Calibration procedure for scales with non-automatic operation

1 Subject calibration

The calibration procedure applies to scales with non-automatic operation included in the category of working meters with an upper limit of the measuring range of 10 kg from the accuracy allowed by the best measuring capability of the laboratory.

2 Related regulations

ČSN EN ISO 10012	Measurement management system - Requirements for the measurement process and measuring equipment
ČSN EN 45501	Metrological aspects of scales with non-automatic operation
ČSN 177001	Nomenclature scales, weighing device and weight
M.P.A 30- 02- xx	Politics CIA for metrological continuity (in valid wording)
Document EA 4/02	Expression uncertainty measurement at calibrations
OILM R 111	Weight classes accuracy E1, E2, F1, F2, M1, M2, M3
CKS	Revision calibration procedures for Scales with non-automatic activities with by the number of parts over 10 000

3 Qualifications workers implementers calibration

Worker performing calibration must be trained and must have certificate for implementation calibration scales with non-automatic activities released recognized authority.

4 Nomenclature and definitions

Nomenclature and definition they are occupied in relevant standards (see Art. 2). Professionally terms used in this one procedure they are said in ČSN EN 45501.

5 gauges, machines and aids needed for calibration

At calibration scales with using secondary standard II. order F1 (set weight from 1 mg to 5 kg), tied up on secondary benchmarks weight AND. order, calibrated at CMI O.I Prague.

Temperature and humidity environment at calibration measured thermohydrometer .

6 Conditions calibration

Calibration of scales is carried out at the place where they are used and under conditions similar to those of use. It is assumed that influences such as vibration, air flow, etc. are already included in the measurement uncertainty.

Scales should be placed in rooms on a solid table so that they are protected from vibrations, drafts and do not run out to unilateral warming up scales and sudden changes temperature rooms. If it isn't by the manufacturer temperature indicated, then the constant temperature should not be too different from the temperature at which the scales were adjusted.

The temperature is considered constant when the difference between the extreme temperatures recorded during the test does not exceed 1/5 of the temperature range of the given scales, but must not be greater than 5 ° C and the rate of change does not exceed ± 2 ° C for an hour with maximum ± 3.5 ° C for 12 hours. Recommended humidity at calibration Yippee in range 40% ÷ 60% with a maximum deviation of 15% in 4 hours.

Calibration is performed at temperature a of relative air humidity, the values of which fall to of the prescribed working range of the scale (usually stated in the scale manual or on the scale label).

If producer thermal range does not determine they are recommended values from + 10°C to + 30°C.

7 Own procedure

7.1 CLEANING

Weight can not show obvious signs damage and pollution. OF weigh yourself removes minor impurities by blowing, using a brush or gentle wiping. If necessary, the scales are cleaned and adjusted by a professional service before calibration.

7.2 TEMPERATURE

Thermal stabilization standard ones weight with performs their saving after enough time in proximity Scales, to prevent the indication from changing due to air convection. The balance must be connected to the power source for a sufficient time before calibration (e.g. as recommended by the manufacturer or user).

7.3 PREPARATION TO CALIBRATE

Checking the reference position. (If the balance is equipped with a setting device and a position indicator, it is checked before own calibration establishment Scales.) Before calibration they are Scales preliminarily loaded approximately to upper between of weight.

To working sheet with they record data needed for calibration gauges

8 Own calibration

Zeroing - zeroing device must enable exactly zeroing and can not cause incorrectly results measurement. The actual calibration consists of a repeatability test, a load eccentricity test and a weighing test.

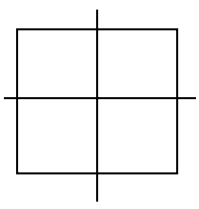
8.1 EXAM REPEATABILITY

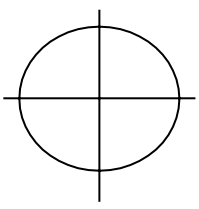
Two weighing series are performed, one with a load of approximately 1/3 Max and one with a load close to 2/3 *Max* . Each series must consist of at least 10 weighings. The reading is taken when the balance is loaded and when it has settled to zero after being unloaded between weighings, the number of pieces of weight being as few as possible.

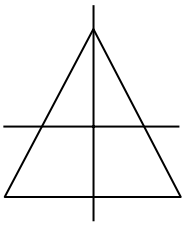
8.2 EXAM ECCENTRIC LOAD

Four quarter sectors, approximately equal to ¼ of the surface of the load carrier, must be loaded after a series of tests by loading with a value of 1/3 Max to the center of gravity of the sectors in the following positions:

- center
- in the back left
- in the back right
- forward right
- forward left







This test is not performed on scales where, due to construction, it cannot occur eccentric load (suspended bowl, scales using a special device for centering the load, etc.).

8.3 EXAM DEAR

For determination mistakes must be chosen at least five load with different values equally spread out in calibrated scope. Selected trial load must contain *Max* and *Min*.

At dear must be used increasing load after steps, whereas with Scales between individual steps relieve.

9 Evaluation

9.1 CALCULATION MISTAKES

Errors in load ratings are determined by comparison with secondary weight standards. The error (determined as the difference: the weight reading minus the load value) is expressed in the form of the standard weight (9.3).

A mistake therefore let's calculate according to formulas:

$$E = I - L$$

where:

Even the average indications of performed repeated measurement the same values

L load Scales benchmark weight

9.2 DETERMINATION UNCERTAINTY

9.2.1 Standard uncertainty type AND

Standard uncertainty type AND with establishes from repeated measurement the same values for the same ones conditions by statistical methods.

OF measurement (number measurement n ≥ 10, in extreme the case more than 5) with calculate selective diameter $\bar{x}$ of measured
values according to formulas:

$$\bar{x} = \frac{1}{n}\sum_{i=1}^{n} x \text{ and}$$

Standard uncertainty type **AND** with in this one the case equal selective authoritative deviations and will determine with
that relationship: $at_A = with \sqrt{\frac{\sum_{i=1} (x_i - \bar{x})^2}{n(n-1)}}$

If Yippee number repeated measurement smaller than 10 will perform with correction on number measurement by multiplying
coefficient $\mathbf{t_r}$ according to relationship: $at_A = \mathbf{t_r} * at_A$

Values coefficient ***to*** _ _ where n Yippee number measurement

n	2	3	4	5	6	7	8	9	≥10
t r	7.0	2.3	1.7	1.4	1.3	1.3	1.2	1.2	1

Continuous result measurement with indicates with by this standard uncertainty *at* $_{A.}$ _

9.2.2 Standard uncertainty type B

Uncertainties type B individual resources *From* $_j$ with will determine of below of the above relationship where
$\wr$ *from* represents maximal holiday
error a parameter 0 has value according to the chosen one probabilistic distribution

$$at_{\mathrm{B}\,j} = \frac{\wr\ of_j}{\mathrm{O}}$$

at $_{\mathrm{Betj}}$'s uncertainty flowing of influence used standard ones weight

$0 = \sqrt{3}$ for equally distribution,

$0 = 2$ for normal distribution

IN ours the case we will use equally distribution.

If Yippee load inferred help more weight, final uncertainty at $_{\mathrm{Bet}}$ Yippee given like simple total uncertainty of individual loads (standard weights).

Uncertainty from (abilities reading) the smallest piece scale calibrated Scales at zero burden

$$at_{\mathrm{B}\,d0} = \frac{d_0}{2 \bullet \sqrt{3}}$$

Uncertainty from (abilities reading) the smallest piece scale calibrated Scales at jth burden

$$at_{\mathrm{B}\,\overline{dj}} \frac{d_j}{2 \bullet \sqrt{3}}$$

Total uncertainty type B:

In sum others powers all of them resources uncertainty type B let's calculate standard uncertainty type B

$$at_{\mathrm{B}}j = \sqrt{u_{Betj}{}^2 + u_{Bd0}{}^2 + u_{Bdj}{}^2 + u_{Bi}{}^2}$$

where:

they are at $_{\mathrm{Bi}}$ eventual next folders uncertainty

Continuous result measurement with indicates with by this standard uncertainty at $_{\mathrm{B.}}$ _

9.2.3 Combined standard uncertainty

In sum of squares standard uncertainty types AND and B with will get square combined standard uncertainty *at* $_C$.

$$at_{\,C} = \sqrt{u_{\mathrm{A}}^2 + u_{\mathrm{B}}^2}$$

Enhanced standard uncertainty AT Yippee given relation:

AT = k . at $_C$***,***

where *to* is the expansion coefficient. Value *to* is chosen 2. With a normal probability distribution this means that

the true value lies with a probability of 95% in the interval defined by the expanded uncertainty.

9.3 EXAMPLE CALCULATION UNCERTAINTY FOR VALUE 200 G

We determine the uncertainties for individual points according to the table (example for 200 g), where ξ is convergent (convergent) probability distribution coefficient

Sourc e	Value	Unit	Sensitive coefficient	Distribution	Coefficient ξ	Contribution to uncertainty
Standard *at* $_{Z1}$	200	G	1	Equally	$\sqrt{3}$	0.0006
Distinction *at* $_{Z0}$	0.00001	G	1	Equally	$\sqrt{3}$	0.0000087
Distinction *at* $_{Z1}$	0.0001	G	1	Equally	$\sqrt{3}$	0.000087
Uncertainty *at* $_{A}$	0.00002	G	1	Gaussian	1	0.00002
Standard burden = 200 G						0.0006 G

*AT = to * at = 2 *0.0006 = 0.0012* ***Enhanced standard uncertainty AT = 0.0012 G***

Expression mistakes:

Nominal weight load	Average load indication and relief	Uncertainty measurement *AT*
200 G	**200.0000 G**	**± 0.0012 G**

10 The results calibration

IN during the calibration, the measured values are recorded in the worksheet. Based on these data, a calibration sheet is drawn up in accordance with PK of the VFN laboratory.

11 Validation and care O calibration method

This calibration method Yippee validated at regular ones interlaboratory comparisons exams usually organized by ČMI Brno.

Least once for year with checks timeliness calibration procedure.

12 Side dishes

Attachment C. 1 Pattern calibration sheet

Všeobecná fakultní nemocnice v Praze
Metrologické středisko
Na Bojišti 1, 128 00 Praha 2

K 2323

KALIBRAČNÍ LIST

číslo :

Datum vystavení :	00.01.1900
Zadavatel :	0 0 0
Datum přijetí :	00.01.1900
Kalibrované měřidlo :	0
Výrobce :	0
Typ :	0
Výrobní číslo :	0
Evidenční / inventární číslo :	0
Horní mez váživosti (Max) :	g
Hodnota skutečného dílku (d) :	10 g
Použitý etalon :	Sada etalonového závaží
Typ :	Třída F1 dle OIML R 111-1: 2004
Výrobní / identifikační číslo :	18529501
Návaznost :	KL č. : 1053-KL-30370-19; vydal : ČMI OI Praha
Podmínky měření :	
Teplota vzduchu :	(21,7 ÷ 21,8) °C
Rel. vlhkost vzduchu :	(31,4 ÷ 31,5) %
Metoda měření :	interní kalibrační postup KP-08-01
Místo provedení zkoušky :	Všeobecná fakultní nemocnice v Praze Oddělení metrologie Na Bojišti 1, 128 00 Praha 2

Pokračování kalibračního listu č. :

Naměřené a vypočtené hodnoty :

1. Zkouška excentricity

Pozice	Zkoušeno zátěží g Indikace g	Odchylka g
střed	0	
vzadu vlevo	0	0
vzadu vpravo	0	0
vpředu vpravo	0	0
vpředu vlevo	0	0

2. Zkouška opakovatelnosti

Číslo měření	Zátěž 2000 g Indikace g	Zátěž 5000 g Indikace g
1	0	0
2	0	0
3	0	0
4	0	0
5	0	0
6	0	0
7	0	0
8	0	0
9	0	0
10	0	0

3. Zkouška vážení

Číslo měření	Jmenovité zatížení	Indikace	Chyba indikace	Rozšířená nejistota
	g	g	g	g
1	...	...	...	...
2	...	...	...	...
3	...	...	...	...
4	...	...	...	...
5	...	...	...	...
6	...	...	...	...
7	...	...	...	...
8	...	...	...	...
9	...	...	...	...
10	...	...	...	...

Uvedená rozšířená nejistota měření je součinem standardní nejistoty měření a koeficientu rozšíření k=2, což

Poznámka :

Kalibroval : 0
technik metrolog

Dne : 00.01.1900

Schválil : Ing. Jiří Pařík
vedoucí MS

----- konec kalibračního listu -----