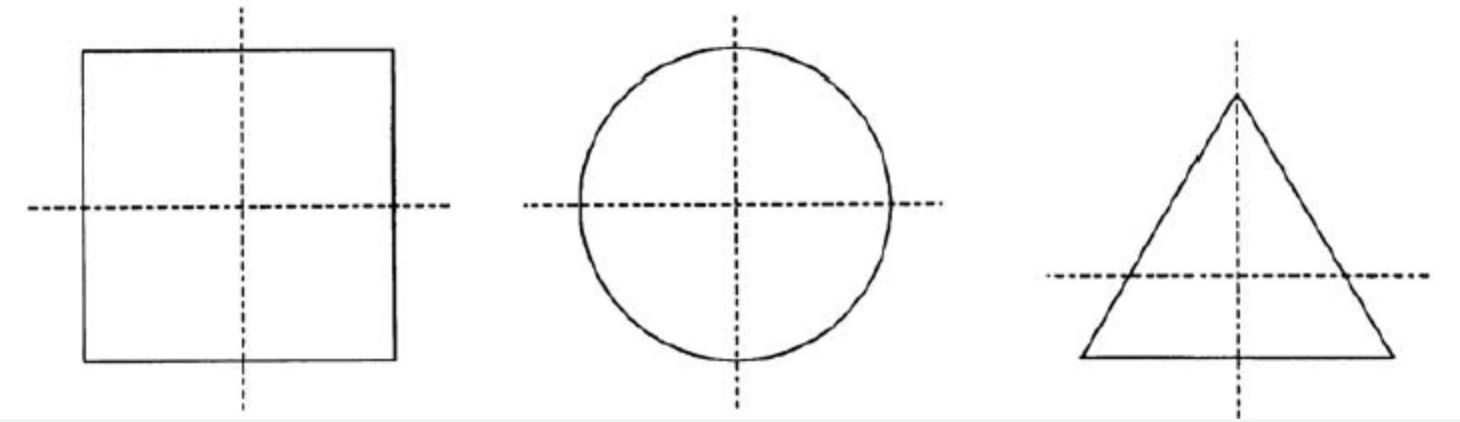
- test loads for other tests should be:
- 1 g, 5 g, 2000 g, 5000 g, 6000 g, 6200 g

10e Min 5000 e Max

A.4.7 Eccentricity tests (3.6.2)

- Large weights should be used in preference to several small weights.
- Smaller weights shall be placed on top of larger weights, but unnecessary stacking should be avoided within the segment to be tested.
- The load shall be applied centrally in the segment if a single weight is used, but applied uniformly over the segment, if several small weights are used.
- It is sufficient to apply the load only to the eccentric segments, not to the centre of the load receptor.

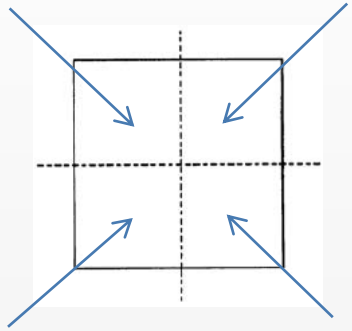
- **A.4.7.1 Instruments with a load receptor having not more than four points of support**



- The four quarter segments roughly equal to ¼ of the surface of the load receptor (as shown in the sketches in Figure or similar sketches) shall be loaded in turn.

A.4.7 Eccentricity tests (3.6.2)

- For example



A.4.7 Eccentricity tests (3.6.2)

- In case of Class I instruments,

3.1 Eccentricity using weights (A.4.7.1, 2 and 3)

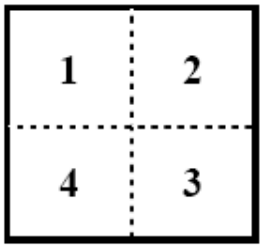
Application no.: .....
Type designation: .....
Date: .....
Observer: .....
Verification scale interval, *e*: .....
Resolution during test (smaller than *e*): .....

	At start	At max	At end	
Temp.:				°C
Rel. h.:				%
Time:				
Bar. pres.:				hPa

(only class I)

1) Test(s) performed on a mobile instrument (A.4.7.5): ☐ Yes ☐ No
2) In case of "Yes" to 1): A.4.7 and A.4.7.1 to A.4.7.4 have been applied: ☐ Yes ☐ No
3) In case of "No" to 2): Description of eccentricity test(s) (see A.4.7.5) under "Remarks"

Location of test loads: mark on a sketch (see example below) the successive locations of test loads, using numbers which shall be repeated in the table below.



Also indicate in the sketch the location of the display or of another perceptible part of the instrument.

Automatic zero-setting and zero-tracking device is:

☐ Non-existent ☐ Not in operation ☐ Out of working range

3.1 Eccentricity using weights (A.4.7.1, 2 and 3)

$E = I + \frac{1}{2} e - \Delta L - L$

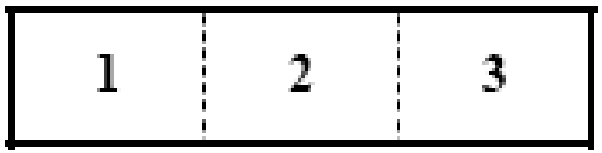
$E_c = E - E_0$ with E_0 = error calculated at or near zero* determined prior to each measurement

Location	Load, L	Indication, I	Add. load, ΔL	Error, E	Corrected error, E_c	mpe
	*			*		
1						
	*			*		
2						
	*			*		
3						
	*			*		
4						

Check if $|E_c| \leq |\text{mpe}|$

- **A.4.7.3 Instruments with special load receptors (tank, hopper, etc.)**
  - The load shall be applied to each point of support.
- **A.4.7.4 Instruments used for weighing rolling loads (3.6.2.4)**
  - A load shall be applied at different positions on the load receptor.
- **A.4.7.5 Eccentricity tests for mobile instruments**
  - A.4.7 and A.4.7.1 to A.4.7.4 should be applied as far as these points are applicable. If not, the positions of the test loads during this test have to be defined according to the operational conditions of use.

A.4.7.4 Instruments used for weighing rolling loads (3.6.2.4)



- A load shall be applied at different positions on the load receptor.
- These positions shall be at the beginning, the middle and at the end of the load receptor in the normal driving direction.
- The positions shall then be repeated in the reverse direction, if the application in both directions is possible.
- Before changing direction **zero has to be determined again**. If the load receptor consists of several sections, the test shall be applied to each section.

A.4.7.4 Instruments used for weighing rolling loads (3.6.2.4)

3.2 Eccentricity using a rolling load (A.4.7.4)

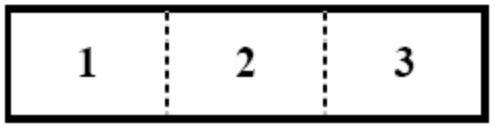
Application no.: .....
Type designation: .....
Date: .....
Observer: .....
Verification scale interval, *e*: .....
Resolution during test (smaller than *e*): .....

	At start	At max	At end	
Temp.:				°C
Rel. h.:				%
Time:				
Bar. pres.:				hPa

(only class I)

Number of sections of the divided load receptor ☐ ☐ Undivided load receptor

Location of test loads for each section of the load receptor: mark on a sketch (see example below) the successive locations of test loads, using numbers which shall be repeated in the table below. Also indicate in the sketch the location of the display or of another perceptible part of the instrument.



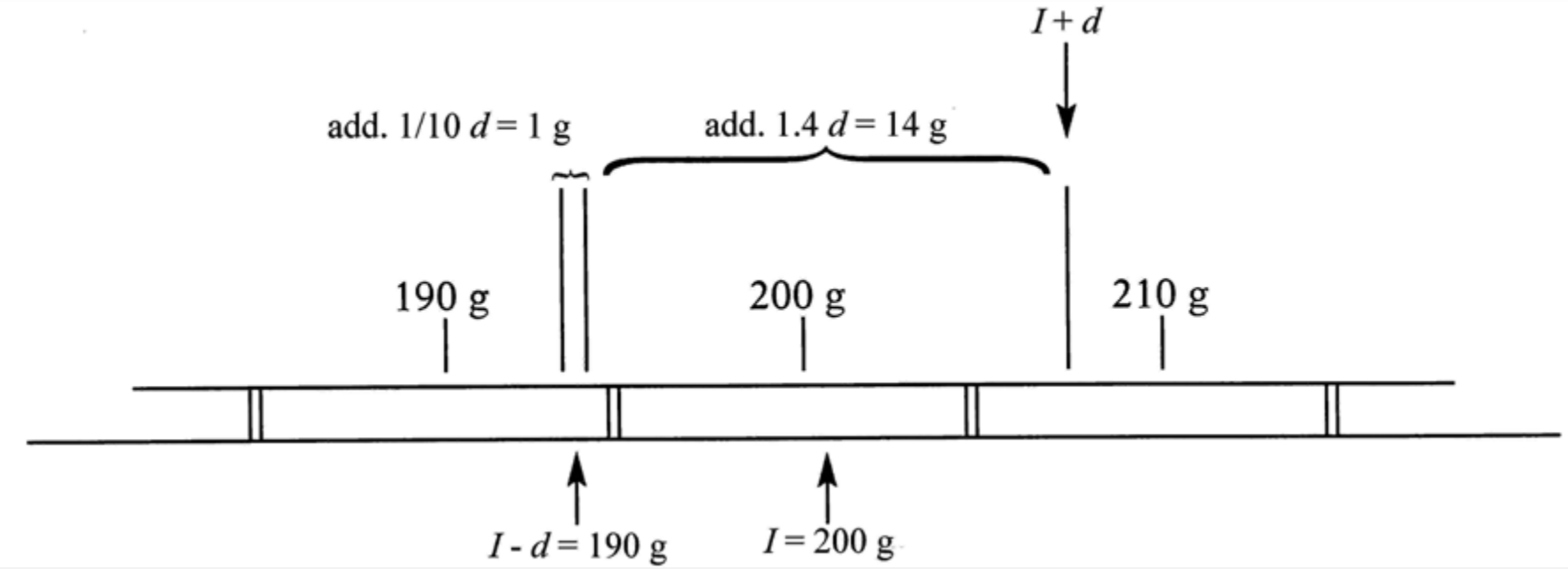
$E = I + \frac{1}{2}e - \Delta L - L$

$E_c = E - E_0$ with E_0 = error calculated at or near zero*

Section	Direction (← / →)	Location	Load, L	Indication, I	Add. load, ΔL	Error, E	Corrected error, E_c	mpe
			*			*		
			*			*		
			*			*		
			*			*		

- **A.4.8 Discrimination test (3.8)**
  - The following tests shall be performed with three different loads, e.g. Min, ½ Max and Max.
- **A.4.8.2 Digital indication**
  - This test applies only to type examination and to instruments with $d \geq 5\ mg$.

e=*d*=10 g
Max=60 kg



- The indication at the start is *I = 200 g.*
- Remove additional weights until the indication changes to *I – d = 190 g.*
- Add 1/10 *d = 1 g and thereafter 1.4 d = 14 g.*
- The indication shall then be *I + d = 210 g.*

4 DISCRIMINATION AND SENSITIVITY

4.1 Discrimination

4.1.1 Digital indication (A.4.8.2)

Application no.: .....
Type designation: .....
Date: ..... Temp.:
Observer: ..... Rel. h.:
Verification scale interval, *e*: ..... Time:
Scale interval, *d*: ..... Bar. pres.:

	At start	At max	At end	
Temp.:				°C
Rel. h.:				%
Time:				
Bar. pres.:				hPa

Load, L	Indication, I_1	Removed load ΔL	Add 1/10 d	Extra load, $= 1.4\ d$	Indication, I_2	$I_2 - I_1$

Check if $I_2 - I_1 \geq d$

☐ Passed ☐ Failed

Remarks:

Min+10*1/10d

1/2Max+10*1/10d

Max+10*1/10d

How to do repeatability tests?

- **A.4.10 Repeatability test (3.6.1)**
  - For type approval two series of weighings shall be performed, one with a load of **about 50 %** and one with a load close to **100 % of Max**. For instruments with **Max less than 1000 kg** each series shall consist of 10 weighings.
  - In other cases each series shall consist of **at least 3 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.

How to do repeatability tests?

- If the instrument is provided with automatic zero-setting or zero-tracking, it shall be in operation during the test.
- For verification one series of weighings with about 0.8 Max is sufficient.
- Three weighings on classes III and IIII or
- six weighings on classes I and II are necessary.

How to do repeatability tests?

- For type evaluation:

½ Max

Close to Max

10 times Max less than 1 000 kg

at least 3 weighings Max more than 1 000 kg

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

How to do repeatability tests?

- For Verification:

Close to 0.8 Max

For verification one series of weighings with about 0.8 Max is sufficient. Three weighings on classes III and IIII or six weighings on classes I and II are necessary.

How to do Time dependence tests?

- **A.4.11 Variation of indication with time (for instruments of classes II, III or IIII only)**
- **A.4.11.1 Creep test (3.9.4.1)**
  - Load the instrument close to Max.
  - Take one reading as soon as the indication has stabilized and then note the indication while the load remains on the instrument for a period of four hours. During this test the temperature should not vary more than 2 ° C.
  - The test may be terminated after 30 minutes if the indication differs less than 0.5 *e during the first 30 minutes and the difference between 15 and 30 minutes is less than 0.2 e.*

6 TIME-DEPENDENCE R76-2:2007

Time of reading		Load, L_0	Indication of zero, I_0	Add. load, ΔL	P
0 min					$P_0 =$
Load during 30 minutes =					
30 min					$P_{30} =$

Change after 30 minutes:

$|\Delta(P_{30} - P_0)| =$

For multiple range instruments keep instrument unloaded for further 5 minutes:

35 min					$P_{35} =$

Change 5 minutes later:

$|\Delta(P_{35} - P_{30})| =$

Check if

a) $|\Delta(P_{30} - P_0)| \leq 0.5\ e$

b) $|\Delta(P_{35} - P_{30})| \leq e_1$ (for multiple range instruments only)

6 TIME-DEPENDENCE R76-2:2007

Time of reading		Load, L	Indication, I	Add. load, ΔL	P	ΔP
	0 min					
	5 min					
	15 min					
	30 min*					
	1 h					
	2 h					
	3 h					
	4 h					

ΔP = difference between P at the start (0 min) and P at a given time.

* If condition a) is met, the test is terminated. If not, the test shall be continued for the next 3.5 hours and condition b) shall be met.

Condition a): $\Delta P \leq 0.5\ e$ after 30 minutes; and
$\Delta P \leq 0.2\ e$ between the indication obtained at 15 minutes and that at 30 minutes

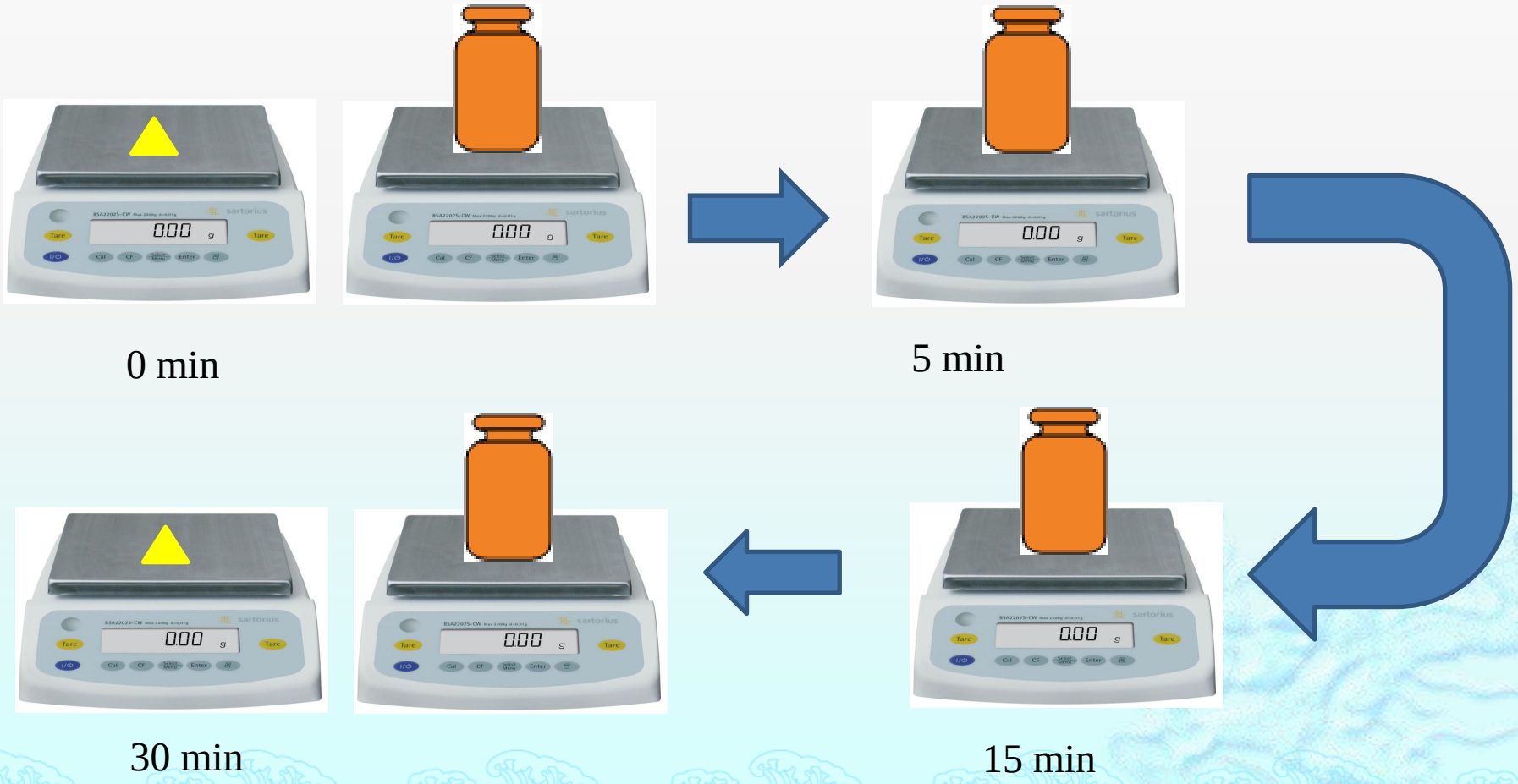
Condition b): $\Delta P \leq$ absolute value of mpe during the period of 4 hours

How to do Time dependence tests?

- **A.4.11.2 Zero return test (3.9.4.2)**
- The deviation in the zero indication before and after a period of loading with a load close to Max for half an hour, shall be determined.
- The reading shall be taken as soon as the indication has stabilized.
- For multiple range instruments, continue to read the zero indication during the following 5 minutes after the indication has stabilized.
- If the instrument is provided with automatic zero-setting or zero-tracking, it shall not be in operation.

How to do Time dependence tests?

- Combined zero-return test and creep test together



How to do Stability of equilibrium tests?

- **A.4.12 Test for the stability of equilibrium (4.4.2)**
  - Check the documentation of the manufacturer, whether the following stable equilibrium functions are described in detail and sufficiently:
  - the basic principle, the function and the criteria for stable equilibrium;
  - all adjustable and not adjustable parameters of the stable equilibrium function (time interval, number of measuring cycles, etc.);
  - securing of these parameters; and
  - definition of the most critical adjustment of the stable equilibrium (worst case). This shall cover all variants of a type.

- **A.4.12 Test for the stability of equilibrium (4.4.2)**
  - Load the instrument up to 50 % of Max or up to a load included in the range of operation of the relevant function.
  - Manually disturb the equilibrium by one single action and initiate the command for printing, data storage, or other function, as soon as possible.
  - In the case of printing or data storage, read the indicated value over a period of 5 seconds following print-out.
  - Stable equilibrium is considered to be achieved when no more than two adjacent values are indicated, one of which being the printed value.
  - For instruments with differentiated scale divisions, this paragraph applies to *e rather than to d*.

How to do Stability of equilibrium tests?

Manually apply disturb to the load receptor.
Press Print or storage button to print out or storage the weight valu
Read the Indication within 5 seconds.
Repeat the above process 5 times.

- **A.4.13 Additional tests for portable weighbridges (4.19)**
- *Note: Portable instruments have very different constructions for a large number of very different applications so that it is principally not possible to define uniform test procedures.*
- *Different requirements, conditions and specifications could be necessary depending on the construction and application and, of course, on the metrological demands (e.g. accuracy class).*
- *These should be mentioned and described in the respective Test Report.*
- *A.4.13 therefore only provides some general means for properly testing a portable instrument.*

- To be performed during type approval:
- At a site agreed with the manufacturer:
  - examine the evenness of the reference area (all points of support of the bridge being at the same level) and then perform an accuracy test and an eccentricity test; and
  - realize several reference areas with some different faults in the evenness (the values of these faults are to be equal to the limits given by the manufacturer) and then perform an eccentricity test for each configuration.
- At a site where the instrument is used:
  - examine the conformity to the requirements for the mounting surface; and
  - examine the installation and perform tests to establish conformity with the metrological requirements.

How to do Tilting?

- **A.5 Influence factors**
- **A.5.1 Tilting (only class II, III and IIII instruments) (3.9.1.1)**
  - The instrument shall be tilted both forwards and backwards longitudinally, and from side to side, transversely.
  - After zero-setting in the reference position, the indication (prior to rounding) is determined at no-load and at the two test loads. The instrument is then unloaded and tilted (without a new zero-setting), after which the indications at no load and at the two test loads are determined. This procedure is repeated for each of the tilting directions.
- If the instrument is provided with automatic zero-setting or zero-tracking, it shall not be in operation.

- **A.5.1.1 Tilting of instruments with a level indicator or automatic tilt sensor (3.9.1.1a and b)**
- **A.5.1.1.1 Tilting at no-load**
  - The instrument shall be set to zero in its reference position (not tilted).
  - The instrument shall then be tilted longitudinally up to the limiting value of tilting.
  - The zero indication is noted.
  - The test shall be repeated with transverse tilting.

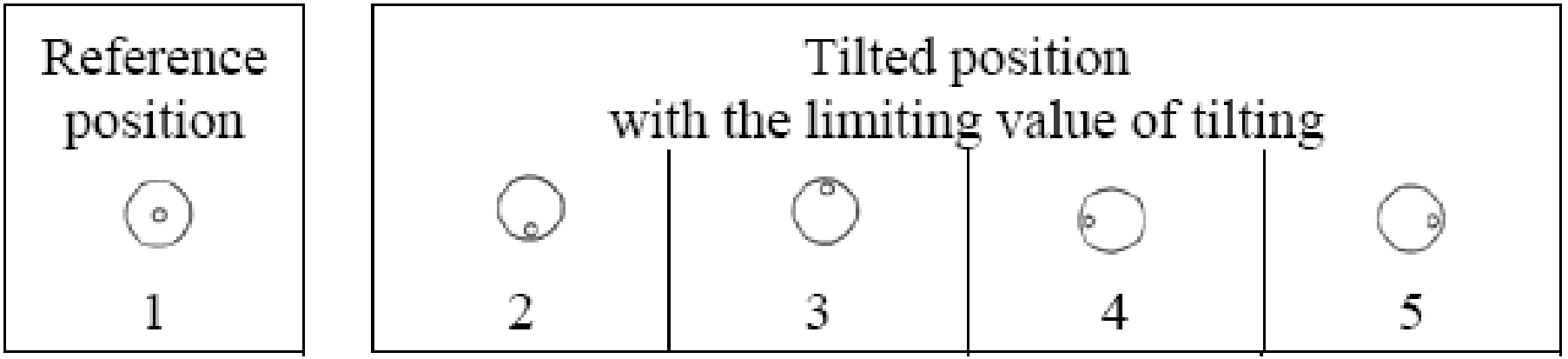
- **A.5.1.1.2 Tilting when loaded**
  - The instrument shall be set to zero in its reference position and two weighings shall be carried out at a load close to the lowest load where the maximum permissible error changes, and at a load close to Max.
  - The instrument is then unloaded and tilted longitudinally and set to zero.
  - The tilting shall be equal to the limiting value of tilting.
  - Weighing tests as described above shall be performed. The test shall be repeated with transverse tilting.

- **A.5.1.2 Other instruments (3.9.1.1 c)**
  - For instruments liable to be tilted and neither fitted with a level indicator nor with an automatic tilt sensor the tests in A.5.1.1 shall be performed with a tilting of 50/1000 or,
  - in case of an instrument with automatic tilt sensor, with a tilting equal to the limiting value of tilting as defined by the manufacturer.

3.9.1.2

- do not apply:
  - Class I instruments **must be** fitted with a leveling device and a level indicator but these need not be tested, because these instruments require special environmental and installation conditions and skilled operating staff.
  - Instruments installed in a fixed position.
  - Freely suspended instruments, for example crane or hanging instrument

- Instrument with level indicator
  - How to select the test loads?



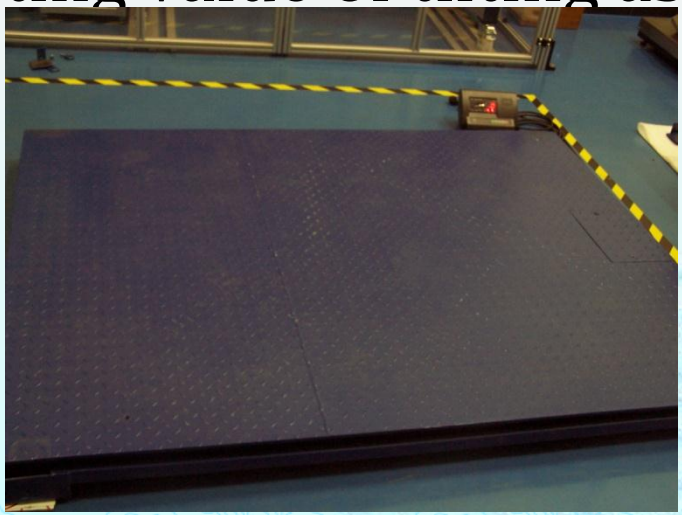
Load, L		Reference position 1	Tilted position with the limiting value of tilting 2	3	4	5	
unloaded 10e	$I_v =$						$2\,e =$
	$\Delta L_v =$						$\lvert E_{1\,0} - E_{v\,0}\rvert_{max} =$
	$E_{v0} =$						
$L =$	$I_v =$						
	$\Delta L_v =$						
	$E_{c\,v} =$						$\lvert E_{c\,1} - E_{c\,v}\rvert_{max} =$
(Max) Max	$I_v =$						
	$\Delta L_v =$						
	$E_v =$						mpe =
	$E_{c\,v} =$						$\lvert E_{c\,1} - E_{c\,v}\rvert_{max} =$

A load close to the lowest load where the maximum permissible error changes,

Check if the differences are a) $\leq 2\,e$ for the unloaded instrument (not valid for class II instruments, if they are not used for direct sales to the public)

b) $\leq$ absolute value of mpe for the loaded instrument

- Instrument without level indicator or automatic tilt sensor
  - For instruments liable to be tilted and neither fitted with a level indicator nor with an automatic tilt
  - sensor the tests in A.5.1.1 shall be performed with a tilting of 50/1000 or,
  - in case of an instrument with automatic tilt sensor, with a tilting equal to the limiting value of tilting as defined by the manufacturer.



- **A.5.1.3 Tilt test for mobile instruments used outside in open locations (3.9.1.1d and 4.18.1)**
  - Appropriate load receptors for applying the test loads are to be provided by the applicant.
  - The tilt test shall be performed with the limiting value of tilting.
  - The instrument shall be tilted both forwards and backwards longitudinally, and from side to side, transversely.

- **A.5.2 Warm-up time test (5.3.5)**
  - An instrument using electric power shall be disconnected from the supply for a period of at least 8 hours prior to the test.
  - The instrument shall then be connected and switched on and as soon as the indication has stabilized, the instrument shall be set to zero and the error at zero shall be determined.
  - Calculation of the error shall be made according to A.4.4.3.

$$E = P - L = I + \tfrac{1}{2}\, e - \Delta L - L$$

$$E_c = E - E_0 \leq \text{mpe}$$

When doing the warm-up test , Pre-load should not be perform first!

A.5.2 Warm-up time test (5.3.5)

- The instrument shall be loaded with a load close to Max.
- These observations shall be repeated after 5, 15 and 30 minutes.
- Every individual measurement performed after 5, 15, and 30 minutes, shall be corrected for the zero error at that time.
- For instruments of class I, the provisions of the operating manual for the time following connection to the mains shall be observed.

How to do Warm-up tests?

- Combined zero-return test and creep test together

0 min

When doing the warm-up test , Pre-load should not be perform first!

How to do Warm-up tests?

- Combined zero-return test and creep test together

0 min

5 min

30 min

15 min

- **B.4 Span stability test**
  - *Note: Not applicable to class I instruments.*
- The test consists in observing the variations of the error of the EUT 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.
- For instruments with an incorporated automatic span adjustment device the device shall be activated during this test before each measurement in order to prove its stability and its intended use.
- The performance tests **shall include** the temperature test and, if applicable, the damp heat test; they shall **not include** any endurance test; other performance tests in Annexes A and B **may be performed**.

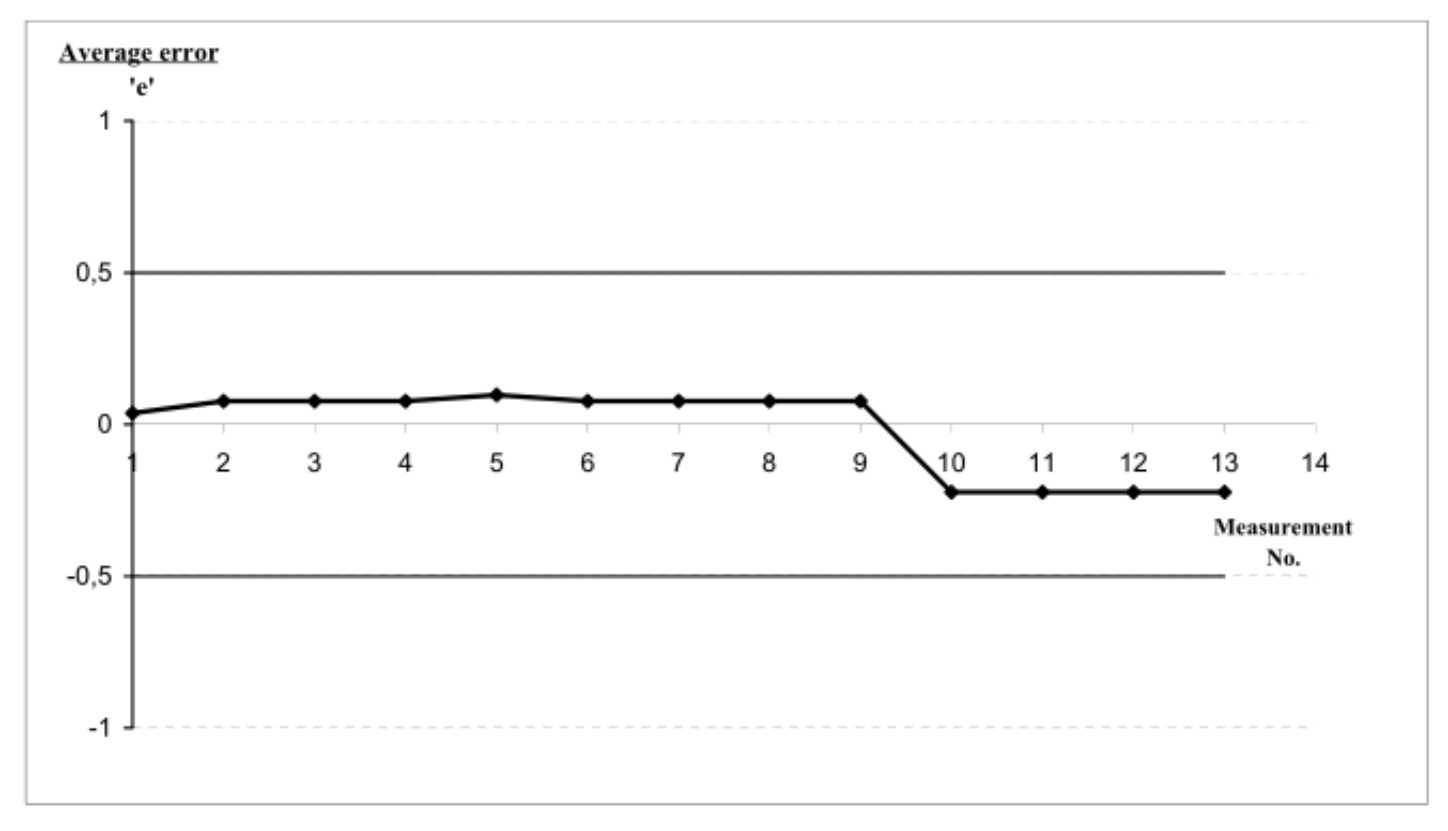
- The EUT shall be **disconnected from the mains power (also battery) or power supply device**, two times for at least 8 hours during the period of the test.
- The number of disconnections may be increased if the manufacturer specifies so or at the discretion of the approval authority in the absence of any such specification.
- The EUT shall be stabilized at sufficiently constant ambient conditions after switch-on for at least 5 hours, but at least 16 hours after the temperature and damp heat tests have been performed.

- Test duration:
  - 28 days or the period necessary for the performance tests to be carried out, whichever is shorter.
- Time between measurements:
  - Between ½ day and 10 days, with a fairly even distribution of the measurements over the total duration of the test.
- Test load:
  - Near Max. The same test weights shall be used throughout this test.

- Number of measurements:
  - **At least 8**.
- 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 automatic built-in span adjustment device shall be made operative.
  - Apply the test weight(s) and determine the error.
  - At the first measurement immediately repeat zeroing and loading four times to determine the average value of the error. For the next 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 *e*.

- Maximum allowable variations:
  - The variation in the errors of indication shall not exceed half the verification scale interval or half the absolute value of the maximum permissible error on initial verification for the test load applied, whichever is greater, on any of the *n measurements.*
  - 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.

B.4 Span stability test



Max of ½ e and ½ MPE at the max

Purpose of the Static Temperature Test

- This test have been designed to ascertain the effect of the external ambient temperature on the accuracy of the instrument under test. As the ambient temperature of the instrument will change continually from season to season and place to place.

The weighing test (loading and unloading) shall be carried out

- at the reference temperature;
- at the specified high temperature;
- at the specified low temperature;
- at 5 ℃ (if the specified low temperature lower than 0 ℃);
- at the reference temperature.

The weighing test at each temperature must meet MPE requirements.

Requirements of the Static Temperature Test

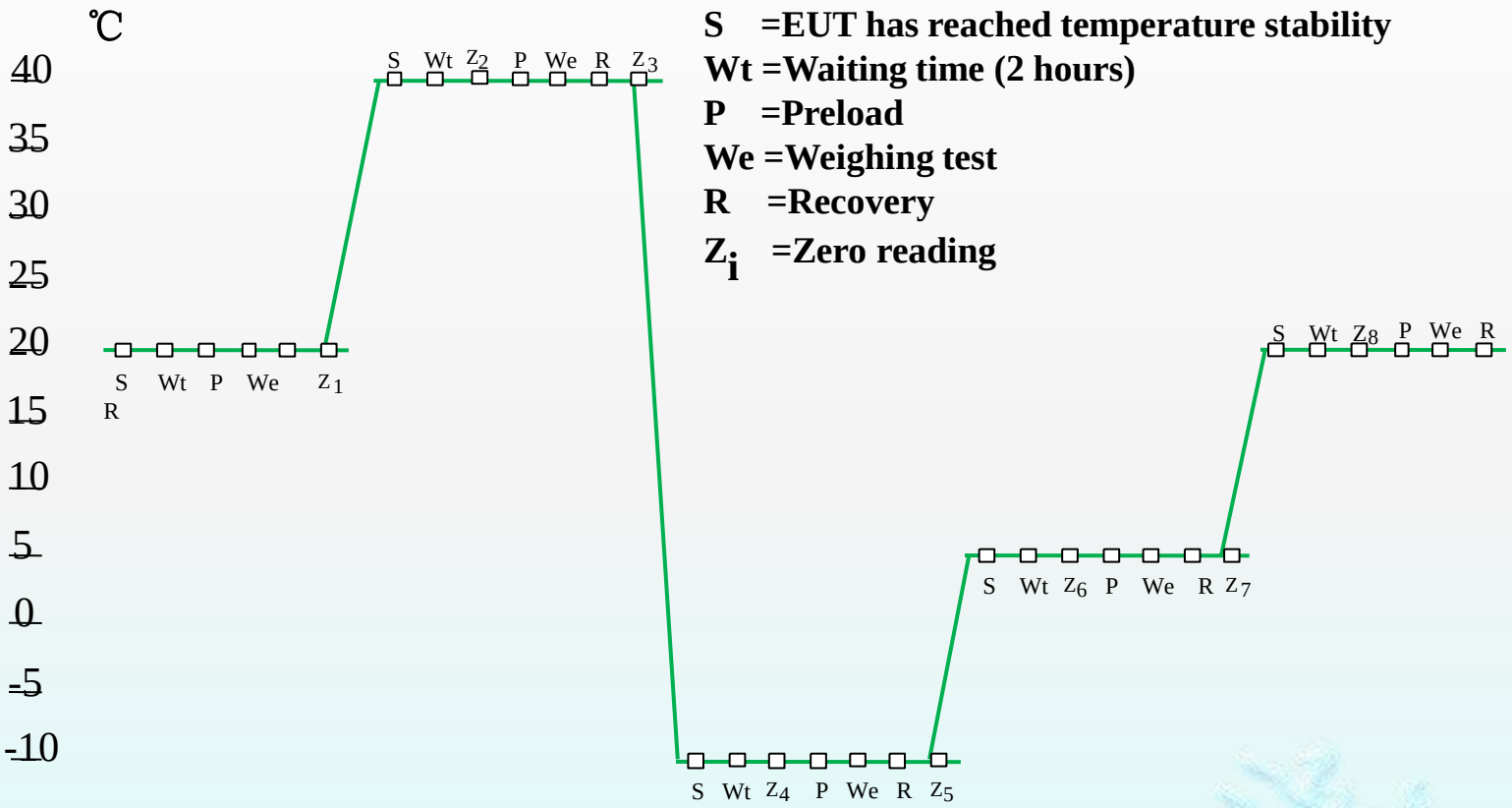
- If no particular working temperature is stated on the descriptive markings of an instrument, this instrument shall maintain its metrological properties within the following temperature limits:

  $-10^{\circ}\,C \sim +40^{\circ}\,C$

- The ranges within those limits shall be at least equal to:
  - 5 ℃ for instruments of class I;
  - 15 ℃ for instruments of class II; and
  - 30 ℃ for instruments of classes III and IIII.

It is very important to make sure that the EUT has reached the test temperature and that the recorded temperature is not just the air temperature inside the chamber.

Test temperature



S =EUT has reached temperature stability
Wt =Waiting time (2 hours)
P =Preload
We =Weighing test
R =Recovery
Z_i =Zero reading

Test equipments for Temperature Tests in NIM

Purpose of the Damp Heat test

- This test has been designed to find out what effect, if any normal fluctuations in atmospheric humidity will have influences on the measuring capability of the instrument.
- High humidity could cause current leakage across the circuitry within the instrument due to the water vapour in the atmosphere.

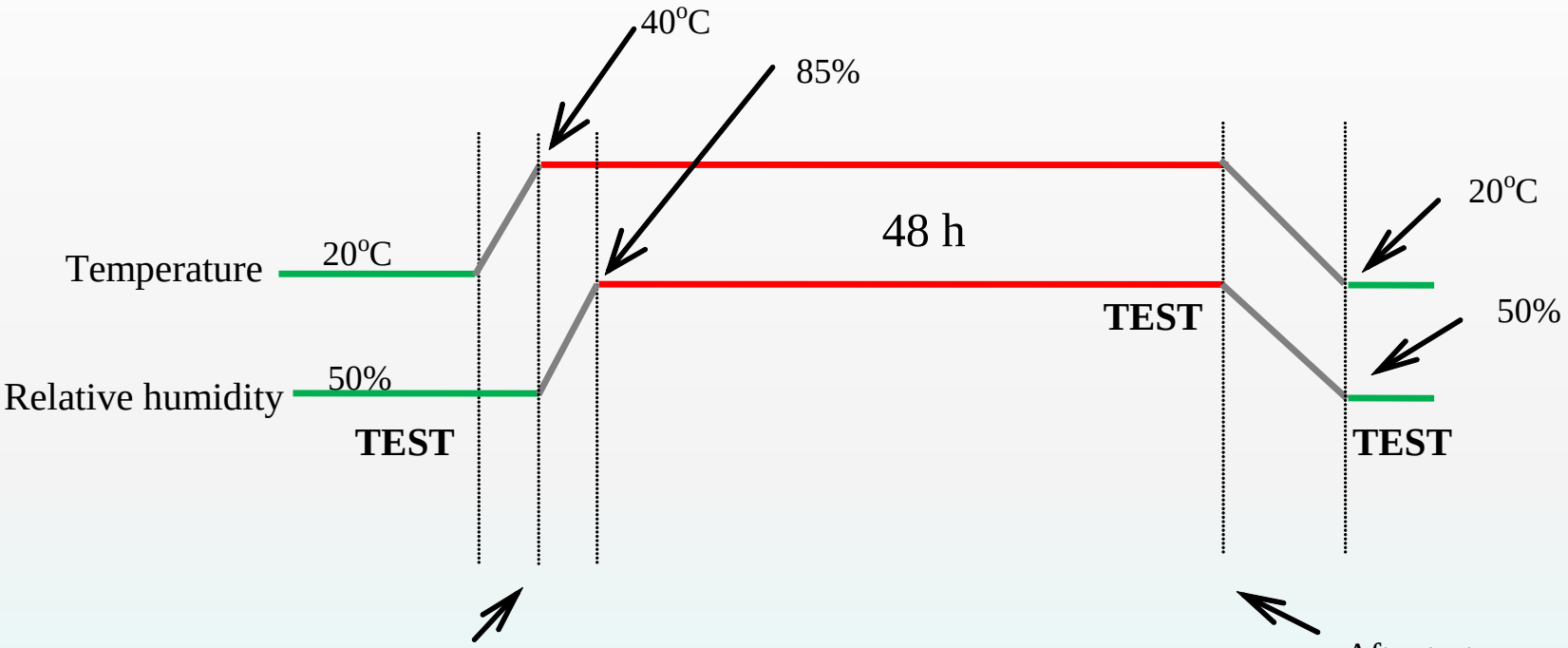
The test consists of exposure of the EUT to a constant temperature and a constant relative humidity. The EUT shall be tested with at least 5 different test loads:

-- *At the reference temperature 20 ℃ and a relative humidity of 50%*

-- *At the high temperature 40 ℃ and a relative humidity 85%*

-- *At the reference temperature 20 ℃ and a relative humidity of 50%*

Damp Heat test



Note: It's important that the test facilities are such that the testing cycle no water is allowed to condense on the instrument. To do this the temperature should increase first to 40 ℃ before the relative humidity is increased.

Disturbance Tests

- AC mains voltage dips and short interruptions
- Electrical bursts:
  - (a) Power supply lines
  - (b) I/O circuits and communication lines
- Surge
- Electrical discharge
  - (a) Direct application
  - (b) Indirect application
- Immunity to radiated electromagnetic fields
- Immunity to conducted radio-frequency fields
- Special EMC requirements for instruments powered from a road vehicle power supply

AC mains voltage dips and short interruptions

- Purpose: This test simulates a brief interruption in the power supply and evaluates whether or not the instrument under test maintains its measurement capability after a brief but major drop in power. This situation often occurs in industry or the market place when where is an interruption in power supply because other equipment is being used.
- Test Severity: B.3.1 of OIML R76 2006, OIML D 11 (2004)

Electrical Bursts

- Purpose: This test has been designed to determine the effect of electrical bursts on the accuracy and operation of the instrument. If there any I/O circuits or communication lines connected to the instrument these must be tested in the same way.

  This is to check if these lines are affected by the electrical noise on the mains which could affect the weighing performance of the instrument.

- Test Severity: B.3.2 of OIML R76 2006, IEC 61000-4-4

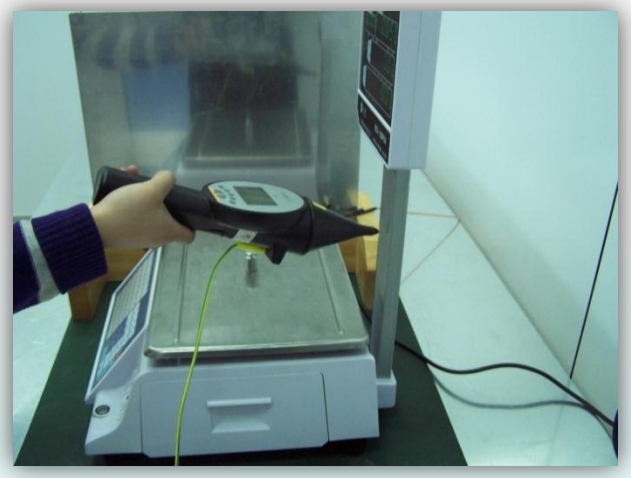


Surge

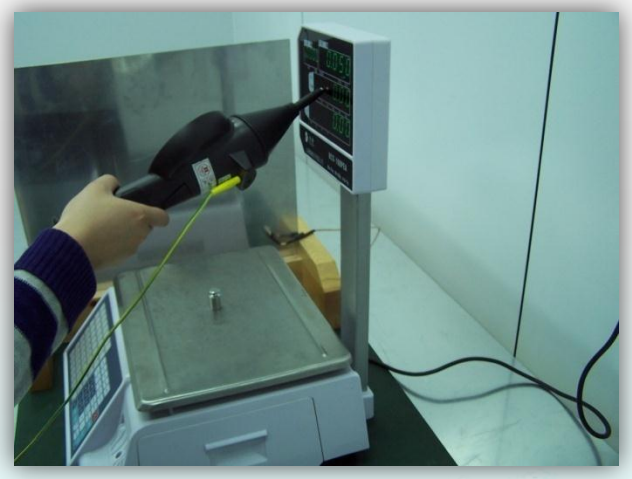
- Purpose: Transient overvoltages on the AC power system are produced by events such as load switching, capacitor bank switching, equipment faults and lightning discharges, etc. This test simulates transient overvoltages in the power supply and evaluates whether or not the instrument under test maintains its measurement capability.
- Test Severity: B.3.3 of OIML R76 2006, IEC 61000-4-5

Discharge

- Purpose : This test has been designed to make sure that the weighing instrument can maintain its performance or make a warning when discharges occur.
- Test Severity: B.3.4 of OIML R76 2006, IEC 61000-4-2



Contact discharge



Air discharges

In the contact discharges mode the electrode shall be in contact with the EUT. In the air discharge mode the electrode is approached to the EUT and the discharge occurs by spark.

Immunity to Radiated Electromagnetic Fields

- Purpose: Antennas, moblie phones and many electrical devices may cause a strong electromagnetic field. This test has been designed to make sure that the weighing instrument can maintain its performance or make a warning when it is affected by a electromagnetic field.
- Test Severity: B.3.5 of OIML R76 2006, IEC 61000-4-3

Immunity to Radiated Electromagnetic Fields

Immunity to Conducted Radio-frequency Fields

- Purpose: This test simulates radio-frequency field of low frequency in the power supply or I/O lines and evaluates whether or not the instrument under test maintains its measurement capability.
- Test Severity: B.3.6 of OIML R76 2006, IEC 61000-4-6

Requirements of Disturbance tests

The difference between the weight indication due to the disturbance and the indication without the disturbance shall either not exceed *e* or the instrument shall detect and react to a significant fault.

T.5.5.6 Significant fault

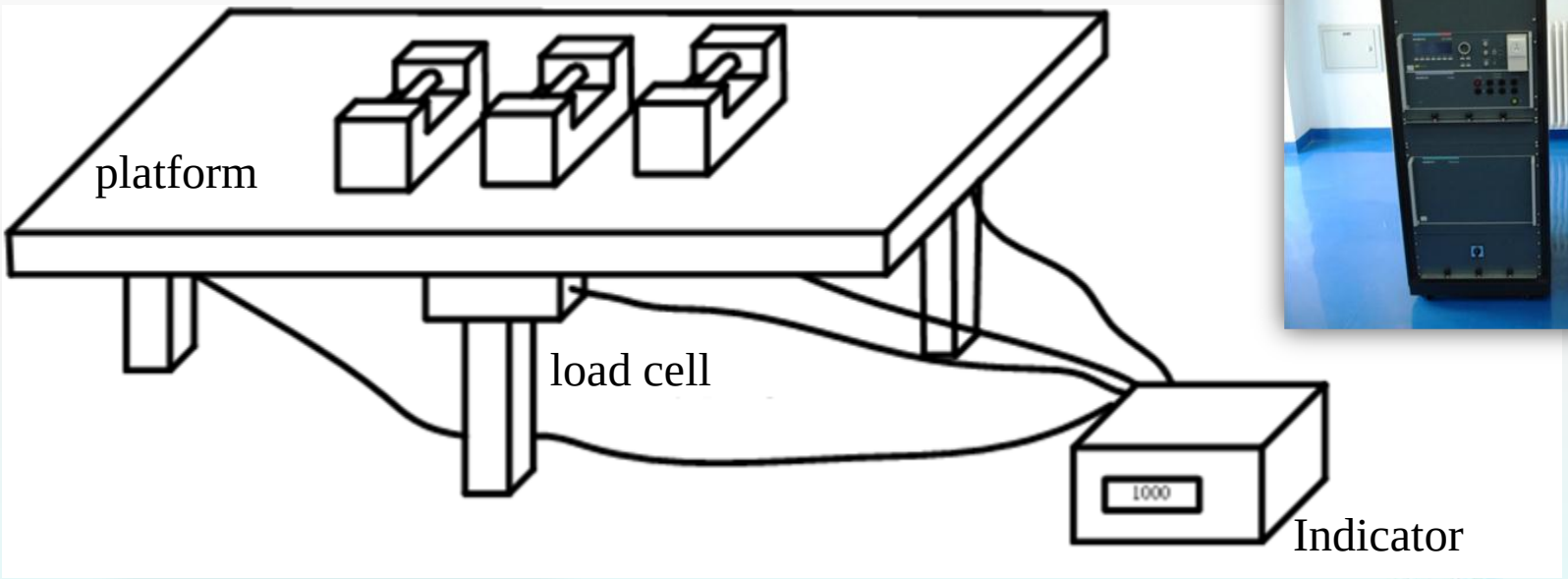
Fault greater than *e*.

Note: For a multi-interval instrument, the value of *e* is that appropriate to the partial weighing range.

The following are not considered to be significant faults, even when they exceed *e*:

- faults arising from simultaneous and mutually independent causes in the instrument;
- faults implying the impossibility to perform any measurement;
- faults being so serious that they are bound to be noticed by all those interested in the result of measurement; or
- transitory faults, being momentary variations in the indication which cannot be interpreted, memorized or transmitted as a measuring result.

➢ A platform with load cells is needed in disturbance tests, the indicator and the platform are combined together and are tested under different disturbances. Be careful, the simulator of the load cell can not be used to instead of the load cell in disturbance tests.



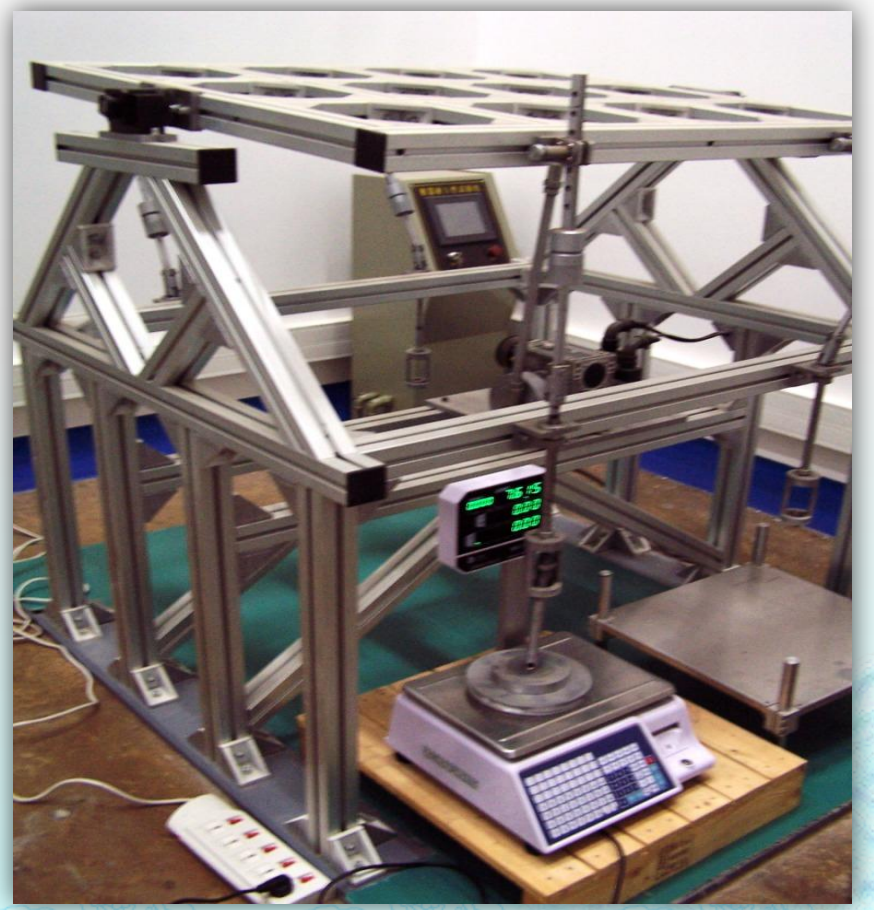
the simulator of the load cell can not be used to instead of the load cell in disturbance tests.

A.6 Endurance test (3.9.4.3)

Note: Applicable only to instruments of classes II, III and IIII with Max ≤ 100 kg.

The endurance test shall be performed after all other tests.

Under normal conditions of use, the instrument shall be subjected to the repetitive loading and unloading of a load approximately equal to 50% of Max. The load shall be applied 100 000 times.



Summary

Type Evaluation Tests (Annex A R76)
Weighing Performance Test
Eccentricity
Discrimination and Sensitivity
Repeatability
Time dependence
Stability of equilibrium
Tilting
Tare
Warm-up test
Voltage various
Temperature test
Temperature effect on no-load indication
Endurance

Type Evaluation Tests (Annex B R76)

Short time power reduction
Electrical bursts: (a) Power supply lines (b) I/O circuits and communication lines
Electrical discharge:(a) Direct application (b) Indirect application
Surge
Immunity to radiated electromagnetic fields
Damp heat, steady state
Span stability test

National Institute of Metrology

Thank you very much for your attention!