ITTC Quality System Manual

Sample Work Instructions

Work Instructions

Calibration of Non-Self Indicating Weighing Instruments

7.6 Control of Inspection, Measuring and Test Equipment

7.6-02 Sample Work Instructions

7.6-02-10 Calibration of Non Self Indicating Weighing Instruments

Disclaimer

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Table of Contents

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Verification regulation of non-self-indicating weighing instrument

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Calibration of Non Self Indicating Weighing Instruments

1. RANGE

This work instruction is applicable to the initial calibration、subsequent calibration and in service calibration of the non-self-indicating weighing instruments with medium and ordinary accuracy. (hereinafter simplified as weighing instrument or balance)

Non-self–indicating weighing instruments are weighing instruments for which the equilibrium position is obtained totally by the operation of the user. They include a variety of mechanical lever balances, such as mobile counter scale, platform scale, stationary weighing-bridge, mechanical suspension scale etc.

2. TERMINOLOGY

2.1 Calibration

The metering performance of the weighing instrument should be evaluated in order to ascertain that it can do all the work required by legal rules or this work instruction.

2.2 Initial Calibration

Initial calibration is the calibration for a weighing instrument that has never been calibrated.

Note: Initial calibration includes the calibration of newly manufactured and newly installed weighing instruments.

2.3 Subsequent Calibration

Is a calibration after the initial one.

Note: The subsequent calibration includes:

A) the period calibration;
B) the calibration after repair;
C) the calibration applied before service of the weighing instrument which is newly put into service and asked to be mandatory-calibrated.

The calibration of a weighing instrument of which the period calibration validity term has not ended. The calibration is usually requested by the owner of the calibrated weighing instrument or by its user.

2.4 Inspection in Service

Examines whether the in-service weighing instrument complies with the requirements of the law; whether it is in good working state; whether it works correctly and reliably. Inspection in service is usually a supervisory inspection.

3. CALIBRATION AND TECHNICAL REQUIREMENTS

3.1 Principle of grade division

3.1.1 Accuracy grade

The grade and the sign of the accuracy are shown in Table 1.

Table 1

Medium accuracy grade	III
Normal accuracy grade	IIII

3.1.2 Division value of the calibration

equals to the actual one, i.e.:

$$e=d$$

3.2 Grade of weighing instrument

The division value, the division number of the calibration and the minimum weighing relevant to the accuracy grade are shown in Table 2

Table 2

Accuracy grade	Calibration division value e	Calibration division number n = Max/e		Minimum weighing *Min*
		Minimum*	Maximum	
Medium III	0.1g≤*e*≤2g	100	10000	20 *e*
	5g≤*e*	500	10000	20 *e*
Normal IIII	5g≤*e*	100	1000	10 *e*
Note: *The minimum number of divisions for weighing instrument which is used for the final account of trade: *n*=1000 for grade III ; *n*=400 for grade IIII .				

Table 3

Maximum permissible error *mpe*	*m* expressed by calibration division value *e*	
	III	IIII
±0.5*e*	0≤*m*≤500	0≤*m*≤50
±1.0*e*	500＜*m*≤2000	50＜*m*≤200
±1.5*e*	2000＜*m*≤10000	200＜*m*≤1000

3.3 Maximum permissible error

3.3.1 Maximum allowable error for the initial calibration

The maximum allowable error for the initial calibration of the loading and unloading is shown in Table 3

3.3.2 Maximum permissible error of the calibration for weighing instruments in service

The maximum permissible error of the calibration for weighing instruments in service is two times the one for the initial calibration.

3.3.3 Maximum allowable error of the metering lever when tested individually

The maximum allowable error of the metering lever when tested individually is half of the one for the complete instrument.

3.4 Allowable difference between weighing results

The error of the weighing result at any time should not exceed the maximum allowable error of the calibrated weighing instrument.

3.4.1 Indication difference

The indication difference between the incremental weight and rider, the main rider and the subsidiary one for the same load should not exceed the absolute value of the maximum allowable error. The maximum allowable error of the incremental weight should usually comply with the requirements for weights of M_2 grade.

3.4.2 Repeatability

Repeatability: the difference between multiple weighing results for the same load should not exceed the absolute value of the maximum allowable error for his weight.

3.4.3 Unbalanced loading

Unbalanced loading: the indication error of the same weight at different positions should not exceed the maximum allowable error for this balance when an unbalance loading inspection is carried out according to the requirement in item 5.2.4.

3.4.3.1 Weight exerted on each bearing point

The weight exerted on each bearing point equals nearly one-third of the maximum load for weighing instruments with carriers with 4 or less bearing points.

The weight exerted on each bearing point equals about $1/(N\text{-}1)$ of the maximum load for the weighing instrument with carriers with more than 4 bearing points.

The weight exerted on each bearing point nearly equals one-tenth of the maximum weight for weighing instruments with carriers which (such as the bunker etc.) carry small unbalanced loads.

Rolling loads of standard mass should be exerted at different positions on the carrier of the weighing instrument. The load nearly equals the usual heaviest and the most concentrated rolling

load but should not exceed 0.8 of the maximum weight.

3.5 Calibration standard device

3.5.1 Weights

The error of the calibration standard weights should not exceed one-third of the maximum allowable error of the relevant weight for the weighing instrument.

3.5.2 Substitution of the standard weights

Other fixed load can be used to substitute the standard weights for the weighing instrument with a maximum load over 1t. A prerequisite is a standard weight of at least 1t or the standard weight with the mass of 50 % of the maximum load; the bigger of both should be taken.

If the following conditions can be met, the amount of the standard weights can be reduced further than 50 % of the maximum weight:

- to 35 % of the maximum load if the repeatability error is not bigger than 0.3*e;*
- to 20 % of the maximum weight if the repeatability error is not bigger than 0.2*e;*

The repeatability error can be determined by loading about 50 % of the maximum weight three times on the carrier.

3.6 Sensitivity

The weight of a mass nearly equalling the absolute value of the maximum allowable error of the relevant weighing range should be lightly and gradually loaded and unloaded on the weighing instrument with the metering lever at equilibrium position. The displacement of the metering lever (the static distance changed at the force point of the metering lever) caused by the weight should be at least:

- 3 mm for weighing instruments with a maximum load $Max \leq 100$kg;
- 5 mm for weighing instruments with a maximum load $Max > 100$kg.

3.7 Requirements on the mounting base for a stationary lever balance.

3.7.1 Mounting base construction

The base should be constructed on the basis of a drawing;

3.7.2 Mounting base integrity

The vicinity of the base and the bearing point's pedestal should not have any defaults such as cracks, honeycomb-like defects etc., which could affect its strength.

3.7.3 Mounting base position

The distance between the base pit bottom and the carrier (platform surface) should not be less than 1.5m.

3.7.4 Instrument position

The carrier (platform surface) should be slightly higher than the ground.

The distance between the periphery of the carrier and the base frame should be between 1 and 1.5cm.

Both the ends of the entry and the exit of the weighing instrument should have plane and straight passages with about the same length as the one of the carrier. The speed of the vehicle going up and down the carrier should not exceed 5km/h.

3.7.5 Draining

There should be a pumping device in the base pit to avoid stagnant water.

4. MARKING OF WEIGHING INSTRUMENT

4.1 Instruction label

The weighing instrument should have following labels:

4.1.1 Mandatory declaration label

Name and trade of the manufacturer;
Accuracy grade:
sign of the medium accuracy grade III
sign of the ordinary accuracy grade IIII;
Maximum weight(*Max)* •••;
Minimum weight (*Min)* •••;
Calibration division value (*e)* •••;
Sign and number of the manufacturing license;
The lever ratio of the weighing instruments with incremental weight.

4.1.2 Label according to necessity

Production number;
Sign and number of the pattern approval;
The maximum safety load expressed as Lim = •••;
The counting ratio of a numbering weighing instrument expressed as 1: ••• or 1/•••.

4.1.3 Additional label

An additional label can be added on the basis of special needs for the weighing instrument, such as:

Not for the final account of the trade;
Special for •••.

4.1.4 Requirements for declaration labels

The declaration label should be solid and reliable. Size and shape of the writing must be clear and easily readable. The labels should be located on a place easily visible, fixed on a nameplate or on a part of the weighing instrument. The nameplate of the label should be sealed and not be removable without being damaged.

4.2 Calibration label

4.2.1 Position

The position of the calibration label should fulfil the following requirements:

A) The label cannot be dismantled without being damaged;
B) The label can easily be fixed;
C) The label can be seen without moving the weighing instrument in service.

4.2.2 Fastening

When a self-sticky calibration label is used, it should be kept for long time and there should

be a mounting position with a diameter of at least 25mm.

5. INITIAL CALIBRATION

5.1 Exterior

The following visual inspections should be made before the calibration of a weighing instrument:

5.1.1 Metering characteristics

The required labels described in item 4.1.1 of this instruction should be inspected.

5.1.2 Nameplate, labels of calibration and management

The required nameplate, the label of calibration and the management as well as their positions described in items 4.1.4 and 4.2 of this work instruction should be inspected.

5.1.3 Working condition

The working condition and the place of the weighing instrument should be checked for suitability.

5.2 Calibration

Several surveys should be made in order to check whether the weighing instrument meets the following requirements .

5.2.1 Preparation before calibration

A) Mobile weighing instruments should be surveyed on a surface plate or a platform;

B) Mobile weighing instruments with four wheels should be pulled a distance before being surveyed then put on a surface plate or a platform. All four wheels should touch the surface of the carrier, the connecting parts should touch normally;

C) The carrier of the weighing instrument with the maximum weight equal to or bigger than 10 t should be passed back and forth by a vehicle with the weight not less than 50 % of the maximum weight at least three times.

5.2.2 Zero point survey

5.2.2.1 Initial conditions

The main and the subsidiary rider should be put to zero position of the point division value line, then the equilibrium can be adjusted by use of the balance screw.

5.2.2.2 Determination of the equilibrium position for the metering lever

The metering lever locates at the equilibrium position when it evenly sways up and down about the position indicator. The distance between the metering lever and the upper and the lower edges of the position indicator should not exceed 1mm during the first period of its amplitude.

5.2.2.3 Disturbance

The metering lever can automatically return to the original position or can stay at a position with a distance from the centre line of the position indicator within 5 mm, when its force point edge is transversely pulled or pushed to any side

of the position indicator with an incremental weight.

5.2.2.4 Operation of knives

The pivot knife, the weight point knife and the force point knife of the weighing instrument should be moved in level and longitudinal direction of their knife carrier up to one limit position; the anti-friction part of the knife should be in tight contact with the knife carrier. Then the knives should be moved to the other limit position. Each time after being moved, the metering lever can still keep balance. As shown in Fig. 1

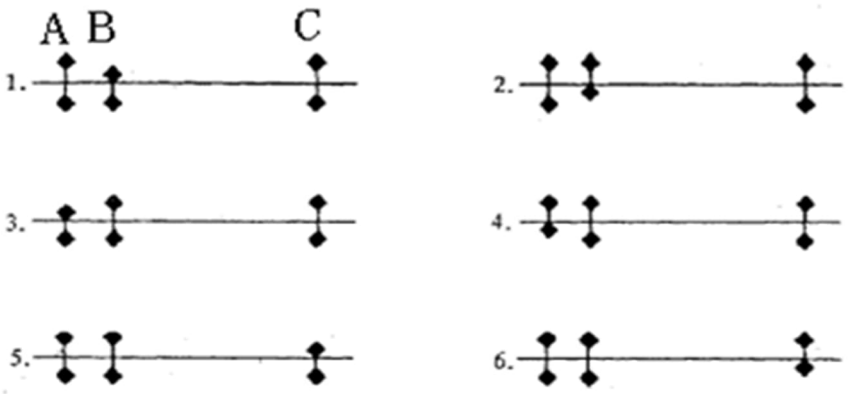

Figure 1

Where, A --- weighing point; B --- pivot; C force point
1 The pivot knife is moved at one extreme position; 2 The pivot knife is moved at another extreme position; 3 The weighing point is moved at one extreme position; 4 The weighing point is moved at another extreme position; 5 The force point is moved at one extreme position; 6 The force point is moved at another extreme position.

Only the weighing point knife and the pivot knife should be moved with the rider.

The amplitude of the metering lever is allowed to shrink, but the distance between it and the upper and the lower edges of the position indicator should not exceed 2 mm after having been moved.

5.2.2.5 Operation of the metering lever

The metering lever should be returned to the original position. Then the carrier should be heavily pulled and lightly set free along the longitudinal direction of the weighing point knife for the loading lever one time each. The metering lever should still keep balance after each pulling and free setting. For stationary-weighing instruments with a maximum weight above 10 t, an empty loading vehicle goes and returns

through the carrier (platen) one time each instead.

5.2.3 Weighing performance

5.2.3.1 Weighing survey

The zero point balance can be adjusted by the adjusting nut after the zero point has been surveyed.

The weighing survey should be continuously made in a sequence from small to big weights. The zero point must not be readjusted during the survey. The following weighing performance must be surveyed.

The minimum weight;

The maximum value of the scale for scale weighing instruments with increment weight;

The maximum values of the rider of the main and the subsidiary scale of the scale weighing instrument;

The weight change of the maximum allowable error, such as:

- Medium accuracy grade: 500*e*、2000*e*;
- Ordinary accuracy grade: 50*e*、200*e*;

The maximum weight.

If the main scale has not been individually surveyed in advance, its “notch” division should be surveyed one by one.

Note: Weight-loading and unloading should be gradually increased and decreased respectively.

5.2.3.2 Weighing survey by use of replacement

The requirements of item 5.2.3.1.2 should be met if replacement standard weights is used.

Firstly, the repeatability error of 50% maximum weight should be checked. The allowable substitution amount should be determined according to the requirements of item 3.5.2.

The replacing method is as follows:

The weighing survey can be carried out using weights from the zero point till the referred weights. The error of this weighing should be measured. Then the weights should be unloaded to the zero point.

The replacement should be used instead of the above added weights till the same error appears. The above operation process should be repeated up to the maximum weight.

5.2.4 Unbalanced loading survey

The effect will be better using bigger mass weights than the combination of many smaller weights. The weight should be put on the central position if a single weight is used. Small weights should be well-distributed over the whole area without unnecessary overlapped piling and without exceeding the boundary The unbalance loading can be surveyed during the weighing survey.

5.2.4.1 Weighing instrument with less than 4 bearing points

The weights should be in turn added onto one quadrant of the carrier area, shown in Fig. 2 or similar as Fig. 2.

5.2.4.2 Weighing instrument with more than 4 bearing points

The weights should be in turn added onto the position near each bearing point on an area nearly equal to 1/*N* of the carrier area, where *N* is the number of the bearing points.

If the bearing points are too close to each other, double the mass weights can be added onto the double area at two sides of the line between the two bearing points.

5.2.4.3 Weighing instruments with special carriers

For weighing instruments with special carriers (vessel、bunker etc.) the weights should be added onto each bearing point.

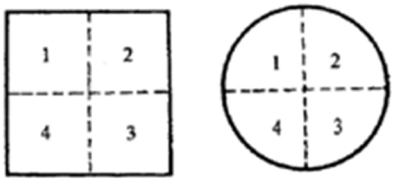

Figure 2

5.2.4.4 Weighing instruments which weigh rolling loads

The rolling load of a standard mass should be added onto the beginning edge, the middle part and the end edge of the carrier in the normal rolling direction. Then this operation should be repeated in the opposite direction.

5.2.5 Sensitivity survey

The sensitivity can be surveyed in the process of the weighing survey. It can be done at the maximum value and the maximum weight of the scale for scale-weighing instruments with incremental weight and subsidiary scale with the rider.

5.2.6 Zero returning survey

The zero point should be surveyed when all weights are unloaded after the maximum weight has been surveyed.

5.2.7 Repeatability survey

Two group surveys with 50% load of the maximum weight and a load close to the maximum should be carried out respectively, at least 3 times each. The weighing instrument should be adjusted to zero before each survey. The survey can also be repeated three times using a loaded vehicle with a relevant load for weighing instruments with a maximum weight $Max \geq 10$t.

5.2.8 Individual survey of the main scale for scale weighing instruments with rider

The main scale should be surveyed separately before the rider scale-weighing instrument is installed. The survey method is as follows:

1. The metering lever should be installed onto a special scale calibration bracket. A scale

pan for hanging the weights should be hung on the weighing point knife.

2. The main and the subsidiary riders respectively should be set to the zero division line then the zero position should be adjusted.
3. The main rider should be moved onto the "notch" position of the maximum weight of the main scale, then the relevant weights *M* should be put onto the scale pan that enables its balance. The equivalent amount of each "notch" division value *m* can be calculated by the following formula:

$$m = \frac{M}{N}$$

where: *N* --- the "notch" division number of the main scale (the zero point "notch" is not included)

The weight with the value of the product of *m* and the ordinal number of "notch" (the zero point "notch" is not included) should be added and the "notch" division value should be surveyed one by one.

The maximum allowable error for the initial calibration should not be exceeded in the survey.

6. MANAGEMENT OF FOLLOW-UP CALIBRATION

6.1 Subsequent Calibration

The examination and the survey described in items 5.1 and 5.2 should also be carried out during subsequent calibrations. The weighing survey can be performed at least up to two-thirds of the maximum weight but must cover the maximum according to the actual usage situation. The repeatability can be only surveyed with 50% of the maximum weight. The survey required by item 5.2.2.4 will not be done for the zero point survey.

The maximum allowable error of subsequent calibrations is the same as that of the initial one.

6.2 In Service Calibration

In service surveys should meet the requirements given in item 6.1. The maximum allowable error can be double of the maximum one of the initial calibration.

7. TREATMENT OF CALIBRATION RESULTS AND CALIBRATION PERIOD

7.1 Documentation

A calibration report should be supplied with a qualified label glued on weighing instruments which are qualified through an initial or a subsequent calibration. The date of the initial or the subsequent calibration and the valid period should be noted; The original calibration certificate can remain unchanged for qualified weighing instruments in service .

A calibration result notice will be supplied for an unqualified weighing instrument, which is not allowed to be used any more.

7.2 Calibration period

The longest calibration period for a weighing instrument is one year.