15 Test weights

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. For further information, see the glossary on page 151.

Testing, doing it right!

The internationally valid OIML Directive R111-2004 classifies test weights hierarchically into 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 to ISO 9000ff if it has the relevant proof of accuracy, all KERN test weights come with an appropriate DKD calibration certificate (optional). For further details, see the DKD calibration service section on page 147.

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

Selection of the appropriate test weight for your balance:

Correctly selected test weights with DKD 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 depends on its tolerance.

Accuracy of the test weight: Should correspond to the readout **d** of the balance, rather than something better.

Nominal weight value: This is shown in adjust mode „CAL" in the balance display. Given the 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 129.

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, stand in accuracy class **F1. KERN-No 327-72**, see page 134.

Exception, analytical balances (readout **d** ≤ 0,1 mg):
E1 test weights are recommended. Depending on the safety requirements, E2 test weights with a DKD calibration certificate will also be sufficient.

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

Test weight → / Features ↓	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 nickel-plated 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	yes	yes
Verification possible	yes	yes	yes	no	yes, from 20 g	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	• High-quality test weight for analytical and precision balances • Highly-refined upper surface • Optimum shape of the top for good grip	• Affordable test weight for analytical and precision balances • Highly-refined upper surface • Affordable price	• Optimum, high-quality test weight for precision balances • Optimum shape of the top for good grip	• Affordable test weight for in-house checking of precision balances • Very affordable price	• Optimum test weight for commercial and industrial scales • Optimum shape of the top for good grip	• Affordable test weight for commercial and industrial scales • Optimum shape of the top for good grip

OIML Directive R111-2004 for weights

The key points from the OIML Directive 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 DKD 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.

Nominal value ↓	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

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