1.1 Measurement of mass

Tests that involve the measurement of mass require the use of balances of capacity and sensitivity corresponding to the degree of accuracy sought.

When weighing quantities of 50 mg or more that are to be "accurately weighed", an analytical balance of 100-200 g capacity and 0.1 mg sensitivity is required. When weighing quantities of less than 50 mg that are to be "accurately weighed", an analytical balance of 20 g capacity and 0.001 mg sensitivity, usually called an analytical microbalance, is required.

Balances of lower sensitivity are used for other tests in which a measurement of mass is involved.

Apparatus

Analytical balances should possess adequate capacity and sensitivity. They may be either of the equal-arm type, requiring the use of a set of calibrated weights, or of any other suitable type (for example, analytical microbalances using magnetic measurement) provided that their performance is periodically checked by means of a reference set of calibrated weights.

The analytical balance should be so constructed as to support its full capacity without developing undue stress and its sensitivity should not be altered by repeated weighings of the full-capacity load. It should preferably be equipped with a damping device (for example, a magnetic or air damper) that causes the beam to come quickly to rest (aperiodic balance).

The analytical balance may be constructed for manual placement of all weights or, preferably, be equipped with a weight-loading device for the whole or part of the balance range. In the latter case it should be equipped with loading registers clearly indicating the load applied. Furthermore, the analytical balance may be equipped with an optical scale projection system, usually encompassing a part of the balance range (e.g. where the displacement of the projected scale relative to the datum line gives a direct reading of weight), or a read-out device of any other type.

The type of analytical balance having constant sensitivity over the whole capacity range is the constant-load, single-pan balance. It has a set of weights suspended from a counterpoised beam; in the process of weighing, these are removed from the beam by a manually operated mechanical device until equilibrium is reached.

The analytical balance should be constructed in a proper housing with suitable openings to permit the placement of weighed material. The openings should be constructed in such a way as to exclude air currents. Desiccants may be placed inside the housing (e.g. silica gel, anhydrous calcium chloride) for the maintenance of a relatively dry atmosphere.

Sets of calibrated weights used with balances that require manual placement of weights and sets of weights used to check the sensitivity of balances of another type should be kept in a case made of suitable material and properly lined.

Placement of balance

The analytical balance should be placed upon a firm foundation that is as free from mechanical vibration as possible, preferably on an antivibration table of proper design. Alternatively, it may be placed on a concrete slab resting upon piers that are either sunk into the ground or connected to the construction elements of the building; or it may be placed upon a stout table or shelf protected by shock absorbers, such as cork mats or sheet rubber.

The balance should also be protected from humidity and acid fumes, preferably by placing it in a separate room of the laboratory. It should not be near a window or radiator, in direct sunlight, or in a position where draughts may come into contact with it.

The balance should be equipped with a levelling device and an indicator of proper position. Proper adjustment of levelling should be frequently checked.

Checking of sensitivity

The sensitivity of the balance should be periodically checked by a qualified expert.

Recommended procedure

Checking the stability of the equilibrium position

Before the balance is used, its equilibrium position without load should be checked several times. After each test, the balance has to be arrested.

The equilibrium position of the balance under load should also be determined from time to time, for example, with one-tenth of the full load and with the full load. The difference between equilibrium positions found in two successive determinations made with equal loads should not exceed 0.1 mg for analytical balances and 0.001 mg for analytical microbalances.

Operation of the balance

When the balance is not in use the balance beam and pan supports should be raised. The doors of the housing should always be kept closed.

To release the balance, the beam and pans should be lowered very carefully.

Objects to be weighed must be allowed to attain the temperature of the balance before weighing is started. The object to be weighed, as well as the weights, should always be placed on the pan as centrally as possible. During a weighing or on any occasion when objects are being added to or removed from the pans, both the beam arrests and the pan supports must be raised. Substances must be weighed in suitable containers such as beakers, weighing bottles, or crucibles. Liquids and volatile or hygroscopic solids must be weighed in tightly closed vessels, such as stoppered weighing bottles. No chemicals or objects that might injure the balance pans should be placed directly upon them.

When small quantities of a substance (for example, the sulfated ash) must be weighed in a large vessel and a fairly long period elapses between the two weighings, atmospheric pressure and temperature may alter sufficiently to affect the buoyancy and thus cause an appreciable error. In two-pan balances, this error may be eliminated by using another vessel of similar shape and weight for taring.

The pans of the balance should be periodically lightly brushed with a camel-hair or similar brush to remove any dust that may have collected.

The weights should be handled only by means of a pair of forceps, which should possess tips covered with suitable material.