



# Total Hardness Test

1.10025.0001  
1.10046.0001

## 1. Definition

The hardness (total hardness) of a given water is due to its content of salts of the alkaline earth metals calcium, magnesium, strontium, and barium ("hardening constituents"). Since strontium and barium are generally present in waters only in traces, the hardness is defined as the content in a water of calcium ions,  $\text{Ca}^{2+}$ , and magnesium ions,  $\text{Mg}^{2+}$  ("hardness ions"). The conventional procedure is to relate the statement of the water hardness only to calcium, in other words to express also the content of magnesium ions as calcium content.

The units for the water hardness relate to calcium or its compounds  $\text{CaO}$  ( $1^\circ\text{d} = 10 \text{ mg/l CaO}$ ) or  $\text{CaCO}_3$  ( $1^\circ\text{e} = 14.25 \text{ mg/l CaCO}_3$ ;  $1^\circ\text{f} = 10 \text{ mg/l CaCO}_3$ ), with the magnesium content being expressed as calcium content and included in the calculation accordingly.

## 2. Method

In the presence of a green indicator, the hardness ions  $\text{Ca}^{2+}$  and  $\text{Mg}^{2+}$  react with Titrplex<sup>®</sup> III<sup>1)</sup> to form a colourless, stable complex. The hardness ions that are present in excess relative to Titrplex<sup>®</sup> III react with the indicator to form a red complex. The reaction zones of the test strip, which are impregnated with differing amounts of Titrplex<sup>®</sup> III, thus assume a green to red colour, depending on the hardness of the water sample. The hardness is determined **semiquantitatively** by visual comparison of the reaction zones with the colour rows of a colour scale.

<sup>1)</sup> ethylenedinitrilotetraacetic acid disodium salt dihydrate

## 3. Measuring range and number of determinations

Cat. No.	Measuring range / colour-scale graduation <sup>°e</sup> 1)	Number of determinations
1.10025.0001	<4 - >5 - >9 - >18 - >26	100
1.10046.0001	>6 - >13 - >19 - >25 - >31	

<sup>1)</sup> for conversion factors see section 9

## 4. Applications

### Sample material:

Groundwater and surface water  
Drinking water  
Mineral water

## 5. Influence of foreign substances

This was checked in solutions with a hardness of  $0^\circ\text{e}$ . The concentrations of foreign substances given in the table lie below the limit at which the determination is interfered with.

Concentrations of foreign substances in mg/l			
$\text{Cu}^{2+}$	10	$\text{Ni}^{2+}$	10
$\text{Co}^{2+}$	10	$\text{Zn}^{2+}$	10

## 6. Reagents and auxiliaries

The test strips are stable up to the date stated on the pack when stored in the closed tube at  $+15$  to  $+25^\circ\text{C}$ .

### Package contents:

Tube containing 100 test strips

### Other reagents:

Universal indicator strips pH 0 - 14,

Cat. No. 1.09535.0001

Sodium hydroxide solution 1 mol/l, Cat. No. 109137

Hydrochloric acid 1 mol/l, Cat. No. 109057

Calcium chloride dihydrate GR for analysis,

Cat. No. 102382

## 7. Preparation

- **The pH must be within the range 5 - 8.** Adjust, if necessary, with sodium hydroxide solution or hydrochloric acid.
- **Other Merckoquant<sup>®</sup> Total Hardness Test: Cat. No. 1.10032.0001 (measuring range <4 - >26 °e)**  
Individually sealed test strips (1000 pcs)

## 8. Procedure

Immerse **all reaction zones** of the test strip in the measurement sample for **approx. 1 sec (not in running water!)**.

Shake off excess liquid from the strip and **after 1 min** determine with which colour row on the label the colours of the reaction zones coincide most exactly.

Read off the corresponding result or, if necessary, estimate an intermediate value.

## Assessment:

Hardness range				Water quality
	<sup>°e</sup>	mmol/l Ca	mg/l Ca	
I	<9	<1,3	<50	soft
II	9 - 17.5	1.3 - 2.5	50 - 100	moderately hard
III	17.5 - 26	2.5 - 3.8	100 - 150	hard
IV	>26	>3.8	>150	very hard

## Note on the measurement:

The colours of the reaction zones may continue to change after the specified reaction time has elapsed. This must not be considered in the measurement.

## 9. Conversions

required given	mmol/l Ca	mg/l (ppm) Ca	German degree °d	English degree °e	French degree °f	mg/l (ppm) CaCO <sub>3</sub>
1 mmol/l Ca	1	40.08	5.61	7.02	10.01	100.1
1 mg/l (ppm) Ca	0.025	1	0.140	0.175	0.250	2.50
1 German degree °d	0.178	7.15	1	1.25	1.78	17.85
1 English degree °e	0.142	5.71	0.799	1	1.43	14.25
1 French degree °f	0.100	4.00	0.560	0.702	1	10.00
1 mg/l (ppm) CaCO <sub>3</sub>	0.010	0.400	0.056	0.070	0.100	1

## 10. Method control

To check test strips and handling: Dissolve 3.670 g of calcium chloride dihydrate in distilled water, make up to 1000 ml with distilled water, and mix. Ca content: 1000 mg/l (=  $175^\circ\text{e}$ ). Dilute this standard solution to 100 mg/l Ca (=  $18^\circ\text{e}$ ) and analyze as described in section 8.

## 11. Note

**Reclose the tube containing the test strips immediately after use.**