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Handling test weights

Sensible selection and correct handling of test weights

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Abstract

Correct weight values are extremely important for weighing processes in production, as well as for (quality) analysis. But how can the balance user be sure that the weight shown on the display is the same as the mass of the substance being weighed?

This white paper describes possibilities for the user to control and test a balance with test weights. Recommendations and practical examples are given for which weights can be used to test a weighing instrument. The importance of the correct handling of weights is also described, and practical tips for handling are provided.

By using the measures presented here, the risk of a faulty weighing process will be reduced, and recalibration intervals will be optimized.

Introduction

For successful quality assurance, test equipment must be used within the specified tolerance ranges. It is also necessary to check test equipment (in this case weighing instruments as well as weights) at appropriate intervals. But how do you check non-automatic laboratory balances? Which weights can be used to carry out intermediate tests independently, and how can they take place?

Are there rules about which test weights need to be used and which conditions apply for these weights?

If regulatory procedures for the inspection of test equipment are available for special applications, these must of course be followed. However, because for the majority of laboratory balance applications there are no procedures that users could simply follow, the various aspects will be illuminated and explained here. Which process ends up being used for which application must be decided on a case-by-case basis. This white paper also aims at providing assistance in such matters.

Handling of weights

How must test weights be handled?
Test weights are only able to test as well (as accurately), as their own weight is known. This means that users should be careful to ensure that the mass of their test weights is as well known as possible, and changes as little as possible.

Due to this, test weights should always be handled with particular care. They should always be stored protected from environmental influences and when in use, should be placed only on clean surfaces. Any scratch on the surface could lead to deposits and contamination or could indicate material abrasion.

With high class weights, it is particularly important that the weights are only handled with clean, lint-free gloves or tweezers | grippers, because even fingerprints alone can weigh approx. 200 µg (2 *d* on a four-digit balance) - let alone the fact that the fingerprint will corrode the surface and, as a result, make the weight more vulnerable to environmental influences.

You can find further recommendations and guidance for handling, storage and cleaning in the Sartorius Brochure on Weights (1).

Even with careful and infrequent use, every test weight should be regularly recalibrated by a specialized provider, so that the user has the updated conventional weight value and | or the nominal value of the weight is confirmed to be within the range of tolerances. Recalibration cycles should be oriented towards the criticality of weighing applications.

How exactly is the mass of a test weight known?
Generally speaking, it must be distinguished whether the nominal value of the weight (e.g. 200 g) is being observed, or the conventional weight value (e.g. 200 g + 0.05 mg = 200.000 05 g), which can be ascertained via calibration and correspondingly indicated on the calibration certificate of the weight. Converted to 20 °C and a reference air density of 1.2 g/cm^3, this value corresponds to the mass of the weight and can be taken as the expected or true value.

However, the mass (and with it, the force on the balance) of a weight is not constant. Over time and with use, this value will change (wear and tear, deposits, etc.). Careful handling is important to ensure this change is as small as possible (see previous section).

In addition, the force that a weight exerts on the balance changes with environmental conditions. For example, temperature differences between the weight and the place of application (weight stored was the office, test is performed in the cold room) can cause buoyancy or convection effects and thus change the force on the weighing pan, even though the mass of the weight is constant. Differences in air pressure (different air pressure between the time of calibration and the time of testing) also lead to different forces and thus to different readings when tested on a balance. As these effects are often difficult to quantify, they should be eliminated as far as possible by storing weights ideally in the same room (i.e. under the same climatic conditions) as the balance(s) to be tested and ensuring constant climatic conditions there.

If the nominal value of a weight is being observed | used, it should be noted that the true value may only deviate within the maximum possible errors (mpe) for this class (see below) according to OIML R 111-1 2004. For a class E_2 weight with a nominal value of 200 g, for example, that would be ± 0.3 mg (see attached table) - the true value of the weight may therefore be between 199.999 7 g and 200.000 3 g (see Fig.1).

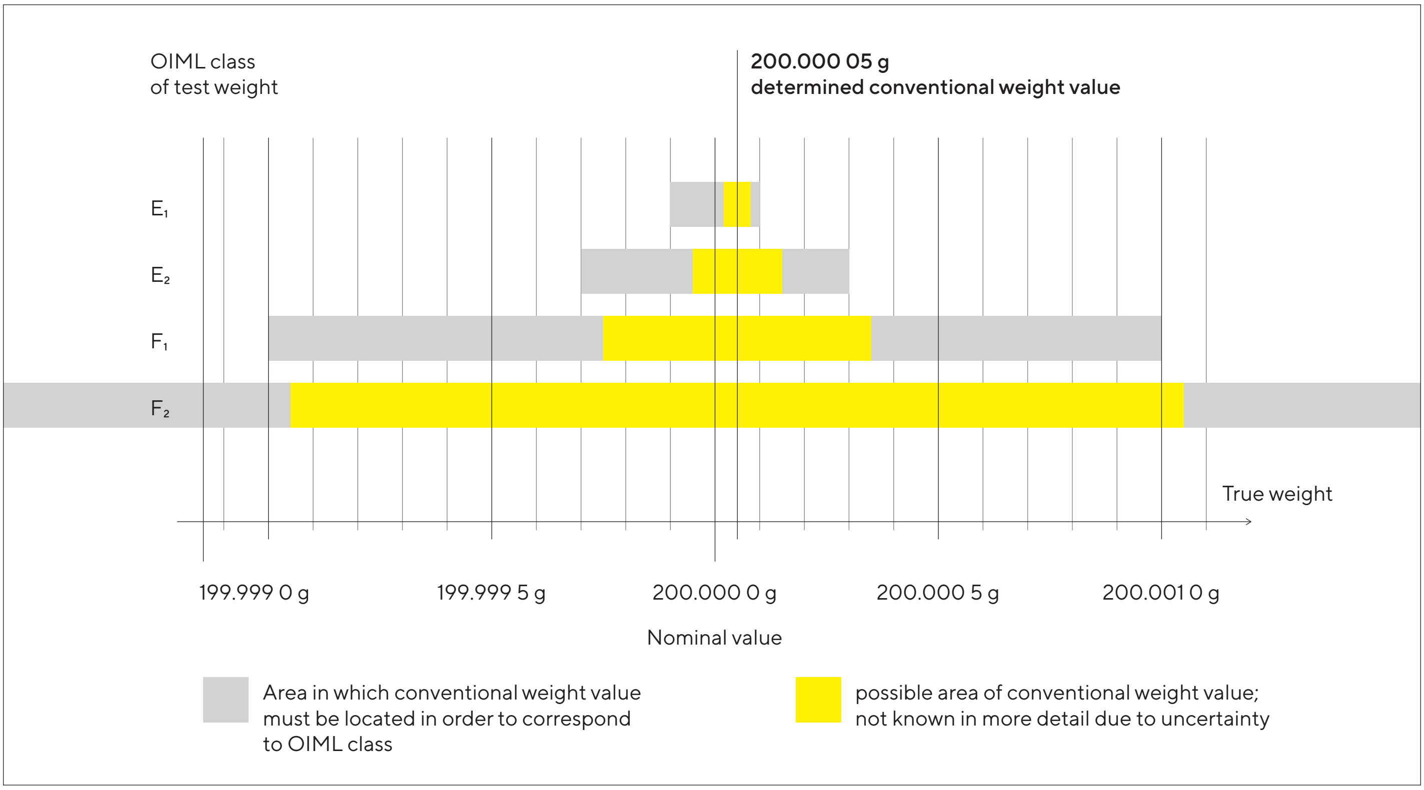

Figure 1: The accuracy of weight determination by using an example of a test weight with a nominal value of 200 g for various OIML classes.

Conversely, if a calibration certificate is available for the weight, the conventional weight value (expected value) specified on it can be used - however, even this is subject to uncertainty. This is indicated as expanded uncertainty *U* and shows the range within which the true value is located (with a probability of 95 %). In the example weight E_2 in Fig.1, *U* is 0.1 mg, meaning the true value is in the range between 200.000 05 mg - 0.1 mg = 199.999 95 g and 200.000 05 g + 0.1 mg = 200.000 15 g.

As the true value of a weight is only known with a degree of uncertainty, and can change over time or due to environmental factors, it is particularly important to bear these factors in mind when choosing tolerances for testing weighing instruments - see also our separate white paper regarding this (2).

How can I ensure that the test weights are still "correct"?
In case of questionable results from an intermediate test with a test weight, the cause is as likely to be measuring equipment that is not functioning optimally (e.g. incorrectly adjusted balance) as it is suboptimal test equipment (e.g. dropped test weight).

In order to find out which it is, measurement should be repeated and it should be ensured that external conditions comply with normal levels (balances are stable and levelled, environmental influences such as temperature, vibration, heat radiation etc are not extraordinary, no contamination is present etc.).

If the questionable result occurs again despite normal conditions, it may be that the test weight is not equivalent to the calibrated data. In order to confirm this, an alternative reference weight may be used to measure and then again for a third time with a combination of the questionable and alternative test weight.

After these investigations, it can be decided whether the measuring equipment (the weighing instrument) or the test equipment (the original test weight) has a defect.

In case of reasonable doubt in the accuracy of the test equipment, a quantitative statement can be established regarding the deviation by checking the weight against a reference weight. To do so, more weights with known calibration data and a mass as close as possible to that of the questionable weight will be required.
During a so-called ABBA-measurement, which is also used by specialized calibration laboratories for calibration, the weight value of the questionable weight (B) can be compared with that of the reference weight (A). This process is described in the international recommendation OIML R 111-1. A rough description: The balance used to check | compare weights A and B (where reference weight A here may consist of multiple individual weights) should have as good a resolution as possible (small scale interval *d*). To start, weight A is placed and weighed, then weight B, then repeated with weight B and finally once again with weight A. In between each individual measurement, the balances should always be reset to zero and all four

displayed values should be noted. The mean values of both differences $|A_1-B_1|$ and $|B_2-A_2|$ provides the measured deviation of the masses. The greater the certainty with which the mass of A is known, the more exactly the mass of B can be determined by this method, and possible changes detected.

Choice of test weights

Which weights can I use to check my balance?
The term "verified weights" appears frequently in this context. A few comments on this first: Just like other measuring equipment, weights can also be verified. Verification is a sovereign confirmation that this test equipment complies with its underlying regulations and is permitted for use from an authorized body. Until a few years ago, verification was also widely accepted as proof of traceability and such verified test equipment was readily used for measuring | calibrating | testing. In the meantime, however, ILAC (the international organization of accreditation bodies) demanded that every piece of testing equipment had a valid calibration as proof of traceability to a national standard (3). Calibration has an advantage over verification in that it doesn't just give a flat positive declaration, but that it also provides the actual state of the test equipment, including measuring conditions and uncertainty, and so provides considerably more information for the user.

In the internationally recognized recommendation OIML R 111 (4), weights are separated into different classes. The higher the class, the better and closer the properties and tolerances. The highest class of weights is class E_1. For this class, the lowest tolerances that apply to surface roughness, density, magnetizability and also deviation of the conventional weight value from the nominal value are relevant. The determined weight value of a weight in this class is the most precise, i.e. its true value is more precisely determined than a weight from a lower class (lower measurement uncertainty). Other classes based on this guidline are (in descending order) E_2, F_1, F_2, M_1, $M_{1\text{-}2}$, M_2, $M_{2\text{-}3}$, M_3. For more on this, see the table in the appendix. Analogous to this, the ASTM E617 (5) standard defines weight classes (000 to 7) with varying high standards of accuracy, density, surface roughness etc. The weight tolerances of weights in ASTM class 00 correspond to that of OIML class E_1, for example.

To judge the accuracy of the balance indication by means of a reference weight, the mass of the reference weight must be known as accurately as possible; but what does that mean in actuality? In order to evaluate a test, the range of tolerance must be determined, within which the deviation is tolerable. For a meaningful evaluation, the uncertainty of the reference weight must obviously be somewhat lower than the tolerable deviation of the balance. As standard, a relationship of 5:1 is assumed, however, a relationship should never fall under 3:1, so that the valuation remains sensible and is also more likely to reflect reality (for more on this, see Figure 2).

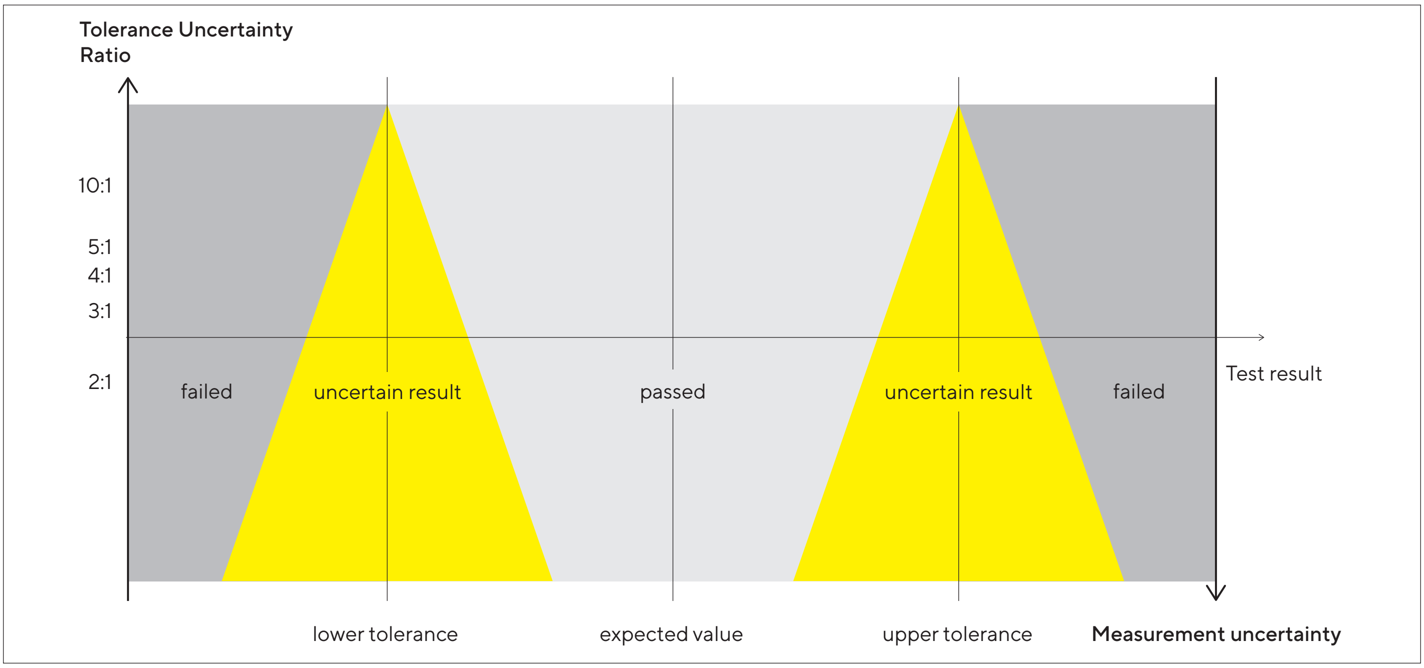

Figure 2: Representation of the range of tolerance with regard to measurement uncertainty (of various degrees).

This so-called tolerance uncertainty ratio is also shortened internationally to TUR. For the example weight of 200 g in class E_2 mentioned above, a tolerance with a corresponding weight to be tested should not be lower than 0.9 mg (for TUR = 3 = 0.9 mg: 0.3 mg), but better would be 1.5 mg (for TUR = 5 = 1.5 mg: 0.3), if the nominal value of the weight is to be used (true value: 200 g ± 0.3 mg). If the conventional weight value of the weight is to be used (true value: 200.00005 g ± 0.1 mg) the tolerance should be less than 0.3 mg (better 0.5 mg).

Of course, in practice this should happen the other way around, i.e. users should first establish the tolerance with which the testing equipment (the balance) will be evaluated and should work out from there how precisely known the reference weight used for testing should be. Therefore, the precision requirements of the balances determine the precision requirements, i.e. the class, of the weight that can be used for testing.

How many weights are needed to check the accuracy of the balance indication?
This can't be answered generally and must be established based on existing circumstances. Strictly speaking, a test of only one point of the load range can only precisely assess this specific load. The further away the measuring point is from this load, the less certain the assessment is about the accuracy in the new position. However, modern laboratory balances demonstrate a very good linearity over the entire weighing range, so that in case of a small deviation at one point, a small deviation at all other points in the weighing range can be assumed.

And as the linearity of a balance is a very stable characteristic, which hardly changes over time or due to environmental factors, it is generally sufficient to test accuracy with just one load. In this case, a load should be chosen that either corresponds to the load range in which the balance is used most frequently | critical weighing is carried out, or to a value close to the maximum load, because here is where possible deviations are the largest, in absolute terms. This principle (testing at only one measurement point) is also used e.g. when assessing the accuracy of a balance according to European (Ph. Eur.) or US American (USP) Pharmacopeia (for more information, also see white paper (6) or (7)).

In case of very high standards of accuracy and for very critical uses, a test can be carried out at multiple points. Due to the stable linearity behavior, and taking economical aspects into consideration, it is also suitable in such cases to use just one precisely known reference weight in a small load area of the balances (e.g. ¼ Max). With these and e.g. two tare weights, it is possible to test the accuracy at three points of the load range.

For more information, see also the later section on various testing possibilities, in particular the point about accuracy testing.

Use of test weights

What can I test as the user myself, and which tests require a specialized provider?
An external provider is not necessary every time a balance is tested. In general, the actual state of every device should be determined at regular intervals via calibration by specialized, and in the best case, accredited service providers, and technical maintenance and adjustments can be made as required. The intervals of such external investigations and also the benefits of accredited service organizations are described in white papers (2) and (8).

In addition to investigations carried out by independent providers, as the user yourself, it is important to regularly test the functionality of individual test equipment, i.e. every individual balance. A routine should be implemented here, and intermediate testing should be documented. The frequency and scope of such intermediate tests should comply with usage and a risk-based specification should occur for each individual device.

What do I need to bear in mind about balances that are used in environments regulated by low or are subject to other regulations?
In addition to the testing that has been adapted to the usage in question and established by the user of the test equipment, it may be the case that external specifications necessitate further testing.

For many balances, there exists legally required verification that absolutely must occur at legally predetermined intervals by an authorized person, independent of your own test specifications - even if these are more frequent and work with smaller tolerances. For such balances, no seals may be broken by the user, e.g. to carry out necessary adjustments.

For the most part, other regulations and test specifications are similar - however, if testing may be carried out by the user, a compulsory inspection can typically be graded as having passed if separate, stricter tolerances are used.

Generally speaking, external (legal | regulatory) provisions must be adhered to, and amendments to the internal intermediate testing may occur as a result.

Which testing possibilities do I have?
In the following section, three quite different methods of intermediate testing are described, and when such methods may be used.

1) The most simple type of intermediate test is an **internal adjustment** of the balances. Almost all modern laboratory balances are fitted with an internal adjustment weight. This weight is inside the casing; its mass was determined very precisely during the production process and this was saved in the balance's software. This weight is weighed with the weighing system either by manual or automatic triggering of the internal calibration and adjustment feature (named in Sartorius devices with isoCAL). The balance indication can be adjusted, i.e. adjusted, to the expected value this way.

Such an internal adjustment can be done very easily and quickly, does not require any additional testing material, and ensures good compensation of the changing influences exerted on the balance. In any case, it should be carried out frequently by the user, and certainly after a change in environmental circumstances at the latest.

2) Another type of intermediate test is testing the **accuracy** of the display, i.e. if the device correctly displays the mass of the substance being weighed. For such a test, a reference weight with an accurately known mass is required. Such a test appears as follows:

If possible, the balance should be internally adjusted and then (in an unloaded state) be set to zero by using the zero button (in some models, this is combined with the tare button). Now the testing weight (a weight with a known mass, also known as a reference weight) should be placed on the balance and the displayed value noted. This is compared with the expected weight value of the test weight. If the difference between the displayed value and the weight value is within the area of tolerance (determined by the user), the test is considered successful, and the balance can continue to be used.

Depending on the criticality of balance usage, such a test can be carried out at one point of the weighing range with a reference weight, or at multiple points of the weighing range (i.e. with various reference weights or one reference weight and multiple tare weights). As a rule, even in applications rated to be highly critical, three testing points are usually sufficient thanks to the good linearity of modern balances.
Making this decision requires consideration of various elements. Of course, the validity of the accuracy testing increases when the balance is tested at as many points as possible. However, this would require multiple, very accurately known reference weights (or at least tare weights). The load range for critical weighing should be considered as a result.

Generally speaking, many possible errors can be considered proportional to the load and as such, are more easily detected at higher loads. At the end of this information, such considerations are put into practice for various situations.

3) In case of doubts regarding accuracy and | or reproducibility of weighing results, the user can also test the device in terms of **repeatability**. In a repeatability test, one and the same reference weight is placed on the balance repeatedly, and as far as possible, in the same way. Between each load, the balance should be set to zero and you should wait until the display returns to zero. Under optimal environmental conditions, a correctly functioning device will show almost the same value with each load. If the displayed value fluctuates, this is either a sign of unfavorable ambient conditions or of a malfunction, which can only be resolved by a repair. A measure of the fluctuation value is the standard deviation of the displayed values.

It is not necessary to know the true value of the reference weight for this additional test, because it is only the differences between the individual repetitions that are being observed. However, in order to compare repeatability tests, it is important that the same weight is always used, as the number of repetitions remains the same. For a statistically significant evaluation, the balance should be loaded at least 10 times, and the value of the standard deviation should be determined. This should not exceed the specified tolerance.

How frequently should a balance be checked?
There is not one single testing interval that is always suitable. The frequency is determined by use and individual requirements. Important considerations and underlying decision-making tools are provided in the white paper "Testing intervals and tolerances" (2).

The different types of intermediate testing described in the previous section (internal adjustment, accuracy and repeatability) are however, as previously mentioned, used differently:
1) An internal adjustment should represent the most frequently used form of intermediate testing.
2) Testing the accuracy should occur in critical weighing or at regular intervals.
3) The result of repeatability testing of a balance is relevant for the minimum sample (for more on this, see also white paper (7)). It is particularly important to test them regularly if small amounts are to be weighed. Additionally, repeatability testing is recommended in case of possible changes to the environmental circumstances or general doubts regarding the functionality of the balance.

Figure 3: Checking the accuracy of laboratory balances with external test weights.

What might a user check look like?

Here are a few examples of which weights could be used for which requirements for an intermediate testing.

Example 1: Precision balance for infrequent sampling of a critical process, verified.
Balance: Secura5102S-1CEU with Max = 5100 g, *d* = 0.01 g, typical weight of sample taken 1 000 g.

- internal adjustment: before every use (because rarely used)
- Testing the accuracy: monthly; established tolerance of 0.10 g for a testing load of 1 kg. In order to evaluate a test against this tolerance with as much certainty possible, a TUR of 5 should be chosen. A weight with an uncertainty of max. 20 mg is required for this, so a test weight from class M_1 or better. The calibration certificate of the example test weight states a conventional weight value of 1 000.0073 g ± 0.016 g. So there is a probability of 95 % that the weight value is somewhere in the interval of 999.9913 g ... 1 000.0233 g. When placing this test weight on the balance, the user would therefore expect to see 1 000.01 g on the display - on a balance without deviations under reference conditions. With a permitted tolerance of 0.10 g the balance testing is considered successful, if the values displayed are between 999.91 g and 1 000.11 g.
- Testing repeatability: only in cases when there is doubt about the weighing results. It is possible to use an uncalibrated weight. However, it should comply with OIML regulations regarding M_1 weights or better in order to ensure sufficient stability of the (unknown) weight value.

Example 2: Analytical balance for weighing a less critical substance multiple times a day.
Balance: MSA324S with Max = 320 g, *d* = 0.1 mg, weights of samples in varying amounts between 10 g und 320 g.

- internal adjustment: daily
- Testing the accuracy: monthly; established tolerance of 2 mg for a testing load of 200 g. As the conventional weight value of a class F_2 200 g weight has an uncertainty of at least 1 mg, a calibrated weight not less than F_1 must be used for testing in order to reliably assess the 2 mg tolerance and testing must occur according to the conventional weight value established on the calibration certificate.
- Testing repeatability: also only in case of doubt, see example 1.

Example 3: Micro balance for daily analysis of a critical substance at varying temperatures.
Balance: MCE10.6S with Max = 10.1 g = 10 100 mg, *d* = 0.001 mg = 1 µg, Weights of samples in varying, sometimes very small weights.

- internal adjustment: before every use
- Testing the accuracy: weekly; established tolerance of 200 µg for a testing load of 10 g. A 10 g class F_1 weight has an uncertainty of the conventional weight value of at least 60 µg. As such, a Test Uncertainty Ratio of TUR = 200/60 ≈ 3.3 results. So in this example, a test weight from class E_2 should be chosen, in which the conventional weight value is precisely determined to be 20 µg (in this case TUR = 10 and a valuation is considerably more reliable). It is again extremely important to not check against the nominal value of 10 g, but against the conventional weight value, which may deviate up to 60 µg from the nominal value for class F_1, or up to 20 µg for class E_2.
  The calibration certificate of the example E_2 test weight states a conventional weight value of 9 999.994 mg ± 0.020 mg. So there is a high probability of 95 % that the weight value is somewhere in the interval of 9 999.974 mg ... 10 000.014 mg. When placing this test weight on the balance, the user would therefore expect to see 9 999.994 mg on the display - on a balance without deviations under reference conditions.
  With a permissible tolerance of 0.200 mg the balance testing is considered successful, if the values displayed are between 9 999.794 mg and 10 000.194 mg. For fine resolution balances, it is extremely important that the balance are adjusted internally prior to testing, and that the test weight has sufficiently acclimatized.
- Testing repatability: monthly, in order to check the minimum sample by means of standard deviation of the repetitive measurement.

Sartorius recommendation

- Adjust your balances as frequently as possible, especially before critical weighing processes, with the internal adjustment weight.
- Establish intervals and tolerances individually for each balance, as well as for internal intermediate testing as well as for checks provided by specialized service companies.
- Always consider the weighing results in terms of plausibility and check the balance in case of doubts.
- Choose the nominal value and class of your test equipment according to the tolerance specifications of the balance.
- Handle testing equipment carefully and get them recalibrated at established intervals by specialized service companies.
- Regular intermediate testing of your test weights compared to reference weights are useful to minimize risks.

This white paper is part of the white paper bundle "Best Practice Guide: Lab Weighing." In order to dynamically add updates and corrections to this whilst at the same time giving users the most clear referencing, e.g. in their QM documentation, these are provided with versioning.

Version history

Version	Date	Changes
1.0	March 2021	Initial version

Literature

1. Recommendations for the handling, maintenance and cleaning of weights and counterweights; Sartorius, Publication No.: W--1508-d12091, Order No.: 98649-013-62
2. Sartorius white paper: Test intervals and tolerances (how are test intervals and tolerances defined practically and on the basis of risk), 2021 (planned).
3. ILAC P10 07/2020 Policy on Metrological Traceability of Measurement Results
4. OIML R 111 Weights of classes E_1, E_2, ... M_3
5. ASTM E617 Standard Specification for Laboratory Weights and Precision Mass Standards
6. Sartorius white paper: Balances in a pharmaceutically controlled environment (chapters <41> and <1251> of the US Pharmacopeia as well as chapter 2.1.7 of the EU Pharmacopeia), 2021.
7. Sartorius white paper: Lowest sample weight according to USP <41>, OIML R76 and EURAMET cg-18 (how large should the lowest sample be, in order to achieve reliable weighing results?). 2020.
8. Sartorius white paper: Calibration certificates from accredited providers (what advantage does our accreditation offer the user), 2021.

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Maximum permissible errors for weights according to OIML R111

Table of the maximum permissible errors (mpe) according to OIML R 111-1: 2004, Table 1.
List of all possible nominal values an their errors (± *δm* in mg).

Nominal value*	Class E_1	Class E_2	Class F_1	Class F_2	Class M_1	Class M_{1-2}	Class M_2	Class M_{2-3}	Class M_3
5 000 kg			25 000	80 000	250 000	500 000	800 000	1 600 000	2 500 000
2 000 kg			10 000	30 000	100 000	200 000	300 000	600 000	1 000 000
1 000 kg		1 600	5 000	16 000	50 000	100 000	160 000	300 000	500 000
500 kg		800	2 500	8 000	25 000	50 000	80 000	160 000	250 000
200 kg		300	1 000	3 000	10 000	20 000	30 000	60 000	100 000
100 kg		160	500	1 600	5 000	10 000	16 000	30 000	50 000
50 kg	25	80	250	800	2 500	5 000	8 000	16 000	25 000
20 kg	10	30	100	300	1 000		3 000		10 000
10 kg	5	16	50	160	500		1 600		5 000
5 kg	2.5	8	25	80	250		800		2 500
2 kg	1	3	10	30	100		300		1 000
1 kg	0.5	1.6	5.0	16	50		160		500
500 g	0.25	0.8	2.5	8	25		80		250
200 g	0.1	0.3	1	3	10		30		100
100 g	0.05	0.16	0.5	1.6	5.0		16		50
50 g	0.03	0.1	0.3	1.0	3.0		10		30
20 g	0.025	0.08	0.25	0.8	2.5		8		25
10 g	0.020	0.06	0.20	0.6	2.0		6.0		20
5 g	0.016	0.05	0.16	0.5	1.6		5.0		16
2 g	0.012	0.04	0.12	0.4	1.2		4.0		12
1 g	0.010	0.03	0.10	0.3	1.0		3.0		10
500 mg	0.008	0.025	0.08	0.25	0.8		2.5		
200 mg	0.006	0.020	0.06	0.20	0.6		2.0		
100 mg	0.005	0.016	0.05	0.16	0.5		1.6		
50 mg	0.004	0.012	0.04	0.12	0.4				
20 mg	0.003	0.010	0.03	0.10	0.3				
10 mg	0.003	0.008	0.025	0.08	0.25				
5 mg	0.003	0.006	0.020	0.06	0.20				
2 mg	0.003	0.006	0.020	0.06	0.20				
1 mg	0.003	0.006	0.020	0.06	0.20				

*other nominal values are not permitted according to OIML R 111-1.

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Maximum permissible errors for weights according to ASTM E617

Table of the maximum permissible errors (mpe) according to ASTM E617.
List of all possible nominal values an their errors (± δm in mg).

Nominal value	Class 0	Class 1	Class 2	Class 3	Class 4	Class 5	Class 6	Class 7
5 000 kg					100 000	250 000	500 000	750 000
3 000 kg					60 000	150 000	300 000	450 000
2 000 kg					40 000	100 000	200 000	300 000
1 000 kg					20 000	50 000	100 000	150 000
500 kg					10 000	25 000	50 000	75 000
300 kg					6 000	15 000	30 000	45 000
200 kg					4 000	10 000	20 000	30 000
100 kg					2 000	5 000	10 000	15 000
50 kg	63	125	250	500	1 000	2 500	5 000	7 500
30 kg	38	75	150	300	600	1 500	3 000	4 500
25 kg	31	62	125	250	500	1 200	2 500	4 500
20 kg	25	50	100	200	400	1 000	2 000	3 800
10 kg	13	25	50	100	200	500	1 000	2 200
5 kg	6	12	25	50	100	250	500	1 400
3 kg	3.8	7.5	15	30	60	150	300	1 000
2 kg	2.5	5	10	20	40	100	200	750
1 kg	1.3	2.5	5	10	20	50	100	470
500 g	0.6	1.2	2.5	5	10	30	50	300
300 g	0.38	0.75	1.5	3	6	20	30	210
200 g	0.25	0.5	1	2	4	15	20	160
100 g	0.13	0.25	0.5	1	2	9	10	100
50 g	0.06	0.12	0.25	0.6	1.2	5.6	7	62
30 g	0.037	0.074	0.15	0.45	0.9	4	5	44
20 g	0.037	0.074	0.1	0.35	0.7	3	3	33
10 g	0.025	0.05	0.074	0.25	0.5	2	2	21
5 g	0.017	0.034	0.054	0.18	0.36	1.3	2	13
3 g	0.017	0.034	0.054	0.15	0.3	0.95	2.0	9.4
2 g	0.017	0.034	0.054	0.13	0.26	0.75	2.0	7
1 g	0.017	0.034	0.054	0.1	0.2	0.5	2.0	4.5
500 mg	0.005	0.01	0.025	0.08	0.16	0.38	1	3
300 mg	0.005	0.01	0.025	0.07	0.14	0.3	1	2.2
200 mg	0.005	0.01	0.025	0.06	0.12	0.26	1	1.8
100 mg	0.005	0.01	0.025	0.05	0.1	0.2	1	1.2
50 mg	0.005	0.01	0.014	0.042	0.085	0.16	0.5	0.88
30 mg	0.005	0.01	0.014	0.038	0.075	0.14	0.5	0.68
20 mg	0.005	0.01	0.014	0.035	0.07	0.12	0.5	0.56
10 mg	0.005	0.01	0.014	0.03	0.06	0.1	0.5	0.4
5 mg	0.005	0.01	0.014	0.028	0.055	0.08	0.2	
3 mg	0.005	0.01	0.014	0.026	0.052	0.07	0.2	
2 mg	0.005	0.01	0.014	0.025	0.05	0.05	0.2	
1 mg	0.005	0.01	0.014	0.025	0.05	0.06	0.1	