



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



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



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

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 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.



Reference



Metric Weight Tolerances

ASTM E 617*



INTERNATIONAL ORGANIZATION OF LEGAL METEOROLOGY RECOMMENDATIONS OIML R111

Denomination Metric	E1 mg	E2 mg	F1 mg	F2 mg	M1 mg	M2 mg	M3 mg	0 mg	1 mg	2 mg	3 mg	4 g & mg	5 g & mg	6 g & mg	7 g & mg
5000 kg												100 g	250 g		750 g
3000 kg												60 g	150 g		450 g
2000 kg												40 g	100 g		300 g
1000 kg												20 g	50 g		150 g
500 kg												10 g	25 g	50 g	75 g
300 kg												6.0 g	15 g	30	45 g
200 kg												4.0 g	10 g	20	30 g
100 kg												2.0 g	5 g	10	15 g
50 kg	25	60	250	600	2500	6000	25,000	63	125	250	500	1.0 g	2.5 g	5	7.5 g
30 kg								38	75	150	300	600 mg	1.5 g	3	4.5 g
25 kg								31	62	125	250	500 mg	1.2 g		4.5 g
20 kg	10	30	100	300	1000	3000	10,000	25	50	100	200	400 mg	1.0 g	2	3.8 g
10 kg	5	16	50	160	500	1600	5000	13	25	50	100	200 mg	500 mg	1	2.2 g
5 kg	2.5	6.0	25	60	250	600	2500	8	12	25	50	100 mg	250 mg	500 mg	1.4 g
3 kg								3.8	7.5	15	30	60 mg	150 mg	300 mg	1.0 g
2 kg	1.0	3.0	10	30	100	300	1000	2.5	5.0	10	20	40 mg	100 mg	200 mg	750 mg
1 kg	0.5	1.6	5	16	50	160	500	1.3	2.5	5.0	10	20 mg	50 mg	100 mg	470 mg
500 g	0.25	0.8	2.5	6.0	25	60	250	0.60	1.2	2.5	5.0	10 mg	30 mg	50 mg	300 mg
300 g								0.38	0.75	1.5	3.0	6.0 mg	20 mg	30 mg	210 mg
200 g	0.1	0.30	1.0	3.0	10	30	100	0.25	0.50	1.0	2.0	4.0 mg	15 mg	20 mg	160 mg
100 g	0.05	0.16	0.5	1.6	5	16	50	0.13	0.25	0.50	1.0	2.0 mg	9 mg	10 mg	100 mg
50 g	0.03	0.10	0.30	1.0	3.0	10	30	0.060	0.12	0.25	0.60	1.2 mg	5.8 mg	7 mg	
30 g								0.037	0.074	0.15	0.45	0.90 mg	4.0 mg	5 mg	44 mg
20 g	0.025	0.080	0.25	0.8	2.5	8	25	0.037	0.074	0.10	0.36	0.7 mg	3.0 mg	3 mg	33 mg
10 g	0.020	0.060	0.20	0.6	2.0	6	20	0.025	0.050	0.074	0.25	0.5 mg	2.0 mg	2 mg	21 mg
5 g	0.015	0.050	0.15	0.5	1.5	5	15	0.017	0.034	0.054	0.18	0.36 mg	1.3 mg	2 mg	13 mg
3 g								0.017	0.034	0.054	0.15	0.30 mg	0.95 mg	2 mg	9.4 mg
2 g	0.012	0.040	0.12	0.4	1.2	4	12	0.017	0.034	0.054	0.13	0.26 mg	0.75 mg	2 mg	7.0 mg
1 g	0.010	0.030	0.10	0.3	1.0	3	10	0.017	0.034	0.054	0.10	0.20 mg	0.50 mg	2 mg	4.5 mg
500 mg	0.008	0.025	0.08	0.25	0.8	2.5		0.006	0.010	0.025	0.060	0.16 mg	0.38 mg	1 mg	3.0 mg
300 mg								0.006	0.010	0.025	0.070	0.14 mg	0.30 mg	1 mg	2.2 mg
200 mg	0.006	0.020	0.06	0.20	0.6	2		0.006	0.010	0.025	0.060	0.12 mg	0.26 mg	1 mg	1.8 mg
100 mg	0.005	0.016	0.05	0.16	0.5	1.6		0.006	0.010	0.025	0.060	0.10 mg	0.20 mg	1 mg	1.2 mg
50 mg	0.004	0.012	0.04	0.12	0.4			0.006	0.010	0.014	0.042	0.085 mg	0.16 mg		0.68 mg
30 mg								0.006	0.010	0.014	0.038	0.075 mg	0.14 mg		0.68 mg
20 mg	0.003	0.010	0.03	0.10	0.3			0.006	0.010	0.014	0.035	0.070 mg	0.12 mg		0.58 mg
10 mg	0.002	0.008	0.025	0.08	0.25			0.006	0.010	0.014	0.030	0.060 mg	0.10 mg		0.4 mg
5 mg	0.002	0.006	0.020	0.06	0.20			0.006	0.010	0.014	0.028	0.055 mg	0.090 mg		
3 mg								0.006	0.010	0.014	0.026	0.052 mg	0.070 mg		
2 mg	0.002	0.006	0.020	0.06	0.20			0.006	0.010	0.014	0.025	0.050 mg	0.08 mg		
1 mg		0.006	0.020	0.06	0.20			0.006	0.010	0.014	0.025	0.050 mg	0.05 mg		

Reference

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.

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Avoirdupois Tolerance Conversion

Nominal Size	Class 1	Class 2	Class 3	Class 4	Class 5	Class 6	Class 7
lb	mg	mg	mg	mg	mg	mg	mg
0.00001	0.010	0.014	0.026	0.052	0.080	0.200	
0.00002	0.010	0.014	0.028	0.055	0.080	0.200	
0.00003	0.010	0.014	0.030	0.060	0.100	0.500	0.400
0.00005	0.010	0.014	0.035	0.070	0.120	0.500	0.580
0.00010	0.010	0.014	0.038	0.075	0.140	0.500	0.680
0.00020	0.010	0.014	0.042	0.085	0.160	0.500	0.880
0.00030	0.010	0.025	0.050	0.100	0.200	1.000	1.200
0.00050	0.010	0.025	0.080	0.120	0.260	1.000	1.800
0.001	0.010	0.025	0.070	0.140	0.0900	1.000	2.200
0.002	0.010	0.025	0.080	0.160	0.380	1.000	3.000
0.003	0.034	0.054	0.100	0.200	0.500	2.000	4.500
0.005	0.034	0.054	0.130	0.260	0.750	2.000	7.000
0.010	0.034	0.054	0.150	0.300	0.950	2.000	9.400
0.020	0.034	0.054	0.180	0.360	1.300	2.000	13.000
0.030	0.050	0.074	0.250	0.500	2.000	2.000	21.000
0.050	0.074	0.100	0.350	0.700	3.000	3.000	33.000
0.100	0.074	0.150	0.450	0.900	4.000	5.000	44.000
0.200	0.120	0.250	0.600	1.200	5.600	7.000	44.000
0.300	0.250	0.500	1.000	2.000	9.000	10.000	100.000
0.5	0.500	1.000	2.000	4.000	15.000	20.000	160.00
1.0	0.750	1.500	3.000	6.000	20.000	30.000	210.000
2.0	1.200	2.500	5.000	10.000	30.000	50.000	300.000
3.0	2.500	5.000	10.000	20.000	50.000	100.000	470.000
4.0	2.500	5.000	10.000	20.000	50.000	100.000	470.000
5.0	5.000	10.000	20.000	40.000	100.000	200.000	750.000
10.0	7.500	15.000	30.000	60.000	150.000	300.000	1000.000
20.0	12.000	25.000	50.000	100.000	250.000	500.000	1400.000
30.0	25.000	50.000	100.000	200.000	500.000	1000.000	2200.000
50.0	50.000	100.000	200.000	400.000	1000.000	2000.000	3800.000
100.0	75.000	150.000	300.000	600.000	1500.000	3000.000	4500.000
200.0	125.000	250.000	500.000	1000.000	2500.000	5000.000	7500.000
250.0				2000.000	5000.000	10000.000	15000.000
500.0				4000.000	10000.000	20000.000	30000.000
1000.0				8000.000	15000.000	30000.000	45000.000
1250.0				10000.000	25000.000	50000.000	75000.000
1500.0				10000.000	25000.000	50000.000	75000.000
2000.0				10000.000	25000.000	50000.000	75000.000
2500.0				20000.000	50000.000	100000.000	150000.000
oz							
1/32	0.010	0.025	0.080	0.160	0.380	1.000	3.000
1/16	0.034	0.054	0.100	0.200	0.500	2.000	4.500
1/8	0.034	0.054	0.150	0.300	0.950	2.000	9.400
1/4	0.034	0.054	0.180	0.360	1.300	2.000	13.000
1/2	0.050	0.074	0.250	0.500	2.000	2.000	21.000
1	0.074	0.100	0.350	0.700	3.000	3.000	33.000
2	0.20	0.250	0.600	1.200	5.600	7.000	44.000
4	0.250	0.500	1.000	2.000	9.000	10.000	100.000

Reference