

International Laboratory Weights & Precision Mass Standards Weight Classification

Excerpts from the Standard Specification for Laboratory Weights and Precision Mass Standards as Regulated by the Organization Internationale De Metrologie Legale (OIML): 1994 Edition (E) Publication OIML R 111



This specification covers various classes of weights and mass standards used in laboratories, and weights used for field standards and commercial measurement.

OIML Weight Classification and Selection

OIML is a worldwide, intergovernmental organization whose primary aim is to harmonize the regulations and metrological controls applied by national metrological services, or related organizations of member states.

The two main categories of OIML publications are:

- International Recommendations (OIML R), which are model regulations that establish the metrological characteristics required of certain measuring instruments and which specify methods and equipment for checking their conformity; the OIML Member States shall implement these Recommendations to the greatest possible extent.
- International Documents (OIML D), which are informative in nature and intended to improve the work of metrological services.

International Recommendations and International Documents are published in French (F) and English (E), and are subject to revision.

OIML publications may be obtained from the Organization's headquarters:

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General Information on Weight Classes: E1, E2, F1, F2, M1, M2

This Recommendation contains the principle physical characteristics and metrological requirements for weights which are used:

- For the verification of weighing instruments,
- For the verification of weights of a lower class of accuracy.

The nominal values of mass of the weights covered by this Recommendation range from 1 milligram (mg) to 50 kilograms (kg).

This recommendation applies to weights in classes of accuracy as follows: E1, E2, F1, F2, M1, M2 and M3.

Weights used for the verification of weighing instruments

The classes of accuracy of the weights used for the verification of weighing instruments shall be specified in the appropriate International Recommendations relating to these instruments.

Weights used for the verification of weights of a lower class of accuracy

- E1 Weights intended to ensure traceability (see OIML R 33, paragraph A.3) between national mass standards (with values derived from the International Prototype of the kilogram) and weights of class E2 and lower. Class E1 weights or sets of weights shall always be accompanied by a calibration certificate.
- E2 Weights intended to be used for the initial verification of weights of class F1. They may be used as class E1 weights if they comply with the requirements for surface roughness and magnetic susceptibility of class E1 weights and if their calibration certificate gives the appropriate data.
- F1 Weights intended to be used for the initial verification of weights of class F2.
- F2 Weights intended to be used for the initial verification of weights of class M1 and possibly M2.
M1 weights intended to be used for the initial verification of weights of class M2.
- F1, F2 Weights used with instruments of accuracy class I.
- F2 Weights intended to be used for important commercial transactions (e.g. gold and precious stones) on weighing instruments of accuracy class II.
- M1 Weights intended to be used with weighing instruments of accuracy class II.
- M2 Weights intended to be used in normal commercial transactions and on weighing instruments of accuracy class III.
- M3 Weights intended to be used on weighing instruments of accuracy classes III and IIII.

The accuracy of weights used with weighing instruments shall be chosen in accordance with the requirements of OIML R 76 "Nonautomatic weighing instruments."

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Construction

Class E1 and E2 Weights

Class E1 and E2 weights shall be solid and have no cavity open to the atmosphere. They shall have an integral construction, i.e., consist of a single piece of material.

Class F1 and F2 Weights

Class F1 and F2 weights from 1g to 50 kg may be one or more pieces from the same material. Class F1 and F2 weights may contain an adjusting cavity; however, the volume of this cavity shall not exceed one-fifth of the total volume of the weight, and the cavity shall be closed either by means of the lifting knob or by any other suitable device.

Calibration or Initial Verification

Certain categories of new weights may either be calibrated individually or be subject to initial verification, depending on their intended use and the national legislation of the country.

Calibration weights shall be accompanied by a certificate which gives at least the conventional mass of each weight, its expanded uncertainty and the value of the coverage factor k (see coverage factor k).

Class E1 weights shall always be accompanied by certificates.

The certificate for class E1 weights shall mention at least the values of conventional mass, the expanded uncertainty and the coverage factor k , and the density or volume for each weight.

The optional certificate for class E2 weights shall mention at least:

- The values of conventional mass of each weight and the extended uncertainty and the coverage factor k , or
- The information required for class E1 weights certificates (under the conditions of the above paragraph).

Recalibration or Periodic Verification

The categories of weights which are subject to calibration or initial verification should either be recalibrated or have a periodic verification. This makes it possible to verify that the weights maintain their metrological properties. Any weights found defective at the time of the periodic verification shall be discarded or readjusted.

Uncertainty of Measurement

Standard uncertainty

Uncertainty of the result of a measurement expressed as an estimated standard deviation.

Combined standard uncertainty

Standard uncertainty of a measurement result. When that result is obtained from the values of a number of quantities, it is equal to the positive square root of the appropriate sum of the variances and covariances of these quantities. The variance of quantity is the square of its standard deviation.

Expanded uncertainty

The expanded uncertainty U is obtained by multiplying the combined standard uncertainty by the coverage factor k .
 $U = k \cdot u_c$

Coverage factor k — level of confidence

In most cases, it is appropriate to use the factor $k = 2$.

For the normal distribution, the factor $k = 2$ signifies that the limits of expanded uncertainty apply when the confidence level is approximately 95%.

Uncertainties for Weights

$u_2 = \sqrt{u_A^2 + u_B^2}$ with u_A, u_B : standard uncertainties of category A and B, respectively.