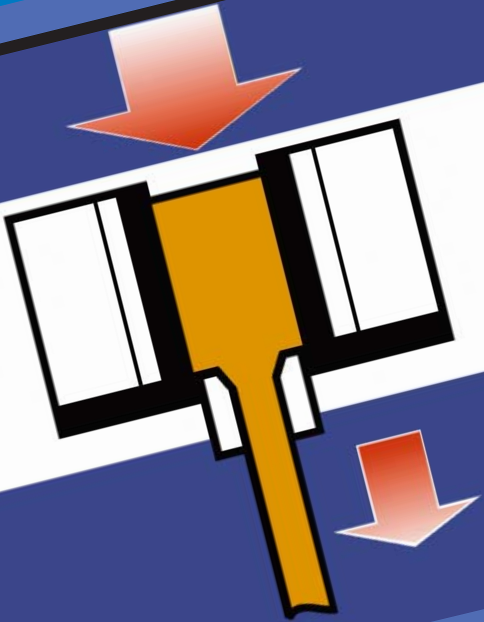
DENSITY METER



DESIGN AND PRODUCTION OF INSTRUMENTS AND APPARATUS FOR QUALITY CONTROL ON MATERIALS

These instruments are made in compliance with CE health and safety requirements

Density Meter - code 6001.000

Range of Application

In the current laboratory practice it is of noteworthy interest to quickly evaluate the materials density value both to classify them, according to this characteristic, to check the uniformity of production and also to study, as a basic research, how some chemical or physical operations can influence the density itself.
Different methods can be used: some very simple, but hardly reliable such as to separately determine the weight and the volume of the item under test or others more sophisticated such as to use the hydrostatic balance, that supplies correct and reproducible results, but requires critical operative conditions to be attained and kept during the time.
There is a method that provides high precision and reproduceability and it s easy to use the density gradient technique. It is based on the comparison of the specimen under test density with the one of known standard specimens.
By this method it is possible to carry out density measurements on non cellular materials such as plastic pellets, samples from finished items, etc.
Another advantage consists in the ability of performing the measurement on very small samples: this cannot always done by other methods.
There is a limitation on the range of density that can be measured: from approximately 0.5 up to 3 g/cm^3. In practice determinations on organic resins, thermoplastic, thermosetting material and light alloys are covered.

Measuring Principle

Following to a particular technique two liquids, one able to solve the other, whose densities represent the extremes of the measuring range, are introduced into a glass cylinder which dimensions are approx: diameter 46 mm and height 1040 mm.
The above mentioned filling technique is such that, inside the column, the two liquids are not mixed together.
In this way an average density is achieved and they set out themselves in such a way that the density varies 1inearly along the column from a minimum to a maximum, from top to bottom.
Example: Methanol (density 0.80 g/cm^3) and benzilic alcohol (density 0.92 g/cm^3). With these two liquids the measuring range will be: 0.80 top 0.92 g/cm^3 bottom.
If we put inside the column some glass floats of known and different density, they will set out themselves into the column at different heights, exactly in correspondence with the density of the column in that points.
By properly selecting the glass floats density values it is possible to have a visual density scale where the glass floats are the reference points.
To get the measurement it is sufficient to introduce a piece of the material under consideration, of whatsoever shape and size, into the column and it will set out itself at a level where the mixture has that right its same density. From said above it appears very easy to exactly determine the material density, simply by reading the distances between the piece of material and the glass floats just above and below it.

We have:

$$Dx = Da + \frac{x \cdot (Db - Da)}{y} \qquad (1)$$

where: Dx = density of the material under test (g/mm^3)
Da = density of the glass float below the specimen (g/mm^3)
Db = density of the glass float above the specimen (g/mm^3)
X = distance between the specimen and the glass float below it
Y = distance between the glass floats below and above the specimen (mm)

Example: in the column previously described we have:
(a) glass float having density: 0.87 g/mm^3

(b) glass float having density: 0.83 g/mm³
The distance between the glass floats is 500 mm.
We introduce the sample to be tested and it sets out in equilibrium at 280 mm above the (a) glass float; it can be seen from the above relation that we have:

$$Dx=0.870+\frac{280\bullet(0.830-0.870)}{500}=$$
$$=0.870+\frac{280\bullet(-0.040)}{500}= \qquad (2)$$
$$=0.8704+\frac{-11.2}{500}=$$
$$0.870+(-0.022)=0.848\ g/mm^3$$

To avoid violent dynamical motions of the liquids that could mix them up and then disturb the density gradient, it is necessary to be very careful to ricover the specimens tested. At the bottom of the column there is a wire screen basket that can be raised, by means of a clock motor, having a very slow rate (about 300 mm/h), so as to avoid such an inconvenient.

Standards

Designed and built to meet specifications set out by the following standards:
ISO 1183, ASTM D 1505, BSI 2782 Method 620 A
and other similar or equivalent.

Technical Characteristics

Test column	glass, double sleeve
Diameters and height of the test cylinder	46 x 65 x 1040 mm
Glass floats and specimen height floats	reference scale, graduated at 1 mm intervals with a circular index
Introduction and ricovery system of glass floats	wire screen basket with motor actuated motion
Basket stroke setting	by presetting zeroing unit
Density range (according to the liquid used)	app. 0.5 ÷ 3 g/cm^3
Max resolution attainable	$1 \times 10^{-4}\ g/cm^3 \cdot mm$

Manufacturing Characteristics

Test column	borosilicate glass, double sleeve
Column dimensions	Ø 46 mm (inside) x 65 mm (outside) x 1040 mm
Column support	solid cast iron base fitted with levelling screws
Levelling control plumb line and reference tapers facing each others	
Column constant temperature bath	double sleeve circulation to be connected to a thermostat
Ability of multiple connections of more columns	parallel on special support
Upper closure	lid with hole for control thermometer
Closure for dehydration	gas tight lid with fittings to connect a vacuum pump

Ancillary Equipments

- Calibrated float with known density (Range Min. 0.8000 to max. 3.0000 g/cm^3) - code 0700.002
- Thermometer +20 ÷ 65°C - Div. 1/10°C - code 0100.001
- Timer group - code 6001.010

Table to chose the liquid system to be used with Density Meter code 6001/000 in function of the required range

SYSTEM	DENSITY RANGE, g/cm^3
Methanol-benzyl alcohol	0.80 to 0.92
Isopropanol-water	0.79 to 1.00
Isopropanol-diethylene glycol	0.79 to 1.11
Ethanol-carbon tetrachloride	0.79 to 1.59
Toluene-carbon tetrachloride	0.87 to 1.59
Water-sodium bromide	1.00 to 1.41
Water-calcium nitrate	1.00 to 1.60
Carbon tetrachloride-trimethylene dibromide	1.60 to 1.99
Trimethylene dibromide-ethylene bromide	1.99 to 2.18
Ethylene bromide-bromoform	2.18 to 2.89

Other liquid systems can be chosen according to specific requirements.
The known density balls are to be selected to cover all the required range. To get a good resolution and keep under control the column we suggest to operate with a minimum of four balls.

Technical Data

Overall dimensions (LxDxH) (mm)	310 x 330 x 1300
Weight (kg)	15
Supply	230 V - 50 Hz - Singlephase (110 V - 60 Hz on request)
Power (W)	0.1
Paint	fuchsia RAL 4006 - gray RAL 7035

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