UDC 628·1/.3 : 531·756 ( Second Reprint DECEMBER 1992 ) IS : 3025 ( Part 12 ) - 1983



*Indian Standard* ( Reaffirmed 1996 )

# METHODS OF SAMPLING AND TEST ( PHYSICAL AND CHEMICAL ) FOR WATER AND WASTE WATER

## PART 12 DENSITY

*( First Revision )*

**1. Scope** — Prescribes a method for determination of density, using density bottle. This is applicable for all types of waters.

**2. Principle** — Determination of density is based on determination of the mass of a known volume of sample at a given temperature. Density should be determined at the same temperature at w hich glassware in use is calibrated ( 27°C ).

**3. Interferences** — Suspended matter interferes and is removed by filtration or centrifugation. Evaporation losses should be kept to the minimum during the operation.

**4. Apparatus**

**4.1** *Density Bottle* — 50 ml capacity.

**4.2** *Balance* — Capable of weighing the density bottle to the nearest 0·1 mg.

**4.3** *Water-Bath* — Constant temperature 27 ± 0·5°C.

**5. Procedure** — Adjust the temperature of the sample to 27 ± 0·5°C. Fill the tared bottle with sample. Stopper and wipe it. Weigh the bottle to the nearest 0·1 mg. If a constant temperature bath is not available, record the temperature with an accurate thermometer and obtain value of relative density for that temperature from Table 1.

**6. Calculations** — Calculate the density of the sample as follows :

$$D = \frac{M\,C}{V}$$

where

$D$ = density of the sample at 27°C, g/ml;

$M$ = mass of sample in the density bottle, g;

$V$ = volume of density bottle, ml; and

$C$ = correction factor for temperature.

**Note** — When measurements are made at 27°C, $C = 1$.

For other temperatures.

$$C = \frac{\text{Relative density at 27°C}}{\text{Relative density at test temperature}}$$

**7. Report** — Report density to three decimal places in terms of grams per millilitre at specified temperature.

**8. Precision and Accuracy** — Precision and accuracy depend, to a large extent, on the density bottle and the balance.

Adopted 30 December 1983  Gr 1

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**TABLE 1 DENSITY OF WATER AT DIFFERENT TEMPERATURE**

( *Clause* 5 )

| Temperature | Density | Temperature | Density |
|---|---|---|---|
| °C | g/ml | °C | g/ml |
| 0 | 0·999 87 | 65 | 0·980 59 |
| 3.98 | 1·000 00 | 70 | 0·977 81 |
| 5 | 0·999 99 | 75 | 0·974 89 |
| 10 | 0·999 73 | 80 | 0·971 83 |
| 15 | 0·999 17 | 85 | 0·968 65 |
| 18 | 0·998 62 | 90 | 0·965 34 |
| 20 | 0·998 23 | 95 | 0·961 92 |
| 30 | 0·995 67 | 100 | 0·958 38 |
| 35 | 0·994 06 | | |
| 38 | 0·992 99 | | |
| 40 | 0·992 24 | | |
| 45 | 0·990 25 | | |
| 50 | 0·985 73 | | |
| 55 | 0·985 73 | | |
| 60 | 0·983 24 | | |

**Note** — The temperature of maximum density for pure water, free from air = 3·98°C ( 277·13 K ).

## EXPLANATORY NOTE

Density is the mass of substance per unit volume at a specific temperature and relative density is the mass of a volume of the substance compared to that of an equal volume of water. Density is used in computation where results are expressed in terms of parts per million ( ppm ).

$$\text{Concentration in terms of parts per million ( ppm )} = \frac{\text{Concentration in terms of mg/l}}{\text{Density}}$$



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