

Commonly Asked Questions About Mass Standards

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Introduction

The National Institute of Standards and Technology, Weights and Measures Division is asked numerous questions throughout the year regarding mass standards, specifications for mass standards, mass manufacturers, calibration intervals, availability of documents and publications, and sources of calibration. This paper summarizes the answers to many commonly asked questions.

Weight Classifications

There are three sources of weight classifications used in the United States. The most common are:

- NIST Class F;
- ASTM E 617-97, Classes 0 through 7; and
- OIML R111, classes: E1, E2, F1, F2, M1, M2, M3.

Please note: OIML F1 and F2 are NOT comparable to NIST Class F. The table comparing these standards shows the general correlation between the classifications and their typical usage. There is not yet a direct relationship between classifications in these specifications and the specifications have changed over time.

Class F. NIST Handbook 105-1 contains the specifications and tolerances for field standards used primarily in weights and measures and commercial applications (e.g., for testing scales when products are bought or sold over them). The standard is NOT designed to be an industry standard, although a number of industries use the specifications and tolerances for their applications.

ASTM E 617-97. The Federal government is required to use industry standards whenever available and wherever appropriate. It is for this reason that Circular 547, which contained specifications and tolerances for Classes M, S, S-1, P, etc, was not updated but was superseded in 1978 by ASTM E 617. A number of rather old requirements specify NBS Class S or Class S-1 weights. These should all be replaced by ASTM Class 1 or 2. The U.S. Pharmacopeia has changed its recommendations for pharmaceutical applications, but Federal agencies may not have changed their recommendations or regulations regarding weights. The latest revision of E 617-97 was a move toward harmonization with the OIML R111 which is currently undergoing revision. ASTM also has three standards that may be used for testing balances/scales for noncommercial applications: E 319, E 898, E 1270. All of these ASTM standards are available in Volume 14.02 of the ASTM Annual Standards.

Mass Standard and Test Weight Accuracy Classes

OIML IR consolidation, 1994	ASTM E 617-1997	NBS Circ. 547, 1954 superseded 1978	NIST 105-1, 1990	Typical Use
Extra-fine accuracy.				
E1				primary laboratory reference standards

E2	0			high precision standards for calibration of weights and special precision analytical balances, accuracy classes I and II (class II, depending on precision)
	1	M, S		
Fine accuracy.				
F1	2			high accuracy class II balances
	3	S-1		working standards for precision and analytical work, built-in weights, external weights used to calibrate moderate precision balances
F2				
Medium accuracy.				
	4	P		accuracy class III, industrial scales, dial scales, trip balances, platform scales also used for accuracy class III L and IIII
M1	5	Q		
M2	6	T	F	
M3	7			

Calibration Intervals

Legal requirements. Each State establishes legal requirements for periodic verification of Class F test weights used for commercial applications. In most cases, this is a fixed interval of 1 or 2 years. In some cases, evaluation of historical data has been used to establish other fixed intervals for periodic calibration.

Industry/scientific. There is NO fixed calibration interval for industrial or scientific applications. For these applications, a calibration interval must be established based on: 1) calibration information, tolerances, uncertainties, and applications at time of test; 2) historical data for weight artifacts showing stability (or lack of stability) with time and use; or 3) use of a measurement assurance program where control standards or check standards are used periodically to verify continued accuracy and traceability or the need for calibration. For example, typical calibration intervals for a 100 gram weight set range from 6 months to 5 years (or longer) based on measurement assurance data or historical data from periodic recalibration. For some defense applications, fixed recalibration cycles are established with a 1-year period.

Primary standards. There is no fixed interval for recalibration of primary standards in the State legal metrology laboratories. When extensive measurement assurance programs are in place to evaluate the accuracy and traceability of the standards and measurement process during use, the laboratory may evaluate when its standards must be recalibrated based on data available in the laboratory. This data is annually reviewed by OWM. As a part of each laboratory's measurement assurance program, it is an essential practice to: 1) periodically insert an outside check on the system (such as through a round robin); 2) have primary kilograms recalibrated periodically when

surveillance programs are in place; or 3) maintain a NIST-calibrated control standard that is not used with the same frequency as other working standards or check standards to periodically verify measurement control.

Guidelines. For further assistance in establishing calibration intervals, the National Conference of Standards Laboratories (NCSL) has a Recommended Practice (RP-1) on "Establishment and Adjustment Calibration Intervals" (1996).

Devices. Calibration intervals for balances and scales are typically established in a pattern similar to that for test weights. For example: scales used for commercial applications must be periodically verified as established by State regulations, and balances or scales used for other applications must have verification intervals evaluated based on stability through time and use.

Tolerance Tables. In addition to the specifications (e.g., ASTM E 617, NIST 105-1), which have tolerance tables, most manufacturers have tolerance tables available with detailed information about choosing appropriate weights and verification periods.

Calibration Services

NOTE: NIST does not sell test weights or mass standards, but provides calibration services. You can obtain detailed cost/schedule information for calibration services by contacting the NIST Mass Group:

- Zeina Jabbour 301-975-4468
- Jerry Keller 301-975-4218
- Bill Crupe 301-975-4215

For other NIST calibration services, contact the NIST Calibration Services and request NIST SP 250, which has contacts and phone numbers for all NIST calibration services: 301/975-2092, or by fax at: 301/869-3548, or by e-mail at: calibrations@nist.gov

For information about calibration services at NIST-recognized State legal metrology laboratories, contact OWM or visit our internet site and look under [State Laboratory Program](#).

OWM also offers mass metrology training seminars at basic, intermediate, and advanced levels. You can also get the latest [training information](#) on our internet site.

Precision Mass Manufacturers

NOTE: Publication of this information does not imply NIST endorsement. There are other mass manufacturers who manufacture cast-iron type weights, but the following are the only known U.S. manufacturers making precision mass standards. International manufacturers are also available.

- Denver Instruments 1-800-321-1135
- Rice Lake Weighing Systems 1-800-472-6703
- Henry Troemner LLC 1-888-724-1856