

Weighty Decisions: Guidelines for choosing the right test weights

Routinely calibrating and validating your scales and balances is critical in ensuring that your measurement equipment is giving your accurate and repeatable measurements. Whether you have an internal calibration program, or your quality system requires that you verify your scales on a regular basis, you may find yourself in the position of determining what type of test weights to purchase.

Like many things in metrology, there are a number of factors that will impact your decision, so choosing the right test weights for your application is not always straight forward. We do always recommend talking with one of our measurement experts to ensure you are purchasing exactly what you need for your application. That being said, below are some general guidelines and considerations.

Do note that in several instances we will refer to rules or guidelines specified by Handbook 44. Any scale that is “legal for trade”, meaning that you are buying or selling based on the weight provided by that device, must adhere to these guidelines. While these are considered best practices, if your scale or balance is not considered legal for trade, you may have different guidelines in place depending on your quality system.

Scale Class

The first step in determining the type of test weights that you require is to determine the class of the scale or balance that is to be tested. Scale classes per NIST Handbook 44 are I, II, III, IIIL, and IIII. The scale class is required to be listed on all scale serial plates for scales manufactured after 1988. If you would like more information on the accuracy parameters for each scale class refer to [this table from Handbook 44](#) which outlines the specific parameters for each. If your scale was manufactured before 1988, or is not marked for any other reason, refer to [this table which shows the tolerances for unmarked scales](#).

In general terms, there are broad types of scales that fall into each classification. Class I scales or balances are used for precision laboratory weighing applications. Class II scales include those used for laboratory weighing, grain test scales, as well as those used for precious metal and gem weighing. Class III is significantly broader and includes all commercial weighing not otherwise specified, with a capacity that is less than or equal to 30,000 lbs. Class IIIL includes scales with a capacity greater than 30,000 lbs. such as vehicle scales, axle-load scales, rail scales, and crane scales. Finally, Class IIII scales include wheel-load weighers and axle-load weighers used by highway weight enforcement.

The test weights that you choose will depend both on capacity of your scale as well as the tolerances required for the class in which your or balance scale falls. As mentioned above, you can refer to Handbook 44 for these specific guidelines. However, if your

scale is not legal for trade, those tolerances may be set by the manufacturer's guidelines, or your own internal quality system.

Weight Class

Test weights are classified based on tolerances. There are three classification systems: NIST, ASTM, and OIML. Choosing the correct class of weights will depend on the tolerances required for specific scale class and weighing application.

NIST Class F weights are field standards. These weights meet the compliance requirements of Handbook 44 and are used to calibrate legal for trade scales. Tolerances and other specifications for NIST weights are found in NIST Handbook 105-1.

ASTM test weights range from Class 000 – 7, the tolerances and specifications for these weights are outlined in ASTM E617-13. Classes 000-4 are considered “high class” meaning that they are highly accurate. To handle these weights, one must wear gloves and/or use tweezers to avoid direct skin contact. This is because they are so precise that even the oil from your hands could cause them to be out of tolerance. They are also very sensitive to ambient temperature and humidity. For this reason, they should be allowed to “soak” in the room with the device under test before being used, and generally are not taken out into the field. ASTM Class 5-7 weights are more comparable to NIST Class F weights.

OIML test weight classifications include E1, E2, F1, F2, M1, M2, and M3, with the most accurate being E1, and the least being M3. The specifications for these weights are outlined in OIML R 111-1. These weight classifications are very similar to ASTM. They range from the highly accurate with very tight tolerances to less accurate field standards.

You can refer to tolerance charts from manufacturers such as [Troemner](#) or [Rice Lake](#) for more specific tolerance information about NIST, ASTM, or OIML test weights.

Material

There are a variety of metals used in the production of test weights, but the choices are somewhat limited depending on the class and size of weights you are purchasing. Cast iron is typically used for NIST Class F, ASTM Classes 6 & 7, as well as OIML Classes M1 & M2. Per Handbook 44, cast iron test weights are only acceptable for weights that are 10kg or 20 lbs. and heavier. Typically, cast iron weights are painted gold if they are in metric units or silver if in avoirdupois units.

Weights that are 5 kg/10 lbs. and larger can be iron, steel or stainless steel. Smaller weights of 5 g/.01 lbs. to 5 kg/10 lbs. should be of a material that has a material hardness of Rockwell B80 or greater such as type 300 stainless steel. In all cases, the material should be one that is resistant to wear and corrosion.

Higher class weights ASTM 000-4 and OIML E1, E2, and F1 will be a highly polished metal, typically stainless steel, and should not be directly touched with your hands.

Shape

Just as there are several choices for test weight material, they are also available in multiple shapes depending on the way that you plan to use them. The most common shapes are grip handle, slotted, cylindrical, and leaf.

Grip handle weights are generally made of cast iron and used for calibrating larger capacity scales in the field. They are typically NIST Class F, ASTM Class 6 & 7, or OIML Class M1 & M2. These weights can be placed into calibrated baskets for applications such as tank weighing where the weights need to be hung from the device under test.

Slotted, or nesting slab, weights are more typically used for applications that require hanging of test weights. Their design allows them to be easily stacked and slotted onto calibrated hangers. These weights are also generally cast iron and of the same classes as grip handle weights.

Cylindrical weights can be used in multiple applications though they are typically 5 kg/10 lbs. and lighter. They are available as Class F weights that are taken into the field for calibrating bench scales and other lower capacity scales, as well as high class weights for calibrating precision balances.

Leaf style test weights are available in very small denominations and are used to calibrate high resolution and high precision balances. Both because of the class of these test weights and their size, they are handled only with tweezers and protective gloves.

Test Load Configuration

To minimize error and uncertainties, we suggest that you utilize as few test weights as possible. For instance, if the test point you are checking is 20 lbs. it is advisable to use one 20 lb. weight instead of two 10 lb. weights. Because error and uncertainties are associated with every standard, using only one (or as few as possible) minimizes the potential for measurement error.

Measurement Units

You should purchase test weights in the same measurement units that you are weighing in. For instance, if you are measuring in metric units make sure to purchase metric test weights, or vice versa. This eliminates the potential error in weight conversions.

Magnetism

Make sure that the test weights you purchase are made of a material that is not easily magnetized. If your test weights do become magnetized, it can cause issues for some scales and balances, which will result in invalid measurements.

Custom Standards

If you are using your test weights for a conveyor style checkweigher, it is highly recommended that you purchase a custom standard for that specific application. These types of scales should be checked at the weight and speed at which they are typically used. This is not possible with traditional test weights, as the size and shape would not be conducive.

Because there are so many considerations when choosing the correct test weights for your application, we do suggest that you speak with one of our measurement experts before making a final selection. Our team has over 75 years of experience in weight and scale calibration, and can give you the insight you need when choosing your test weights. To find out what weights are right for your application, contact a J.A. King expert today.