PART I - GENERAL INFORMATION

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1. PURPOSE OF THIS MANUAL

The purpose of this manual is:

- to provide detailed criteria enabling manufacturers of weighing devices, technologists of the Measurement Canada Approval Services Laboratories and metrologists of United States National Type Evaluation Laboratories to determine whether the design, operation and characteristics of the devices they build or evaluate meet the requirements or the intent of the requirements prescribed by the *Specifications for Non Automatic Weighing Devices*; and

- to describe the laboratory evaluation and test procedures for non automatic weighing devices so as to ensure that they are applied uniformly.

Warning: **from time to time the criteria provided in this manual may have to be updated due to weighing device technology changes. It is recommended that manufacturers contact the manager of the Approval Services Laboratories to discuss any new and special features that they plan to incorporate into their devices to ensure that they comply with the requirements.**

2. SCOPE

This manual provides the examination criteria and test procedures for non automatic weighing devices and major components thereof that may be subject to separate evaluation.

A **non automatic weighing device** is a weighing device that requires the intervention of an operator in the weighing process. Such devices weigh commodities statically and require the intervention of the operator during the weighing process, for example to apply or remove the material to be weighed from the load receiving element, to read the weight or initiate the printing of tickets, etc.

Examples of non automatic weighing devices are

- retail computing scales used in grocery stores to weigh food in the presence of consumers;

- railway track scales used for the static single-draught weighing of railway cars;

- vehicle-mounted scales used to weigh statically anhydrous ammonia (NH_3).

An **automatic weighing device** weighs without the intervention of an operator and follows a predetermined program of automatic processes that are characteristic of the device. Weighings can be done in motion or statically.

Examples of automatic weighing devices are

- continuous totalizing weighing devices (commonly called conveyor belt scales);
- discontinuous totalizing weighing devices (automatic bulk weighers);
- self-indicating railway track scales (commonly called in-motion railway scales);
- checkweighing machines;
- weight grading machines;
- automatic weight fillers.

Note: An automatic weighing device designed for the static weighing of prepackaged commodities of variable weight to which accessories are attached to automate the application and removal of packages remains in the non automatic category although the system is somewhat automated.

3. ABBREVIATIONS USED IN THIS MANUAL

ABBREVIATIONS

AC	Alternating Current
AZSM	Automatic Zero-Setting Mechanism
Max	Maximum Device Capacity
CDN	Canadian
CofZ	Centre of Zero
d	Scale Interval (also: division, graduation)
DC	Direct Current
DUT	Device Under Test
e	Verification Scale Interval
IZSM	Initial Zero-Setting Mechanism
LCD	Liquid Crystal Display
LED	Light Emitting Diode
LRW	Load Receiving/Weighing Element
MC	Measurement Canada
$\mathbf{E_{min}}$	Minimum Permissible Error
$\mathbf{E_{max}}$	Maximum Permissible Error
n	Number of Intervals (graduations, divisions)
OIML	International Organization of Legal Metrology
POS	Point-of-Sale System
RH	Relative Humidity
SAZSM	Semi Automatic Zero-Setting Mechanism
VDT	Video Display Terminal
ZU	Zone of Uncertainty
+ve	Positive
-ve	Negative

<u>Technologist</u> means a member of the staff of the Measurement Canada Approval Services Laboratory who is responsible for evaluating devices.
<u>Laboratory</u> means the Approval Services Laboratories.

4. REVIEW AND UP-DATE OF THE REQUIREMENTS, COMMUNICATION AND CONFIDENTIALITY

Evaluation for approval usually consists of three parts: (1) examination of the design of the device; (2) performance testing, including susceptibility to influence factors; and (3) durability testing. Examination of the design is intended to ensure that the device conforms to prescribed standards, is appropriate to the intended use and has the characteristics that will ensure accurate measurement and reasonable protection from fraud. Such examination is particularly important when a device has new or unusual characteristics or features. The technologist has to determine whether these new characteristics meet the requirements. Any major question will be reviewed by Policy and Engineering. This manual will be updated from time to time to take into account of technological changes. Good communications internally and with clients are essential to the effectiveness of the device approval program.

All information relating to the design, performance and intended use of devices submitted for approval is confidential. The Laboratory is bound to protect this information and must limit access to it, or to data developed during the approval process, to properly authorized organizations or individuals (usually the applicant or manufacturer).

The technologist is not necessarily an expert in the design of weighing devices. When a noncompliance comes to light, the technologist is not required to determine the cause or suggest ways of correcting it. The technologist informs the applicant, who is responsible for solving the problem.

5. WEIGHING DEVICES AND MAJOR COMPONENTS SUBJECT TO APPROVAL EVALUATION

Weighing devices and major components are normally examined and tested entirely in the Laboratory. However, some devices and load receiving/weighing elements, because of their size or capacity and the present limitations of the Laboratory, are evaluated and tested partly or entirely in the field. In addition, some peripheral devices that perform simple complementary metrological functions such as price computation or that cannot affect the performance of the device to which they are interfaced are evaluated and tested in the field only. Such is the case of a printer that merely reproduces the weight values displayed by the device. The table below gives an overview of which device types are evaluated in the laboratory and which are evaluated in the field.

Device Type	Test Location
Any electronic or mechanical **primary indicating element** that performs metrological functions.	Examined and tested entirely in the Laboratory.
Secondary indicating element, printer, secondary display, price-computing scale, cash register and any other peripheral equipment that may be interfaced to a device but <u>does not alter the device performance or does not perform metrological functions</u>.	These elements are evaluated in the field by inspectors on initial inspection of the weighing device. Such elements will, however, be examined and tested by the Laboratory if they are built into a device submitted for approval.

Device Type	Test Location
Cash register/software of a point-of-sale system (POS) that performs significant metrological functions that may affect measurement (functions other than the computation of total prices on the basis of the weight data provided by the weighing element or the scale, and the printing of the data on a cash register tape.	Examined and tested entirely in the Laboratory. **Weighing elements intended to be interfaced with cash registers of that category may be approved separately**.
Complete weighing device and load **receiving/weighing element** whose capacity is not more than 1000 kg or whose dimensions do not exceed 1.6 m x 1.6 m.	Examined and tested entirely in the Laboratory, including temperature susceptibility tests and durability tests.
Complete weighing device and load **receiving/weighing element** whose capacity is more than 1000 kg to no more than 10,000 kg and whose dimensions do not exceed 1.6 x 1.6 m.	Examined and tested entirely in the Laboratory. Only partial tests are performed in the environment chamber. There is no durability tests performed.
Complete weighing device and load **receiving/weighing element** whose capacity is more than 10,000 kg or whose dimensions exceed 1.6 m x 1.6 m. (This category includes vehicle scales, tank scales, large capacity hopper scales and railway track scales.)	The examination and testing are conducted in the field in accordance with the requirements of the Weights and Measures document entitled "Class Approval". <u>Note that indicating elements for these types of devices are examined and tested in the Laboratory.</u>
Load cells.	Procedure to follow.
Software that performs significant metrological functions.	Examined and tested entirely in the Laboratory. A policy, requirements and procedures concerning the evaluation of softwares are being drafted.

6. REQUEST FOR APPROVAL AND ASSISTANCE TO BE PROVIDED DURING EVALUATION

The applicant must complete the appropriate approval request form and send it to the manager of the Approval Services Laboratories. The applicant must also provide two copies of the instruction manual and the operator's manual, photographs of the device, and blueprints or drawings showing the arrangement of the components of the device. The applicant must provide the Laboratory technologist with all pertinent details concerning the construction, operating and sealing characteristics of the device, the various functions that the device can perform, the intended use of the device, and its installation particulars.

At the technologist's request, the applicant must submit one or more sample devices and one or more pieces of peripheral equipment, such as a printer, that will be of assistance in assessing the operation of the device in association with such equipment. In some cases, the applicant will be asked to supply and assemble the material and equipment necessary to conduct the adequate tests (for example: supports for overhead-rail scales). The applicant must provide all assistance necessary to enable the technologist to properly conduct the evaluation of the device.

The applicant must prepare, set the operating parameters of, calibrate and install, as applicable, the sample devices necessary to allow proper assessment.

The purpose of these measures is to make for more efficient assessment of devices.

7. SELECTION CRITERIA FOR SAMPLE DEVICES

Criteria have been established to determine the number of devices and the particular devices of the same type or family that are required to be submitted to the Laboratory for type evaluations. Deviations from the criteria occur when the criteria do not target those devices within the family that may represent the most difficult technological challenge to achieve compliance with the requirements. The general criteria are as follows:

- The devices with the largest and the smallest capacity in the family.
- The devices with the largest number of graduations.
- The devices with the smallest interval values.
- The devices whose load receiving element has the largest surface area for a given capacity.
- The various types of load cell or load cells made of different materials (options).
- The device or major component with the fullest options.
- The various power supplies available (DC, AC).

Furthermore, when the housing is available in various materials (plastic, stainless steel), each version must be submitted for radio interference testing (RFI). Each version of the housing must be examined for compliance with general requirements, especially sealing requirements. So-called "intrinsicly safe" housings that operate at low voltages must also have to be submitted.

The technologist, in consultation with the manufacturer, will determine how many and what devices of a family or type have to be submitted to the Laboratory for evaluation.

Note: Large capacity devices such as vehicle scales are tested individually in the field after installation in accordance with the Weights and Measures document entitled "Class Approval". Indicating elements of such devices, however, must be of a design approved by the Approval Services Laboratories.

8. REPRESENTATIVENESS OF SAMPLE DEVICES AND PERIPHERAL EQUIPMENT SUBMITTED FOR EVALUATION

The sample device submitted for evaluation and approval testing must be complete in assembly and representative of the model that will be marketed.

If the device can be used with one or more peripheral modules, such as a printer, or if the device can be configured or adjusted remotely by means of a device such as a computer, the applicant must provide a representative peripheral module to allow assessment of the compatibility and operation of the device when connected to peripheral modules.

A device or major component may be designed to perform functions that are not allowed in Canada but are authorized in other countries, for example, use of a unit of measurement prohibited in Canada but allowed in the United States. The device may have such functions provided that the prohibited features can be deactivated and sealed.

A counting feature incorporated in weighing devices is not tested by the Laboratory. It may, however, remain active and be used in trade. Devices used to count numbers of units are not subject to the *Weights and Measures Act*.

9. TESTING, MARKING AND APPROVAL OF COMPLETE DEVICES AND SEPARATE COMPONENTS

Complete weighing devices consisting of an indicating element and a load receiving/weighing element in the same housing are tested as complete units and are approved as such. The major components of such devices cannot be separated and connected to other components to form a new device. A single identification plate giving all the prescribed information is required.

Complete weighing devices made up of individual components or modules connected together are tested as complete units if the applicant specifies that the modules are not intented to be separated and connected to other modules approved separately to form another device. In this case, a single approval notice will be issued for the complete device. The Notice of Approval will state that the modules of the device cannot be separated and used with other modules to form a different device. A single identification plate for the entire device giving all the prescribed information will be required.

If the applicant indicates that the major components of a device like that described in the foregoing paragraph may be used with other major components approved separately, the latter components will then be tested separately to a limit of error equal to 0.7 times the acceptance limit of error normally applied to a complete device. Each major component of the device will have to bear its own identification plate giving the prescribed information. A single Notice of Approval may be issued for the complete device stating that the major components of the device may be separated and connected to other compatible approved modules, or each major component may be approved separately.

Major components submitted individually for approval are tested separately. In this case, a tolerance of 0.7 times the acceptance limit of error normally applied to a complete device will be used. These components will be approved separately and may be connected to other compatible approved devices. Each major component must be marked with the prescribed information.

10. ALTERATION, MODIFICATION AND ADJUSTMENT DURING EVALUATION

The applicant will be informed of the progress of the examination and testing during evaluation and will be notified promptly of any points of noncompliance. The applicant may then make the necessary corrections or adjustments. The technologist will ensure that any alterations or adjustments made have corrected the noncompliance. The technologist will also have to ensure that any alterations or adjustments made have not changed other characteristics already verified and tested. Where alterations or adjustments are made to a device during evaluation, the technologist will have to determine from the nature of the alteration or adjustment whether some or all of the tests have to be repeated.

11. REPEATABILITY OF TESTS DURING EVALUATION

The Laboratory endeavours to design and execute the tests in a way and under conditions that ensure as much reproducibility of the results as possible. Some degree of variation, however, is unavoidable. Devices that clearly do not meet the performance requirements would not meet them even under more controlled conditions, no matter how many times the tests were repeated.

A device whose performance is marginally unsatisfactory may be able to meet the limits of error once out of two or three times if the tests are repeated several times. The performance of such a device is nevertheless unsatisfactory.

The Approval Services Laboratories is under no obligation to repeat any tests or portions of tests at the applicant's request where such tests have been duly performed and any repetition of them would add nothing to the evaluation of the device.

12. ALTERATIONS SUBSEQUENT TO APPROVAL

The manufacturer or the applicant must notify the Approval Services Laboratories of its intents to make alterations to the design of an approved device or major component. The alterations may be major or minor. They can include changing the appearance of the housing, changing the material of which the housing is made, physical reorganization of the electronic cards, modification of the software, additional features or options, and so on.

Depending on the scope of the alterations and their potential impact on the performance of the device and its overall compliance with requirements, theApproval Services Laboratories may merely endorse the file and update the Notice of Approval if necessary, or it may carry out a re-examination and partial or complete retesting of the device.

Where the Approval Services Laboratories deems necessary, it may ask the manufacturer to submit a device for examination.

13. UPDATING DESIGNS PURSUANT TO CHANGES IN SPECIFICATIONS

When ministerial design, composition, and construction specifications are changed, the designs of devices approved prior to the change in the specifications do not have to be altered to meet the new requirements. They may continue to be marketed without alteration.

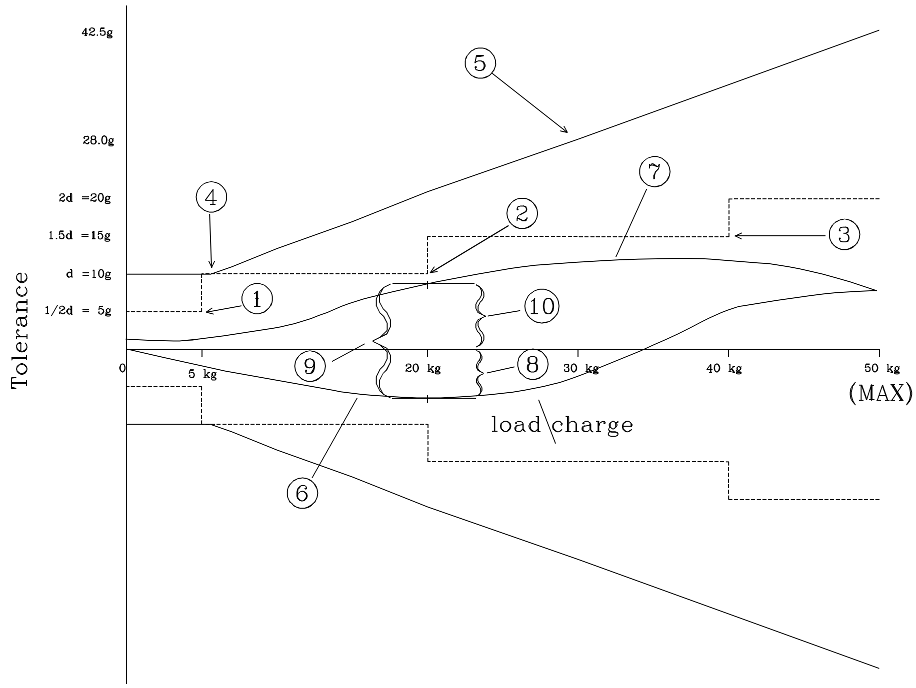
Unless otherwise indicated, changes to performance requirements, such as the limits of error, apply to all designs of device even if they were approved prior to the introduction of the changes.

14. LIMITS OF ERROR

14.1 General

The limits of error depend upon the class designation of the device and its value of verification scale interval "e" (most of the time e = d (graduation)). Contrary to the previous weights and measures requirements, the limits of error are the same for increasing and decreasing loads, and they are not increased by half-graduation for digital-display devices.

The following graph shows a typical performance curve of a weighing device at one temperature, the acceptance limits of error applicable to a Class III, 50 kg x 10 g device and the previous Canadian limits of error.



Legend:

1	***First tolerance step***	***0-500 e***
2	***Second tolerance step***	***+500-2000 e***
3	***Third tolerance step***	***+2000-4000 e***
4	***Turning point of old limits of error***	
5	***Previous Canadian percentage limits of error***	
6	***Increasing-load performance curve***	
7	***Decreasing-load performance curve***	
8	***Linearity; increasing-load error***	
9	***Hysteresis error***	
10	***Sum of errors***	

14.2 Limits of error applicable to complete devices and major components tested separately

The full acceptance limits of error apply to complete devices subjected to approval testing.

When a major component, such as an electronic indicating element or a load receiving/weighing element, is tested separately, the limits of error that apply are 0.7 times the acceptance limits of error normally applied to a complete device. This does not apply to a major component that is the only element likely to produce measurement errors (linearity, hysteresis, repeatability and so on) because of disturbances or influence factors (for example, a load receiving/weighing element that produces a digital signal interpretable by computer software). In this case, the full acceptance limits of error will be granted to the load receiving/weighing element.

14.3 Limits of error applicable to multiple range and multi-interval devices

A multiple range device has two or more weighing ranges with different capacities and different intervals for the same load receiving/weighing element, and each range extends from zero to its maximum capacity. Each range is considered a separate device. The limits of error for each range are determined on the basis of the value of the verification scale interval of that range.

A multi-interval device has a single weighing range divided into partial weighing ranges with different intervals, and the weighing range is determined automatically by the load applied, for increasing and decreasing loads. The limits of error are determined on the basis of the class of the device and the value of the verification scale interval "e" of the partial range corresponding to the load applied.

The following example shows how to determine the limits of error applicable to a Class III 15 kg weighing device with partial ranges and verification scale intervals "e" (graduations) set as follows:

First range	0-2 kg x 1 gram
Second range	2-5 kg x 2 grams
Third range	5-15 kg x 5 grams

The acceptance limits of error applicable to Class III weighing devices are:

Load expressed in number of verification scale intervals "e"	**Acceptance limits of error expressed in number of verification scale intervals "e"**
0-500	±0.5 e
> 500-2000	±1 e
> 2000-4000	±1.5 e
> 4000	±2.5 e

The limits of error applicable to each range are therefore:

	Number of intervals "e"	Value in kilograms	Limits of error (Acceptance)
First Range (e = 1 g)	0-500 e > 500-2000 e	0-500 g >500 g - 2 kg	0.5 g (0.5 e) 1 g (1 e)
Second Range (e = 2 g)	0-500 e > 500-1000 e > 1000-2000 e > 2000-2500 e	0-1 kg >1-2 kg > 2-4 kg > 4-5 kg	N/A N/A 2 g (1 e) 3 g (1.5 e)
Third Range (e = 5 g)	0-500 e >500-1000 e >1000-2000 e >2000-3000 e > 3000 e	0-2.5 kg > 2.5-5 kg > 5-10 kg >10-15 kg > 15 kg	N/A N/A 5 g (1 e) 7.5 g (1.5 e) N/A

15. DETERMINING THE ERROR BEFORE ROUNDING - DIGITAL-DISPLAY DEVICES

In some cases during approval testing, the internal error or error before rounding will have to be determined in order to accurately establish the performance curve of the device and whether it meets the prescribed limits of error. When the device is tested to full capacity and the errors noted are well within the prescribed limits, direct reading of the registrations may be satisfactory. If the errors are marginal, it will be necessary to determine the internal error or error before rounding.

Two methods may be used: (1) the enhanced resolution of the device; or (2) the "small weights" method (weights equal to no more than 1/10 of the value of the verification scale interval).

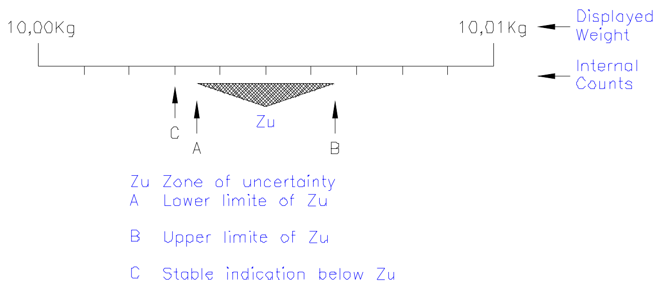
15.1 Enhanced resolution

If the device has a resolution-enhancing feature (multiplied by 10 or more), this feature will be used during testing.

15.2 "Small weights" method

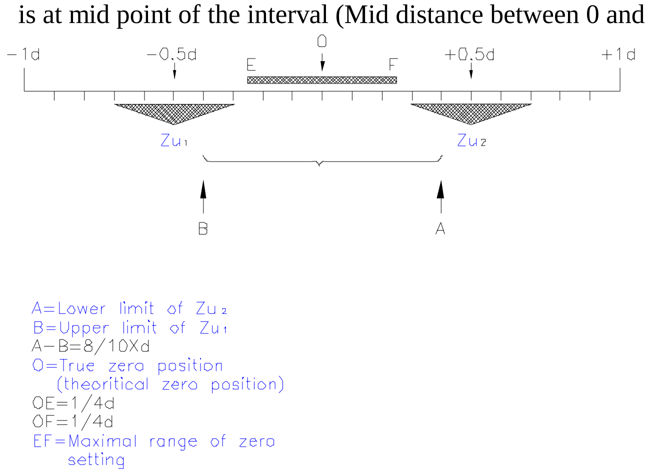
The following example illustrates the procedure to determine the internal error on a 50 kg x 10 g device. Small weights of 1 gramme (1/10 "d") will be used.

The "break point" refers to the upper and the lower limit of the zone of uncertainty (ZU) between two scale intervals. It is the point where the scale first starts to enter or leave the ZU. For example, a device displays 10.00 kg; small weights are added in units of 1 gramme, and the device begins to display in alternance 10.00 kg and 10.01 kg. The device has entered the zone of uncertainty. The following graph illustrates the upper and lower limits of the ZU (breakpoints). The lower limit of ZU is at point A, and the upper limit of ZU is at point B. At point C, a stable indication is provided.



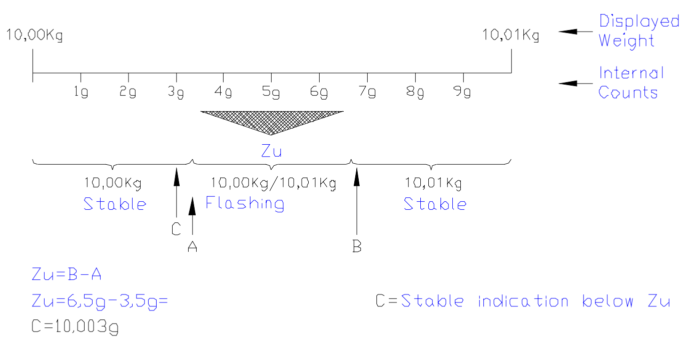
To test a scale using error weights, it is necessary to know "where you are" within a scale interval (to have a reference point). The zero reference point is the point within the zero interval at which the scale is located when under zero load. It is necessary to establish the true "zero reference point" location in order to determine the relative location of the ZU within the interval.

Location of the Zero Reference Point The AZSM must be deactivated. Place error weights (10 x 1/10 d) on the scale and set the device to zero. Remove the weights from the scale in 1/10 d steps until upper limit of ZU_1 is reached (point B, graph below). Add 1/10 d to return to a stable indication. This is the starting point for determining the width of zero interval. Add weights in multiple of 1/10 d until the lower limit of ZU_2 is reached (point A, graph below). The amount of weights added from the starting point is considered the width of zero. The zero reference point should be at the center of interval or mid distance between ZU_1 and ZU_2 . In such a case, ZU is at mid point of the interval (Mid distance between 0 and + 1d) .



If the zero reference point is not located at mid distance of the interval (equidistant from ZU_1 and ZU_2), any deviation must be taken into consideration in the calculation of internal or true errors.

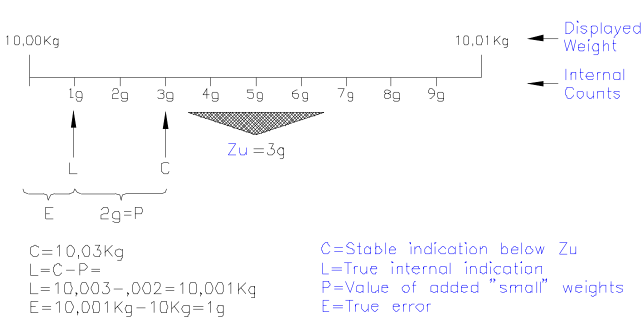
The width of ZU. This can be done at zero following the determination of the with of zero interval or anywhere within the weighing range. In the following example, a load of 10 kg is used. Small weights are added in units of 1 g until the lower limit of the ZU is reached (breakpoint A). The display alternates between 10.00 kg and 10.01 kg. The amount of weights that must be added to reach a stable indication of 100.01 kg is the width of the zone of uncertainty. The zone of uncertainty should not be more than 0.3 d wide. See the following illustration.



Note: On a multiple range device and a multi-interval device the determination of the location and the width of ZU must be done for each range.

Calculation of internal errors. For the following example it is assumed that the zero reference point is at the mid range of the interval (equidistant from ZU_1 and ZU_2) and that the width of the uncertainty zone is 0.3 d or 3 g. The device is set to zero and a load of 10 kg is placed on the platter. The device displays 10.00 kg. Small weights are then added by 1 g steps until the display begins to alternate between 10.00 kg and 10.01 kg. One gramme is removed to obtain a stable registration of 10.00 kg. The device is at the edge of the interval or lower limit of the ZU (point C). Knowing that the width of ZU is 3 g and that the ZU is located at the mid range of the interval, since only 2 g are added to reach the breakpoint, the scale has an error of + 1 g. See the following illustration.

$$E = 3\text{ g} - 2\text{ g} = 1\text{ g}$$



16. INCREASING AND DECREASING LOAD TESTS - SELECTION OF LOADS

The increasing and decreasing load tests are procedures required to determine the performance characteristics of weighing devices or major components tested separately. These tests are performed several times during the evaluation at room temperature and at prescribed extremes of temperature (generally -10°C, 20°C and 40°C).

At least five known increasing and decreasing test loads (preferably 10 loads), ranging between zero and the maximum capacity, will be applied. The internal error before rounding will be determined for each load unless the error is well within the limits of error.

Known test loads will be selected whose value corresponds as much as possible to the turning points of the limits of error (see items 1, 2 and 3 of the graph in point 14.1 above). These are the critical points where the device is most likely to fail.

17. SEQUENCE OF TESTS

The tests described in this manual and the order in which they are to be carried out must be followed as closely as possible. The sequence of tests has been established to simplify the procedure as a whole and to minimize the time required to complete full evaluation of devices. The order in which the tests are to be carried out is given in Part 3 of the present manual.

18. ADJUSTMENT AND CALIBRATION OF THE DEVICE DURING EVALUATION

18.1 General

The device will be calibrated as close to zero error as possible before the test program begins, and thereafter, if necessary, only as indicated in the recommended test sequence in Part 3 of the manual. Unless otherwise indicated by the applicant or the manufacturer, the device will be calibrated as close to zero error as possible at 70% of its maximum capacity.

18.2 Adjustment of calibration points

A. Electronic indicating elements evaluated separately

Calibration points normally serve to correct linearity errors of load receiving/weighing elements to which indicating elements are connected. The calibration points of indicating elements tested separately will be set at zero or inhibited. The indicating element will be adjusted to the maximum number of verification scale intervals "e" (counts) requested by the applicant, within the limits imposed by the class of the device.

B. Complete device

The linearity of complete weighing devices will be set as close to zero error as possible at the appropriate time by means of the calibration points.

C. Weighing elements tested separately

The calibration points of a high precision indicating element used as standard for the evaluation of a weighing element will be set to zero effect or inhibited.

18.3 Temperature of device at time of adjustment

All adjustments before and during evaluation will be made with the device at room temperature (≈20°C).

18.4 Warm-up of device before testing

The performance of some devices is sometimes affected when the internal temperature (electronic components) varies and is not stable. When a device is unplugged for a length of time and then plugged in again, the manufacturer usually recommends allowing the device to warm up before being used. The device should have a mechanism to prevent the display and printing of weights until the internal temperature is sufficiently stable to allow accurate measurement. The technologist will conduct the test as soon as the device displays a weight value.

18.5 Preloading (exercising) the device before testing

After the device has been assembled and installed, and whenever it is moved and reinstalled, it may be loaded, if necessary, up to its full capacity to "exercise" the load cell or cells before testing. The recommended test sequence and the test procedures described in Part 3 of this manual provide information as to when it is necessary and permitted to "exercise" the device.

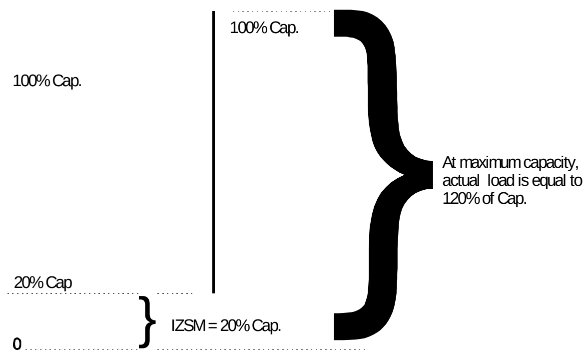
18.6 AZSM adjustment

Unless otherwise indicated in the description of the test procedures, if the device is equipped with AZSM, the AZSM will be set at the minimum value. If the minimum value is zero, the AZSM will be set at zero. Where a particular procedure specifies that the AZSM is to be deactivated and the device does not allow this to be done easily, the effect of the mechanism will be cancelled by applying a small load (10 d) to conduct the tests.

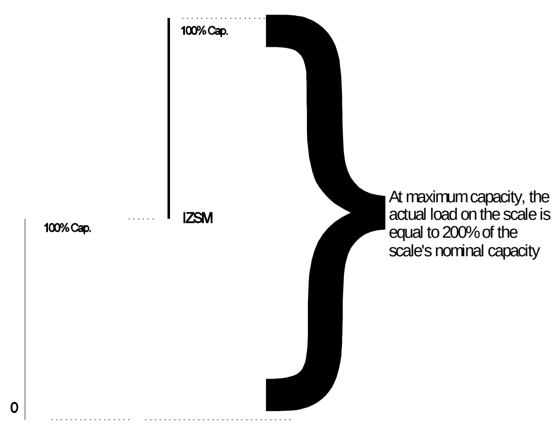
19. DEVICES EQUIPPED WITH IZSM

Some devices are equipped with IZSM. This feature allows rough setting of the zero according to the weight of the platter, platform or load receiving element. This setting operation occurs automatically whenever the device is turned on or plugged in. The IZSM range is usually limited to 20% of the device capacity, but may range up to 100%. The load cells of such devices are likely to operate over a much wider range than the capacity marked on the device. The technologist must therefore perform appropriate tests to ensure that the performance of the device is acceptable over its whole extended capacity.

When the IZSM limit is 20%, the largest load to which the device will be subjected will be 120% of the capacity (capacity + 20%). In this case, all the tests will be carried out while the IZSM is at the maximum (20%). See the following illustration.



When the IZSM limit is 100%, the largest load to which the device will be exposed will be 200% of the marked capacity (capacity + 100%). When the IZSM capacity exceeds 20%, the increasing and decreasing load tests (linearity, hysteresis and repeatability) at room temperature will be performed twice, that is, when the IZSM is at minimum capacity (0%) and maximum capacity (100%). All other tests, including the tests for susceptibility to temperature variations (-10°C and 40°C) will be performed while the IZSM is at maximum capacity (100%). See the following illustration.



The possible adjustment of the IZSM of a separately approved indicating element must not exceed 20% of the maximum approved capacity of the indicating element, because the performance of the load receiving/weighing elements to which it will be associated is not known.

20. CONTROL OF THE ENVIRONMENT

The environment in which the tests will be carried out is considered constant and suitable when:

- temperature variations during testing do not exceed 2.5°C (total range);
- the relative humidity is sufficiently constant that no condensation is observed on the device or the standard weights during testing; and
- the relative humidity does not exceed 50 %.

During temperature variation susceptibility testing, the rate of passage from one temperature to another must not exceed 1°C per minute.

For a given influence test, one factor is varied at a time (temperature, humidity) while the others are kept constant.

21. SEPARATE TESTING OF ELECTRONIC INDICATORS - METHOD AND EQUIPMENT

Electronic indicating elements may be tested in one of the following ways:

- connected to a suitable load receiving/weighing element;
- connected to a load-cell simulator;
- connected to a load cell placed in a calibrated dead load tester.

The preferred method is that involving the use of a load receiving/weighing element, because, unlike the load-simulator method, it can be used to carry out the whole test program.

21.1 Tests using a load receiving/weighing element or load cell installed in a dead load tester

The accuracy of the load receiving/weighing element or the load cell as regards linearity, repeatability and hysteresis must allow proper evaluation of the indicating element. The intrinsic errors of the load receiving/weighing element or the load cell must not lead to rejection of the indicating elements under assessment.

The performance of the load receiving/weighing element or the load cell must first be checked using a suitably calibrated high-precision reference indicator. The maximum combined linearity, repeatability and hysteresis error must not exceed 70% of the limits of error allowed for a complete device (Except a weighing element that is the only element likely to produce measurement errors; for instance a weighing element that produces digital signals interpretable by a computer software would be given full limits of error). During testing, the load receiving/weighing element or the load cell will be kept at constant temperature and humidity.

21.2 Simulator tests

The accuracy of the simulator must first be checked to ensure that the intrinsic errors are minimal and will not cause rejection of the indicating element, and that its overall performance makes it possible to properly determine the performance of the indicating element. The linearity and hysteresis of the simulator must therefore be checked first by means of a calibrated high-precision electronic indicator. During testing of the indicating element, the simulator will be kept at constant temperature and humidity.

The precision simulator used depends on the type of excitation current for which the indicating element is set.