

## Test weights

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### Weights yesterday and today

Weights have always been used to carry out weighing procedures. This original purpose has almost disappeared. Today, weights are used almost exclusively for adjusting and testing = calibration of electronic balances. We therefore call them "Test weights" as this is their purpose of use.

#### Adjustment or calibration?

→ **Adjusting** a balance means that you are intervening in the weighing system, to make sure that the display is set to show the correct nominal value. With → **calibration**, on the other hand, there is no intervention, you are testing whether the display is correct and documenting any deviation.

#### Testing, the right way!

The internationally valid OIML norm R111-2004 classifies test weights hierarchically in accuracy classes, where E1 is the most accurate and M3 is the least accurate weight class. With KERN you get the whole test weight range in all OIML accuracy classes E1, E2, F1, F2, M1, M2, M3.

As the appropriate test weight is only classed as checking equipment according to → **ISO 9000ff** if it has the relevant proof of accuracy, all KERN test weights come with an appropriate → **DAkkS-calibration certificate**. For further details, see the calibration service section on page 185.

KERN offers you the appropriate test weight package for your balance, consisting of the test weight, box and DAkkS-calibration certificate, as proof of its accuracy. The best pre-requisite for proper balance calibration.

→ See the glossary on page 191 – 192

Test weights: classes of accuracy E, F, M and their general relation to the types of balances:

- E1 Test weights for customers who require a high degree of accuracy for the most demanding applications.  
For high-resolution balances with  $d > 1,000,000$   
Use recommended with DAkkS calibration certificate only.
- E2 Most accurate test weights for high resolution analytical balances of verification class I  $\geq 100,000$  e
- F1 Test weights for analytical balances / precision balances for verification class I / II  $\leq 100,000$  e
- F2 Test weights for precision balances of verification class II,  $\leq 30,000$  e
- M1 Test weights for industrial and commercial scales of verification class III  $\leq 10,000$  e

# Selection of the appropriate test weight for your balance

Correctly selected test weights with DAkkS calibration certificate are the pre-requisite for ensuring that your balances are not only correctly adjusted, but also correctly calibrated. Scheduled testing of your balances with such test weights helps to guarantee your quality requirements and to maintain your quality targets.

## Here's how you find the right test weight for your balance:

A balance can never be more accurate than the test weight used to adjust it, it all depends on its tolerance.

**Accuracy of the test weight:** Should correspond to the readout [d] of the balance, or rather be better.

**Nominal weight value:** This is shown in adjust mode "CAL" in the balance display. Given a choice, the heaviest weight is the most suitable for accurate measurement.

Once accuracy and nominal weight value are specified, the suitable test weight is selected according to the tolerances "Tol" of the individual accuracy classes E2 – M3, see column "Tol ± mg" at the respective weight and table at page 167.

## Example:

Balance with weighing range [Max] 2000 g = 2 kg  
and readout [d] = 0,01 g = 10 mg

- The accuracy of the required test weight is determined by readout [d] with approx. ± 10 mg.
- Displayed weight size on "CAL" mode: 1000 g or 2000 g.  
The required test weight has a 2 kg weight size.
- Suitable test weights with ± 10 mg tolerance and 2 kg weight size, can be found in accuracy class F1. KERN-No 327-72, see page 172.

## Exception, analytical balances (readout [d] ≤ 0,1 mg):

E1 test weights are recommended. Depending on the safety requirements, E2 test weights with a DAkkS calibration certificate will also be sufficient.

## From brass to stainless steel - the right test weight for every situation



| Test weight<br>→<br>Features<br>↓                            | Cylindrical shape with lifting knob, polished stainless steel  | Compact shape with carrying grip, polished stainless steel   | Cylindrical shape with lifting knob, polished stainless steel or nickelplated and polished brass   | Compact shape with carrying grip, finely turned stainless steel  | Cylindrical shape with lifting knob, finely turned stainless steel   | Cylindrical shape with lifting knob, finely turned brass  |
|--|--|--|--|--|--|---|
| conforms to OIML R111  | yes  | yes  | yes  | no   | yes  | yes   |
| Available classes  | E1, E2   | E2, F1   | F1   | adjusted to F1 error limit class   | F2, M1   | M1, M2, M3  |
| Upper surface  | polished   | polished   | polished   | finely turned  | finely turned  | finely turned   |
| Material   | Stainless steel  | Stainless steel  | Stainless steel or nickel-plated brass   | Stainless steel  | Stainless steel  | Brass   |
| Adjusting cavity   | no   | no   | yes  | yes, from 20 g   | yes, from 20 g   | yes, from 20 g  |
| Verification possible  | yes  | yes  | yes  | nein   | yes  | yes, except M2  |
| Checking equipment for verification purposes                 | approved   | approved   | approved   | not approved   | approved   | approved  |
| Ideal as checking equipment in QM systems (e.g. ISO 9000 ff) | yes  | yes  | yes  | yes  | yes  | yes   |
| Benefits   | <ul style="list-style-type: none"> <li>• High-quality test weight for analytical and precision balances</li> <li>• Highly-refined surface</li> <li>• Ideal shape of the top for good grip</li> </ul> | <ul style="list-style-type: none"> <li>• Affordable test weight for analytical and precision balances</li> <li>• Highly-refined surface</li> </ul> | <ul style="list-style-type: none"> <li>• Ideal, high-quality test weight for precision balances</li> <li>• Ideal shape of the top for good grip</li> </ul> | <ul style="list-style-type: none"> <li>• Affordable test weight for in-house checking of precision balances</li> </ul> | <ul style="list-style-type: none"> <li>• Ideal test weight for commercial and industrial scales</li> <li>• Ideal shape of the top for good grip</li> </ul> | <ul style="list-style-type: none"> <li>• Affordable test weight for commercial and industrial scales</li> <li>• Ideal shape of the top for good grip</li> </ul> |

OIML norm R111-2004 for weights

The key points from the OIML norm R111-2004

OIML (Organisation Internationale de Metrologie Legale) has established the exact metrological requirements for weights in verified applications in approx. 100 states all over the world. The OIML recommendation R111 (2004 Edition) for weights relates to sizes 1 mg – 50 kg. Statements are made on the accuracy, materials, geometric shape, marking and storage of the weights.

Error limits for weights of classes E1 to M3

The error limit classes are in fixed hierarchical levels in the proportion of 1:3, where E1 is the most accurate and M3 is the least accurate weight class. When testing weights with other weights, the correct test class is the next highest class.

Error limit classes (= tolerances)

The values given in the table below (tolerances ± ... mg) are the respective permitted fabrication tolerances. They are to be equal to the → *measuring uncertainty* of the weight, if no → *DAkkS calibration certificate* is available.

Conventional mass

The problem is the air buoyancy, which makes the weight appear lighter. In order to avoid this “distortion” in daily use, all weights are adjusted to the unit specifications as given in R111, i.e. it is accepted that: material density of the weights is 8000 kg / m³, air density is 1.2 kg / m³ and measuring temperature is 20 °C.


KERN cylindrical test weights

Comply with OIML R111-2004 in all respects, without exception.

→ See the glossary, page 191 – 192

| Nominal value<br>↓ | OIML R111-2004 Maximum permissible errors for weights = permissible tolerances “Tol ± mg” |            |            |            |            |            |            |
|--------------------|---|------------|------------|------------|------------|------------|------------|
|                    | E1  | E2         | F1         | F2         | M1         | M2         | M3         |
| 1 mg               | ± 0,003 mg  | ± 0,006 mg | ± 0,020 mg | ± 0,06 mg  | ± 0,20 mg  | -          | -          |
| 2 mg               | ± 0,003 mg  | ± 0,006 mg | ± 0,020 mg | ± 0,06 mg  | ± 0,20 mg  | -          | -          |
| 5 mg               | ± 0,003 mg  | ± 0,006 mg | ± 0,020 mg | ± 0,06 mg  | ± 0,20 mg  | -          | -          |
| 10 mg              | ± 0,003 mg  | ± 0,008 mg | ± 0,025 mg | ± 0,08 mg  | ± 0,25 mg  | -          | -          |
| 20 mg              | ± 0,003 mg  | ± 0,010 mg | ± 0,03 mg  | ± 0,10 mg  | ± 0,3 mg   | -          | -          |
| 50 mg              | ± 0,004 mg  | ± 0,012 mg | ± 0,04 mg  | ± 0,12 mg  | ± 0,4 mg   | -          | -          |
| 100 mg             | ± 0,005 mg  | ± 0,016 mg | ± 0,05 mg  | ± 0,16 mg  | ± 0,5 mg   | ± 1,6 mg   | -          |
| 200 mg             | ± 0,006 mg  | ± 0,020 mg | ± 0,06 mg  | ± 0,20 mg  | ± 0,6 mg   | ± 2,0 mg   | -          |
| 500 mg             | ± 0,008 mg  | ± 0,025 mg | ± 0,08 mg  | ± 0,25 mg  | ± 0,8 mg   | ± 2,5 mg   | -          |
| 1 g                | ± 0,010 mg  | ± 0,03 mg  | ± 0,10 mg  | ± 0,3 mg   | ± 1,0 mg   | ± 3,0 mg   | ± 10 mg    |
| 2 g                | ± 0,012 mg  | ± 0,04 mg  | ± 0,12 mg  | ± 0,4 mg   | ± 1,2 mg   | ± 4,0 mg   | ± 12 mg    |
| 5 g                | ± 0,016 mg  | ± 0,05 mg  | ± 0,16 mg  | ± 0,5 mg   | ± 1,6 mg   | ± 5,0 mg   | ± 16 mg    |
| 10 g               | ± 0,020 mg  | ± 0,06 mg  | ± 0,20 mg  | ± 0,6 mg   | ± 2,0 mg   | ± 6,0 mg   | ± 20 mg    |
| 20 g               | ± 0,025 mg  | ± 0,08 mg  | ± 0,25 mg  | ± 0,8 mg   | ± 2,5 mg   | ± 8,0 mg   | ± 25 mg    |
| 50 g               | ± 0,03 mg   | ± 0,10 mg  | ± 0,3 mg   | ± 1,0 mg   | ± 3,0 mg   | ± 10 mg    | ± 30 mg    |
| 100 g              | ± 0,05 mg   | ± 0,16 mg  | ± 0,5 mg   | ± 1,6 mg   | ± 5,0 mg   | ± 16 mg    | ± 50 mg    |
| 200 g              | ± 0,10 mg   | ± 0,3 mg   | ± 1,0 mg   | ± 3,0 mg   | ± 10 mg    | ± 30 mg    | ± 100 mg   |
| 500 g              | ± 0,25 mg   | ± 0,8 mg   | ± 2,5 mg   | ± 8,0 mg   | ± 25 mg    | ± 80 mg    | ± 250 mg   |
| 1 kg               | ± 0,5 mg  | ± 1,6 mg   | ± 5,0 mg   | ± 16 mg    | ± 50 mg    | ± 160 mg   | ± 500 mg   |
| 2 kg               | ± 1,0 mg  | ± 3,0 mg   | ± 10 mg    | ± 30 mg    | ± 100 mg   | ± 300 mg   | ± 1 000 mg |
| 5 kg               | ± 2,5 mg  | ± 8,0 mg   | ± 25 mg    | ± 80 mg    | ± 250 mg   | ± 800 mg   | ± 2 500 mg |
| 10 kg              | ± 5,0 mg  | ± 16 mg    | ± 50 mg    | ± 160 mg   | ± 500 mg   | ± 1 600 mg | ± 5 000 mg |
| 20 kg              | ± 10 mg   | ± 30 mg    | ± 100 mg   | ± 300 mg   | ± 1 000 mg | ± 3 000 mg | ± 10 g     |
| 50 kg              | ± 25 mg   | ± 80 mg    | ± 250 mg   | ± 800 mg   | ± 2 500 mg | ± 8 000 mg | ± 25 g     |
| 100 kg             | -   | ± 160 mg   | ± 500 mg   | ± 1 600 mg | ± 5 000 mg | ± 16 g     | ± 50 g     |
| 200 kg             | -   | ± 300 mg   | ± 1 000 mg | ± 3 000 mg | ± 10 g     | ± 30 g     | ± 100 g    |
| 500 kg             | -   | ± 800 mg   | ± 2 500 mg | ± 8 000 mg | ± 25 g     | ± 80 g     | ± 250 g    |
| 1 000 kg           | -   | ± 1 600 mg | ± 5 000 mg | ± 16 g     | ± 50 g     | ± 160 g    | ± 500 g    |
| 2 000 kg           | -   | -          | ± 10 g     | ± 30 g     | ± 100 g    | ± 300 g    | ± 1 000 g  |
| 5 000 kg           | -   | -          | ± 25 g     | ± 80 g     | ± 250 g    | ± 800 g    | ± 2 500 g  |

Composition table, valid for all KERN weight sets from 1 mg

| Individual weights per set → | <div>1 2 2 5 10 20 20 50 100 200 200 500</div> <div></div> |  |  |  |  |  |  |  |  |  |  |  |             |  |  |  |  |  |  |  |  |  |  |
|------------------------------|--|--|--|--|--|--|--|--|--|--|--|--|-------------|--|--|--|--|--|--|--|--|--|--|
| Weight set ↓                 | <div>mg mg mg mg mg mg mg mg mg mg mg mg g g g g g g g g g g kg kg kg kg kg</div>  |  |  |  |  |  |  |  |  |  |  |  |             |  |  |  |  |  |  |  |  |  |  |
| 1 mg – 500 mg                | Total weight   |  |  |  |  |  |  |  |  |  |  |  | 1,11 g      |  |  |  |  |  |  |  |  |  |  |
| 1 mg – 50 g                  |  |  |  |  |  |  |  |  |  |  |  |  | 111,11 g    |  |  |  |  |  |  |  |  |  |  |
| 1 mg – 100 g                 |  |  |  |  |  |  |  |  |  |  |  |  | 211,11 g    |  |  |  |  |  |  |  |  |  |  |
| 1 mg – 200 g                 |  |  |  |  |  |  |  |  |  |  |  |  | 611,11 g    |  |  |  |  |  |  |  |  |  |  |
| 1 mg – 500 g                 |  |  |  |  |  |  |  |  |  |  |  |  | 1.111,11 g  |  |  |  |  |  |  |  |  |  |  |
| 1 mg – 1 kg                  |  |  |  |  |  |  |  |  |  |  |  |  | 2.111,11 g  |  |  |  |  |  |  |  |  |  |  |
| 1 mg – 2 kg                  |  |  |  |  |  |  |  |  |  |  |  |  | 6.111,11 g  |  |  |  |  |  |  |  |  |  |  |
| 1 mg – 5 kg                  |  |  |  |  |  |  |  |  |  |  |  |  | 11.111,11 g |  |  |  |  |  |  |  |  |  |  |
| 1 mg – 10 kg                 |  |  |  |  |  |  |  |  |  |  |  |  | 21.111,11 g |  |  |  |  |  |  |  |  |  |  |

Test weights class E2

Class E2 **Weight sets, compact shape, polished stainless steel**

Test weight material: Polished stainless steel  
Case material: Lined plastic



| Weight set |             | + | DAkkS certificate |  | =    |
|------------|-------------|---|-------------------|--|------|
| KERN       |             |   | KERN              |  | KERN |
| 312-024    | 1 g – 50 g  |   | 962-315           |  |      |
| 312-034    | 1 g – 100 g |   | 962-316           |  |      |
| 312-044    | 1 g – 200 g |   | 962-317           |  |      |
| 312-054    | 1 g – 500 g |   | 962-318           |  |      |
| 312-064    | 1 g – 1 kg  |   | 962-319           |  |      |
| 312-074    | 1 g – 2 kg  |   | 962-320           |  |      |
| 312-084    | 1 g – 5 kg  |   | 962-321           |  |      |

Class E2 **Weight sets, cylindrical shape, polished stainless steel**

Test weight material: Individual weights, polished stainless steel, milligram weights aluminium / German silver  
Case material: Lined plastic. Milligram weights 1 mg – 500 mg in removable plastic box



| Weight set |               | + | DAkkS certificate |  | =    |
|------------|---------------|---|-------------------|--|------|
| KERN       |               |   | KERN              |  | KERN |
| 318-22     | 1 mg – 500 mg |   | 962-350           |  |      |
| 313-024    | 1 mg – 50 g   |   | 962-301           |  |      |
| 313-034    | 1 mg – 100 g  |   | 962-302           |  |      |
| 313-044    | 1 mg – 200 g  |   | 962-303           |  |      |
| 313-054    | 1 mg – 500 g  |   | 962-304           |  |      |
| 313-064    | 1 mg – 1 kg   |   | 962-305           |  |      |
| 313-074    | 1 mg – 2 kg   |   | 962-306           |  |      |
| 313-084    | 1 mg – 5 kg   |   | 962-307           |  |      |
| 314-024    | 1 g – 50 g    |   | 962-315           |  |      |
| 314-034    | 1 g – 100 g   |   | 962-316           |  |      |
| 314-044    | 1 g – 200 g   |   | 962-317           |  |      |
| 314-054    | 1 g – 500 g   |   | 962-318           |  |      |
| 314-064    | 1 g – 1 kg    |   | 962-319           |  |      |
| 314-074    | 1 g – 2 kg    |   | 962-320           |  |      |
| 314-084    | 1 g – 5 kg    |   | 962-321           |  |      |

Class E2 **Weight sets, cylindrical shape, polished stainless steel**

Test weight material: Individual weights, polished stainless steel, milligram weights aluminium / German silver  
Case material: Lined wood. Milligram weights 1 mg – 500 mg in removable plastic box



| Weight set |               | + | DAkkS certificate |  | =    |
|------------|---------------|---|-------------------|--|------|
| KERN       |               |   | KERN              |  | KERN |
| 318-22     | 1 mg – 500 mg |   | 962-350           |  |      |
| 313-02     | 1 mg – 50 g   |   | 962-301           |  |      |
| 313-03     | 1 mg – 100 g  |   | 962-302           |  |      |
| 313-04     | 1 mg – 200 g  |   | 962-303           |  |      |
| 313-05     | 1 mg – 500 g  |   | 962-304           |  |      |
| 313-06     | 1 mg – 1 kg   |   | 962-305           |  |      |
| 313-07     | 1 mg – 2 kg   |   | 962-306           |  |      |
| 313-08     | 1 mg – 5 kg   |   | 962-307           |  |      |
| 313-09     | 1 mg – 10 kg  |   | 962-308           |  |      |
| 314-02     | 1 g – 50 g    |   | 962-315           |  |      |
| 314-03     | 1 g – 100 g   |   | 962-316           |  |      |
| 314-04     | 1 g – 200 g   |   | 962-317           |  |      |
| 314-05     | 1 g – 500 g   |   | 962-318           |  |      |
| 314-06     | 1 g – 1 kg    |   | 962-319           |  |      |
| 314-07     | 1 g – 2 kg    |   | 962-320           |  |      |
| 314-08     | 1 g – 5 kg    |   | 962-321           |  |      |
| 314-09     | 1 g – 10 kg   |   | 962-322           |  |      |

Test weights accessories

Cases / boxes for individual weight sets

**Individual weight sets:**  
You can create your own “tailor-made” individual weight sets yourself. KERN will customise your own personal wooden box / plastic carrying case. The largest individual weight which will fit is given in the table.

**Sample order:**  
Your individual weight set:  
1 x 50 g, 2 x 100 g, 1 x 500 g, 2 x 1 kg, 1 x 2 kg.

The correct individual box is **KERN-Nr. 313-080-400** (plastic) or **KERN-Nr. 315-070-100** (wood).



| <b>Plastic case</b><br>for individual weight sets classes E2 – M3,<br>not appropriate for cast iron weights |                         |  |
|---|-------------------------|--|
| KERN  | Largest possible weight |  |
| 313-050-400   | ≤ 500 g                 |  |
| 313-080-400   | ≤ 5 kg                  |  |



| <b>Wooden box</b><br>for individual weight set classes F2 – M3 |                         |  |
|--|-------------------------|--|
| KERN   | Largest possible weight |  |
| 335-040-200  | ≤ 200 g                 |  |
| 335-050-200  | ≤ 500 g                 |  |
| 335-060-200  | ≤ 1 kg                  |  |
| 335-070-200  | ≤ 2 kg                  |  |
| 335-080-200  | ≤ 5 kg                  |  |
| 335-090-200  | ≤ 10 kg                 |  |



| <b>Wooden box</b><br>for individual weight sets classes E1 – F1 |                         |  |
|---|-------------------------|--|
| KERN  | Largest possible weight |  |
| 315-040-100   | ≤ 200 g                 |  |
| 315-060-100   | ≤ 1 kg                  |  |
| 315-070-100   | ≤ 2 kg                  |  |
| 315-080-100   | ≤ 5 kg                  |  |
| 315-090-100   | ≤ 10 kg                 |  |

Plastic carrying case for standard weight sets



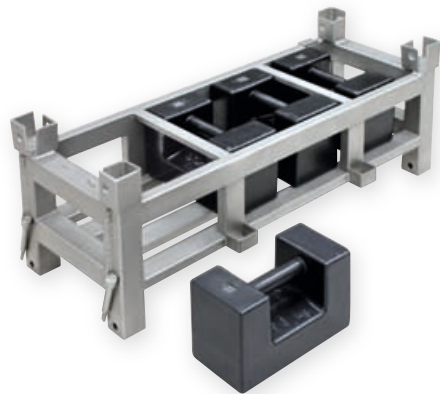
| <b>Plastic case for weight sets</b><br>with standard denomination classes E2 – M3,<br>not appropriate for cast iron weights |                         |  |
|---|-------------------------|--|
| KERN  | Largest possible weight |  |
| 313-052-400   | ≤ 500 g                 |  |
| 313-082-400   | ≤ 5 kg                  |  |

**Aluminium case**  
for safe storage and transportation under harsh industrial conditions.



| <b>Aluminium case</b><br>for weight sets with standard denomination<br>classes E1, E2 |                         |  |
|---|-------------------------|--|
| KERN  | Largest possible weight |  |
| 313-042-600   | ≤ 200 g                 |  |
| 313-062-600   | ≤ 1 kg                  |  |
| 313-082-600   | ≤ 5 kg                  |  |
| 313-090-600   | ≤ 10 kg                 |  |

Weight carriers for block weights or other test weights



Individual weight carriers for testing high capacity floor scales, pallet scales, pallet truck scales, crane scales, etc. This can also be used for storing the weights.  
This means the weight container and the weights can be placed on the scale in one go, saving time and money.

The weight container can be calibrated to OIML accuracy classes M1 – M3.

On request, KERN will make you a “tailor-made” weight carrier to your specifications.





**Wolflabs**

# Wolf Laboratories Limited

[www.wolflabs.co.uk](http://www.wolflabs.co.uk)

Tel: 01759 301142

Fax: 01759 301143

[sales@wolflabs.co.uk](mailto:sales@wolflabs.co.uk)



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The specifications listed in this brochure are subject to change by the manufacturer and therefore cannot be guaranteed to be correct. If there are aspects of the specification that must be guaranteed, please provide these to our sales team so that details can be confirmed.

