

Weight Classification, U.S. Laboratory Weights & Precision Mass Standards



Weight Classification and Selection

Selection of type and class depends upon the application of the weights. For primary standards, stability and information about the values of the weights is more important than the closeness of the values to nominal. Weights to be used with balances of low precision do not require small tolerances nor need the choice of materials to be limited to those of high stability. The suggested application table should serve as a guide in selecting weights for specific applications.

Type

Weights are divided into two types based upon the design:

Type I

These weights are of one-piece construction and contain no added adjusting material. They should be specified when weights are to be used as standards of the highest order and where maximum stability is required. A precise measurement of density can be made only for one-piece weights.

Type II

Weights of this type can be of any appropriate design such as screw knob, ring, or sealed plug. Adjusting material can be used as long as it is of a material at least as stable as the base material and is contained in such a way that it will not become separated from the weight.

Physical Characteristics

Class 0 must be Type I, one-piece construction, and classes 1–7 can be either Type I or II depending on the application. All weights must meet other design requirements for density, hardness, permitted surface area, surface finish, magnetic properties, corrosion resistance, surface protection and markings. Class selection depends upon the degree of stability required. Density limitations are important in minimizing the effects of air buoyancy in high precision measurements. Class 0 weights shall not bear any indication of nominal value.

Class

Tolerance limitations are described in Classes 0, 1, 2, 3, 4, 5, 6 and 7 as shown in the weight tolerance tables. Classes with small numerical designations represent smaller tolerances. Classes 0, 1 and 2 are used primarily in metric but are also available in avoirdupois denominations. Classes 3, 4, 5, 6 and 7 include tolerances for metric, avoirdupois pound, avoirdupois ounce, troy ounce, pennyweight, and grain weights. Class 1 through 7 tolerances are comparable to those in the obsolete NIST Circular 547, Section 1, with the following exception: Class 1 replaces the smaller tolerances of Classes M and S, while Class 2 replaces the larger tolerances of Classes M and S.



Excerpts from the Standard Specification for Laboratory Weights and Precision Mass Standards: ASTM E 617-97

This specification covers various classes of weights and mass standards used in laboratories, and weights used for field standards and commercial measurement are excluded, as NIST Handbook 105-1 and NIST Handbook 44 cover those classes of weights.

Weight Classification, U.S. Laboratory Weights & Precision Mass Standards (continued)



Application Table

Class	Type	Application
0	I	Primary Laboratory Reference Standards
0	I	Reference standards used for calibrating Class 1 weights
0	I	Reference standards used for calibrating Class 2 weights
1	I	Reference standards used for calibrating Class 3 weights
1	II	Calibration weights used with calibration Class I balances
1	I or II	Built in weights for high quality analytical balances
1,2	I or II	Calibration weights used with calibration Class II balances, laboratory weights for routine analytical work
2	I or II	Standards used for calibrating Class 4 weights
3	I or II	Standards used for calibrating Class 5 weights
4	I or II	Standards used for calibrating Class 6 weights
4,5,6	I or II	Student laboratory use
5,6	I or II	Student laboratory use
7	I or II	Rough weighing operations in physical and chemical laboratories such as force measuring apparatus

Term Abbreviations

Name of Unit	Accepted Abbreviation	Conversion Factor (g/unit of measure)
Assay Ton	AT	29.1667 g
Carat	c	0.2 g
Dram, apothecaries'	dr ap	3.8879346 g
Grain, Troy	GN	0.06479891 g
Gram	g	1 g
Kilogram	kg	1000 g
Milligram	mg	0.001 g
Ounce, apothecaries (480 grains)	oz ap	31.1034768 g
Ounce, avoirdupois (437.5 grains)	oz	28.349523125 g
Ounce, troy (480 grains)	oz t	31.1034768 g
Pennyweight	dwt	1.55517384 g
Pound avoirdupois	lb	453.59237 g
Scruple, apothecaries'	s ap	1.2959782 g

To place an order call **800-472-6703** or visit **ricelake.com/precision**

Metric Weight Tolerances



INTERNATIONAL ORGANIZATION OF LEGAL METROLOGY RECOMMENDATIONS OIML R111

Tolerance for weights of denominations between those listed can be determined as follows:

- If the unit of measure is non-metric, convert the nominal value to a metric unit.
- For weights that are between those listed, the tolerance for the next lower weight shall be applied.

OIML R111-I 2004

Class	E1	E2	F1	F2	M1	M2	M3
Nominal Size	mg	mg	mg	mg	mg	mg	mg
5000 kg			25,000	80,000	250,000	800,000	2,500,000
3000 kg							
2000 kg			10,000	30,000	100,000	300,000	1,000,000
1000 kg		1,600	5,000	16,000	50,000	100,000	500,000
500 kg		800	2,500	8,000	25,000	80,000	250,000
300 kg							
200 kg		300	1,000	3,000	10,000	30,000	100,000
100 kg		160	500	1,600	5,000	16,000	50,000
50 kg	25	80	250	800	2500	8000	25,000
30 kg							
25 kg							
20 kg	10	30	100	300	1000	3000	10,000
10 kg	5	16	50	160	500	1600	5000
5 kg	2.5	8.0	25	80	250	800	2500
3 kg							
2 kg	1.0	3.0	10	30	100	300	1000
1 kg	0.5	1.6	5	16	50	160	500
500 g	0.25	0.8	2.5	8.0	25	80	250
300 g							
200 g	0.1	0.30	1.0	3.0	10	30	100
100 g	0.05	0.16	0.5	1.6	5	16	50
50 g	0.03	0.10	0.30	1.0	3.0	10	30
30 g							
20 g	0.025	0.080	0.25	0.8	2.5	8	25
10 g	0.020	0.060	0.20	0.6	2.0	6	20
5 g	0.016	0.050	0.16	0.5	1.6	5	16
3 g							
2 g	0.012	0.040	0.12	0.4	1.2	4	12
1 g	0.010	0.030	0.10	0.3	1.0	3	10
500 mg	0.008	0.025	0.08	0.25	0.8	2.5	
300 mg							
200 mg	0.006	0.020	0.06	0.20	0.6	2	
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		
30 mg							
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		
3 mg							
2 mg	0.003	0.006	0.020	0.06	0.20		
1 mg	0.003	0.006	0.020	0.06	0.20		

ASTM

0	1	2	3	4	5	6	7
mg	mg	mg	mg	g & mg	g & mg	g & mg	g & mg
				100 g	250 g	500 g	750 g
				60 g	150 g	300 g	450 g
				40 g	100 g	200 g	300 g
				20 g	50 g	100 g	150 g
				10 g	25 g	50 g	75 g
				6.0 g	15 g	30 g	45 g
				4.0 g	10 g	20 g	30 g
				2.0 g	5 g	10 g	15 g
63	125	250	500	1.0 g	2.5 g	5 g	7.5 g
38	75	150	300	600 mg	1.5 g	3 g	4.5 g
31	62	125	250	500 mg	1.2 g	2.5 g	4.5 g
25	50	100	200	400 mg	1.0 g	2	3.8 g
13	25	50	100	200 mg	500 mg	1	2.2 g
6	12	25	50	100 mg	250 mg	500 mg	1.4 g
3.8	7.5	15	30	60 mg	150 mg	300 mg	1.0 g
2.5	5.0	10	20	40 mg	100 mg	200 mg	750 mg
1.3	2.5	5.0	10	20 mg	50 mg	100 mg	470 mg
0.60	1.2	2.5	5.0	10 mg	30 mg	50 mg	300 mg
0.38	0.75	1.5	3.0	6.0 mg	20 mg	30 mg	210 mg
0.25	0.50	1.0	2.0	4.0 mg	15 mg	20 mg	160 mg
0.13	0.25	0.50	1.0	2.0 mg	9 mg	10 mg	100 mg
0.060	0.12	0.25	0.60	1.2 mg	5.6 mg	7 mg	
0.037	0.074	0.15	0.45	0.90 mg	4.0 mg	5 mg	44 mg
0.037	0.074	0.10	0.35	0.7 mg	3.0 mg	3 mg	33 mg
0.025	0.050	0.074	0.25	0.5 mg	2.0 mg	2 mg	21 mg
0.017	0.034	0.054	0.18	0.36 mg	1.3 mg	2 mg	13 mg
0.017	0.034	0.054	0.15	0.30 mg	0.95 mg	2 mg	9.4 mg
0.017	0.034	0.054	0.13	0.26 mg	0.75 mg	2 mg	7.0 mg
0.017	0.034	0.054	0.10	0.20 mg	0.50 mg	2 mg	4.5 mg
0.005	0.010	0.025	0.080	0.16 mg	0.38 mg	1 mg	3.0 mg
0.005	0.010	0.025	0.070	0.14 mg	0.30 mg	1 mg	2.2 mg
0.005	0.010	0.025	0.060	0.12 mg	0.26 mg	1 mg	1.8 mg
0.005	0.010	0.025	0.050	0.10 mg	0.20 mg	1 mg	1.2 mg
0.005	0.010	0.014	0.042	0.085 mg	0.16 mg	0.5 mg	0.88 mg
0.005	0.010	0.014	0.038	0.075 mg	0.14 mg	0.5 mg	0.68 mg
0.005	0.010	0.014	0.035	0.070 mg	0.12 mg	0.5 mg	0.56 mg
0.005	0.010	0.014	0.030	0.060 mg	0.10 mg	0.5 mg	0.4 mg
0.005	0.010	0.014	0.028	0.055 mg	0.080 mg	0.2 mg	
0.005	0.010	0.014	0.026	0.052 mg	0.070 mg	0.2 mg	
0.005	0.010	0.014	0.025	0.050 mg	0.06 mg	0.2 mg	
0.005	0.010	0.014	0.025	0.050 mg	0.05 mg	0.1 mg	

*Reprinted, with permission from the Annual Book of ASTM Standards, Copyright American Society for Testing and Materials, 100 Barr Harbor Drive, West Conshohocken, PA 19428. Reprinted OIML R111-I:2004(E)