

ICS 83.060

CCS G 40



**NATIONAL STANDARD OF THE
PEOPLE'S REPUBLIC OF CHINA**

GB/T 533-2008

**Rubber, vulcanized or thermoplastic -- Determination of density
(English Translation)**

Issued on: June 4, 2008

Implemented on: December 1, 2008

**Issued by: General Administration of Quality Supervision, Inspection and
Quarantine of PRC**

Table of Contents

Foreword...	3
1 Scope...	5
2 Terms and definitions...	5
3 Principle...	6
4 Equipment...	6
5 Specimen...	6
6 Time interval between forming and testing...	7
7 Conditioning of specimens...	7
8 Test temperature...	7
9 Procedure...	7
10 Representation of results...	9
11 Test report...	10

1 Scope

This standard specifies two methods for determining the density of solid vulcanized or thermoplastic rubber.

This standard applies to the control of the quality of rubber compounds AND the estimation of the amount of rubber compound, which is required to produce rubber products of known volume.

This standard does not apply to the measurement of the relative density of rubber. The relative density of rubber refers to the ratio -- of the mass of a certain volume of rubber to the mass of an equal volume of pure water, at a certain temperature.

2 Terms and definitions

The following terms and definitions apply to this standard.

2.1

Density

The mass of rubber per unit volume, at a certain temperature, which is expressed in megagrams per cubic meter (Mg/m³).

3 Principle

This standard specifies two test methods: Method A and Method B.

Method A: Use an analytical balance, which has a horizontal span, to measure the mass of the specimen in air and the mass in water. When the specimen is completely immersed in water, its mass in water is less than that in air; the reduction in mass is equal to the mass of the water which is replaced by the specimen; the volume of the drained water is equal to the volume of the specimen.

Method B: It is only used to test the density of specimens that need to be cut into small pieces to eliminate voids, such as the test of small hole hoses and density of insulated cables. The testing equipment is usually a balance and a density bottle.

Note: For convenience, all gravity in this standard is expressed in mass units.

4.2 Analytical balance

The analytical balance shall be accurate to 1 mg.

4.3 Horizontal span

The size of the horizontal span is determined, by the size of the beaker, which is used to weigh the specimen in water (Method A).

4.4 Beaker

The volume of the beaker is generally 250 cm³ (smaller can be selected, according to the balance) (Method A).

5 Specimen

5.1

The surface of the specimen shall be smooth. There shall be no cracks and dust. The mass shall be at least 2.5 g. The shape of the specimen for Method B shall be made into a suitable sheet (see 9.3).

5.2

At least two specimens shall be made for each sample.

with fabric, the covering fabric on the specimen surface shall be removed completely;

the exposed surface of the rubber shall be polished smooth (see GB/T 2941).

9.2 Method A

Use a filament of suitable length, to hang the specimen (Chapter 5) on the hook of the balance (4.2), so that the bottom of the specimen is approximately 25 mm above the horizontal span (4.3). The material of the filament shall neither be soluble in water NOR absorb water. The mass of the filament can be ignored or weighed separately. If weighed alone, its mass shall be subtracted from the weighing of the specimen (see Note 1).

First weigh the mass of the specimen in air, accurate to 1 mg. Weigh the mass of the specimen in water again. Place a beaker (4.4), which contains freshly prepared cooled distilled or deionized water, at standard laboratory temperature ($23\text{ }^{\circ}\text{C} \pm 2\text{ }^{\circ}\text{C}$ or $27\text{ }^{\circ}\text{C} \pm 2\text{ }^{\circ}\text{C}$), on the horizontal span rack. Immerse the specimen (with a weight if necessary, see Note 2) in water. Remove the air bubbles (see Note 3 and Note 4), which are attached to the surface of the specimen. Weigh it, accurate to 1 mg. Observe for a few seconds, until it is sure that the pointer no longer drifts, before reading the result.

Note 1: If filaments, which have a mass less than 0.010 g, are used, such as fine nylon filaments, their mass can be ignored. However, when the specimen is less than 2.5 g (such as measuring the density of very small O-rings), ignoring the mass of the filament can lead to erroneous results; in this case, it needs to be included in the calculation of the final result. If a hanging wire other than filament is used, its volume and mass must be taken into the calculation of the final result.

Note 2: If weighing a specimen, which has a density of less than 1.00 Mg/m^3 , a weight shall be added. The mass of the weight in water shall be weighed separately. Other liquids other than distilled water, that do not have any effect on the rubber, can also be selected as the weighing liquid. In this case, the formula in 10.1 shall be used, to calculate the density value. In the formula, the density of the weighing liquid is used to replace the density of water.

Note 3: The main source of error:

- a) Air bubbles on the surface of the specimen, when weighed in water;
- b) Influence of filament's surface tension;
- c) The specimen is suspended in water with convection. To minimize this effect, the air temperature inside the balance shall be kept the same as the water temperature.

Note 4: In order to remove air bubbles on the surface of the specimen, a small amount of surface-active substances, which are similar to detergents, can be added to distilled water (the recommended ratio is 1:10000), OR the specimen can be quickly dipped in a suitable liquid, such as methanol or industrial alcohol; the liquid is easily soluble in water and does not swell or dissolve with rubber. If the latter method is used to remove bubbles, it shall be ensured that the residual amount of liquid, on the surface of the specimen, is controlled to a minimum.

9.3 Method B

Weigh the clean and dry density bottle and stopper (4.5), each before and after the specimen (Chapter 5) is placed. Cut the specimen into small pieces; the exact shape and size depends on the thickness of the original specimen. The size of the cut pieces shall be not more than 4 mm in two directions, AND not more than 6 mm in the third direction.

The small pieces shall be as large as possible, within this limit. All cut edges shall be smooth. At standard laboratory temperature, fill the density bottle, which contains the specimen, with freshly prepared cooled distilled or deionized water, to remove air bubbles on the surface of the specimen AND on the inner wall of the density bottle (Note 4 and the following notes). Use a stopper to close the density bottle. Note that there shall be no air in the density bottle or capillary tube. After drying the outer wall of the density bottle, weigh the total mass of the density bottle, specimen, water. Pour out all the specimen and water from the density bottle. Then fill it with freshly prepared cooled distilled or deionized water. Remove air bubbles. Add the stopper to the density bottle. Dry the outer wall of the density bottle. Weigh the total mass of the density bottle and water. The above weighing shall be accurate to 1 mg.

Note: The main error comes from the air bubbles in the density bottle. If necessary, to eliminate air bubbles, the density bottle and its contents can be heated to about 50 °C. However, in this case, the density bottle and its contents shall be cooled, before weighing. It can also put the density bottle into a vacuum desiccator. Apply vacuum several times, until there are no more air bubbles in the density bottle.

10.1 Method A

Density (Δ), in megagrams per cubic meter, is calculated from formula (1):

Where:

ρ - The density of water, in megagrams per cubic meter (Mg/m³);

m_1 - The mass of the specimen in air, in grams (g);

m_2 - The mass of the specimen in water, in grams (g).

The above is measured, at standard laboratory temperature.

The test results of this method are accurate to two decimal places.

In most cases, the density of water, at standard laboratory temperature, can be regarded

.....