

Technical Directions

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Water Conditioning Devices for the Prevention of Scaling:
Requirements and Tests

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Water Conditioning Devices for the Prevention of Scaling: Requirements and Tests

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Foreword

The requirements on the configuration, operating safety, suitability and hygiene of equipment for preventing scale are specified in this worksheet as are also the appropriate tests to be carried out.

The worksheet is not applicable for equipment for conditioning drinking water for which particular requirements and tests are stipulated in specific standards or worksheets. Equipment of this type is for example feed units according to DIN 19635, water softening equipment according to DIN 19636 as well as decarbonizing processes pursuant to the definition in DIN 54400

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DVGW Deutsche Vereinigung des Gas- und Wasserfaches e.V. [German Association of Gas and Water Utilities, registered]

Technical and scientific association

1 Applicability

This worksheet is applicable for equipment for conditioning drinking water (fixed installation) used for reducing the formation of scale in drinking water installations. Equipment of this type will be described in the following text as "scale prevention equipment". The description, however, only includes equipment which functions by forming crystal nuclei of the calcium carbonate present. Equipment in which a sole or additional reduction of scale comes about by the addition of complex formers (e.g. phosphates) or by reducing the hardness formers in water (e.g. ion exchange or partial desalination) are not dealt with in this worksheet. The reduction of the hardness formers by the formation of crystal nuclei is not meant by this.

2 Normative references

The references in this text to specifications contained in the normative documents listed below are in effect components of this part of the DVGW Rules and Standards. For references given with dates, later amendments or revisions of this publication do not apply. Users of this part of the DVGW Rules and Standards are however requested to check the possibility of using the latest version in each case of the normative documents listed below. In the case of references without dates the latest issue of the normative document referred to is applicable. Any DIN standard mentioned can be a component of the DVGW Rules and Standards.

DIN 1988, *Technical directions for Drinking Water Installations (TRW I); General considerations; Technical directions of the DVGW*

DIN 19635, *Feed units for Conditioning Drinking Water; Requirements, test, operation; Technical directions of the DVGW*

DIN 19636, *Water Softening Equipment (Cation Exchanger) in Drinking Water Installations: Requirements*

DIN 50930-6, *Metal Corrosion – Corrosion of Metallic Materials inside Pipelines, Containers and Apparatus in the Case of Corrosion by Water – Part 6: Effects on Drinking Water Consistency (applicable in connection with DIN 50931-1 (1999 -11))*

DIN 54400, *Ion exchange; Terms*

DIN EN 1213, *Building valves. Copper alloy stopvalves for potable water supply in buildings. Tests and requirements*

DIN EN 1717, *Protection against pollution of potable water installations and general requirements of devices to prevent pollution by backflow - (DVGW Code of practice).*

DIN EN 50081-1, *Electromagnetic compatibility. Generic immunity standard. Residential, commercial and light industry*

DIN EN 50082-1, *Electromagnetic compatibility. Generic immunity standard. Residential, commercial and light industry*

DIN EN 60335-1, *Household and similar electrical appliances. Safety. General requirements*

DIN EN ISO 3822-3, *Acoustics. Laboratory tests on noise emission from appliances and equipment used in water supply installations – Part 3: Mounting and operating conditions for in-line valves and appliances*

DIN V 8418 (provisional standard), *User Information; Instructions for Preparation [of documents]*

DVGW worksheet W 270, *Propagation of Microorganisms on Materials Used in Drinking Water Systems – Tests and Evaluation*

DVGW worksheet W 512, *Process for Evaluating the Effectiveness of Water Conditioning Equipment for Reduction of Scaling*

TrinkwV (*Drinking Water Ordinance*), *Ordinance regarding the Quality of Drinking Water*

Low Voltage Directive, *Council Directive of 19 February 1973 on the harmonisation of the laws of Member States relating to Electrical Equipment designed for use within certain voltage limits (73/23/EEC)*

EMVG, *Law concerning electromagnetic compatibility of apparatus*

KTW [*Plastics in Drinking Water [issued by the DVGW]] recommendations, Health-Related Evaluation of Plastics and Other Non-Metallic Materials within the Framework of the [German] Law Concerning Food and Consumer Goods*

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in Connection with Drinking Water: announcements in the [German] federal health gazette (KTW recommendations Part 1.3.1)

3 Terms

Scale protection

Scale protection as defined by this worksheet means the focused and sustainable reduction of scale formation, above all in drinking water heating and circulation equipment without the addition of hardness stabilizers and without reduction of the concentration of hardness formers in drinking water.

Nominal flow rate

The nominal flow rate as defined by this worksheet is the total flow rate in m³ /h, in which an adequate effectiveness is achieved and in which the pressure drop is limited to 0.8 bars.

Nominal rating

For equipment connected to the hot water circulation system a nominal performance rating shall be specified in addition to the nominal water flow rate. This rating corresponds to a maximum water extraction from the hot water system in l/d [liters per day], by means of which the effectiveness of the scale protection equipment is adequately assured.

4 Requirements

4.1 Effectiveness

4.1.1 DVGW worksheet W 512

The requirements in accordance with the DVGW worksheet W 512 must be met. For equipment which is installed in circulation or bypass pipes of drinking water heating systems, the requirements must be fulfilled in connection with the DVGW worksheet W 512 (hot water test mode, cf. 5.1.1).

4.1.2 Suitability

As proof of its suitability when being tested in accordance with subsection 5.1.2, the equipment must show for the applications stipulated in each case an effectiveness with respect to scale reduction that meets the requirements specified in the DVGW worksheet W 512.

4.2 Hygiene

4.2.1 Materials

Materials, protective casings and production consumables and auxiliary materials coming into contact with drinking water must not affect hygiene adversely. They must not emit or release any material which influences the compatibility, taste, odor or color of the drinking water. If plastics or other non-metallic

materials are used, the KTW recommendations and the requirements of the DVGW worksheet W 270 must be fulfilled. In the case of metallic materials the requirements defined in DIN 50930-6 are applicable.

The materials and protective casings used must be stable with respect to all physical, chemical and corrosive influences to which they could be exposed.

Surfaces coming into contact with water must not be nickel plated.

4.2.2 Microbiological requirements

When used pursuant to the regulations the conditioned water must meet the microbiological requirements of the Drinking Water Ordinance. The development of the colony figures in accordance with downtime (cf. Subsection 5.2.2) shall be monitored. It is prohibited to include coliform nuclei and *Pseudomonas aeruginosa* in any of the trials.

4.2.3 Chemical requirements

It must be ensured that the parameters of the Drinking Water Ordinance, Annex 2 a and b are attained when the water is used as stipulated. When testing in accordance with 5.2.3 the maximum values must not be exceeded.

4.3 Tensile strength, watertight condition and resistance to high temperatures

The parts of the equipment subject to water pressure shall be measured in accordance with DIN 1998-2 with a nominal pressure of at least 10 bars.

The equipment is to be configured for ambient and water temperature of at least 30°C.

For equipment to be installed in connection with drinking water heating systems or with its own overpressure safety connectors, it is sufficient if it meets lower requirements with respect to resistance to pressure, as among other things it is not expected that high pressure values (pressure peaks) would occur without overpressure safety connectors, as would be the case in cold water installations. Equipment intended for installation systems with heated drinking water must be configured for water temperatures of at least 80°C.

4.4 Pressure loss

The pressure loss for the specified nominal flow rates must not exceed 0.8 bars.

4.5 Water surge pressure

The sum of water surge and background pressure must not exceed the permitted operating overpressure. In the case of an operating pressure of six bars the value of the positive water surge pressure must not exceed two bars measured directly in front of the equipment. The negative surge pressure must not exceed 50% of the ensuing flow pressure.

4.6 Noise

Scale prevention equipment in normal operating conditions must not cause noise within any part of the total working area. When being tested in accordance with subsection 5.6 they must correspond to noise category 1.

4.7 Maintaining safety of the equipment

Adequate safety provisions for the equipment to be delivered shall be stipulated in accordance with the safety concept of DIN EN 1717.

4.8 Marking the direction of flow

The direction of flow of the water through the equipment must be marked in a long-lasting and unambiguous way on the equipment's housing.

4.9 Electrical safety

The equipment must meet the following relevant electrical standards and regulations:

Low Voltage Directive

DIN EN 60335-1

EMVG

DIN EN 50081-1

DIN EN 50082-1

4.10 Connections

Connections to drinking water installations must fulfill the requirements of DIN EN 1213.

4.11 Installation, operating and maintenance instructions

Comprehensive and technically adequate insulation operating and maintenance instructions are to be supplied with the equipment. These instructions must contain the following:

- Specifications for determining system size
- Specifications of the application or working areas and additional equipment
- Description of the equipment: specifications of the function and also of the safety, locking down and disinfection equipment, specifications of special properties and the measures connected with them.
- Specifications of where and how the equipment is to be installed : required space for operation and maintenance, energy requirements, connections for utilities and their configuration, disposal of process water, indications of danger that are to be avoided by the appropriate installation or set-up, safety equipment to be stipulated by the user (operator). Any tools or fastening torques required are to be specified.
- Operating specifications: description of the operating devices, instructions for the initial commissioning, required consumables and ancillary materials, replenishment material (type and quantity), measures to be taken before commissioning, instructions for turning on, shutting down and safe operation, in particular safety measures for use as stipulated, working methods that are not permitted, reaction to disruption.

4.12 Marking

The information on the nameplate shall be fitted permanently to the apparatus in such a way that it can be easily read, and should include at least the following:

- a) Type of equipment
- b) Name of manufacturer

- c) Nominal extent of the connection
- d) Nominal flow rate... with pressure loss...
- e) Nominal pressure in bars
- f) Maximum water temperature in °C
- g) DVGW test mark

5 Prototype tests

The manufacture is to confirm that the appropriate requirements of this worksheet have been fulfilled by means of a test certificate issued by a test center named by DVGW.

Before the external body responsible for monitoring the installed equipment assumes this role it must convince itself that the personnel-related and technical conditions exist for a permanent and orderly execution of quality-related inspections.

5.1 Effectiveness

5.1.1 DVGW worksheet W 512

An inspection report in accordance with DVGW worksheet W 512 shall be submitted.

For equipment that is to be installed in the hot water zone (circulation operation) inspections of the hot water are to be carried out according to the DVGW worksheet W 512 and with requirements that are otherwise unchanged in a manner that pipe sections accessible for inspection and also inaccessible sections are extended in each case by a hot water circulation pipe with the same volume, in which the scale reduction equipment to be tested can be installed. The circulation within the accessible and non-accessible sections shall be carried out simultaneously and operated identically with respect to the volume of water flowing through. The switch-on times of the circulation pumps shall be set pursuant to the stipulated values of the operating instructions.

5.1.2 Suitability: cold water equipment

Before being inspected the equipment used shall be thoroughly rinsed out. To check for suitability the equipment should be subjected to a tests for 21 days with daily volumes of water that were determined on the basis of the following stipulated application ranges (nominal flow rate):

Table 1: test volumes by nominal flow rate

Nominal Flow Rate	Test Volumes
0 – 1.5 m ³ /h	375 liters/day
1.51 – 3 m ³ /h	750 liters/day
3.01 – 6 m ³ /h	1500 liters/day
6.01 – 14 m ³ /h	3500 liters/day

The throughput times and volumes for the throughput quantities in each case are shown in Annex 2. Of the total throughput per day 130 liters of water are to be channeled to an effectiveness test bed in accordance with the cycle analogous to the DVGW worksheet W 512. In a direct comparison with non-conditioned water a reduction in scale formation must be attained that is at least as high as the value specified in the DVGW worksheet W 512.

5.1.3 Suitability: hot water equipment

Equipment intended for installation in hot water circulation systems will be tested for their suitability as follows. For a test period of three months they are installed within the area of circulation of a 500 liter hot water vessel from which for 15 hours each day and for five minutes of each half an hour 18 liters/minute of hot water are extracted and then disposed of.

After that the equipment is operated in accordance with subsection 5.1.1, paragraph 2. In a direct comparison with non-conditioned water a reduction in scale formation must be attained that is at least as high as the value specified in the DVGW worksheet W 512.

5.2 Hygiene

5.2.1 Materials

For metallic materials:

The technical directions according to DIN 50930-6 must be followed, as required in connection with DIN 509301-1.

For components made from non-metallic materials: submission of valid test reports KTW and W 270.

5.2.2 Microbiological tests

For all test purposes only drinking water that has not been disinfected will be used. Between test cycles, de-installed equipment must be protected from contamination. For microbiological evaluation, equipment is used for which at least one complete test in accordance with the DVGW worksheet W 512 and a test in accordance with subsection 5.2 were already carried out. The tests are carried out after a stagnation period of 4 days. Samples are taken at intervals of 0, 1, 2, 3, 5 and 10 minutes (for 20 % of the nominal flow rate). Coliform bacteria and pseudomonas aeruginosa must not be included in any of the samples. The measured values for the samples taken after 3, 5 and 10 minutes are used to evaluate the colony figures. The requirements of the Drinking Water Ordinance must be fulfilled.

5.2.3 Chemical Tests

The tests take place at room temperature after 24 hours stagnation. If a higher temperature than 30°C is specified on the name plate the tests must be carried out at this higher temperature. The Drinking Water Ordinance parameters must be met (Annexes 2 a and b). Moreover, material-specific parameters are to be checked.

For equipment for which in keeping with its function electrochemical processes occur, an additional test shall be made, i.e., a check for whether nitrite was formed. For this purpose the water to be tested must contain at least 80 % of the maximum nitrite content permitted by the Drinking Water Ordinance. The test sample is taken from a composite sample taken during a three minute flow at 10 % of the nominal flow rate. The nitrite value prescribed by the Drinking Water Ordinance must not be exceeded.

5.3 Tensile strength, watertight condition and resistance to high temperatures

Testing for resistance to high temperatures takes place through the tensile strength checks with water at room temperature. If a higher temperature than 30°C is specified on the name plate the tests must be carried out at this higher temperature.

The test piece must be able to withstand three times the nominal pressure. In this case the test piece is subjected for 10 minutes to a static pressure equal to three times the nominal pressure. Leaks or permanent deformations must not materialize during this time. A pressure of twice the nominal pressure is sufficient for equipment intended for installation in heated drinking water systems. Leaks must not materialize for any equipment items.

Metallic containers > 20 liters will be tested with 15 bars for over 2 hours.

Dynamic pressure fluctuation test for plastic components subjected to pressure:

The equipment must withstand without damage at least 50,000 pressure fluctuations with a pulsing pressure of 0.5 bars to 1.3 x the nominal pressure with an impulse frequency of $(15 \pm 1) \text{ min}^{-1}$.

5.4 Pressure loss

Pressure loss is established in accordance with DIN 3546-1.

5.5 Water surge pressure

The equipment is tested in accordance with DIN 50084.

5.6 Noise

The equipment is tested at 2/3 of the nominal flow rate in accordance with EN ISO 1717.

5.7 Maintaining safety of the equipment

Maintaining safety of the equipment tested in accordance with DIN EN 1717.

5.8 Marking the direction of flow

By visual inspection

5.9 Electrical safety

Submission of valid test certificates

5.10 Connections

By visual inspection

5.11 Installation, operating and maintenance instructions

It shall be checked if the installation and operating instructions in accordance with 4.11 contain the required technical parameters and operating instructions in their entirety and in a manner that can be understood by the user.

5.12 Marking

By visual inspection

6 The monitoring system and reviewing the monitoring system

The fulfillment of the imposed requirements shall be documented at every manufacturing plant within the framework of a monitoring system.

The monitoring system is subdivided in in-house and external components, with the external monitoring to be carried out by one of the DVGW test centers. Details of the monitoring system are to be stipulated in a monitoring agreement between the manufacturer and the test center. The monitoring agreement will be valid as confirmation of the monitoring system only after the DVGW has agreed to it and shall be concluded after the first inspection.

The tests to be carried out are described in Annex 1.

7 In-house production monitoring

The manufacturer shall carry out checks of the production in such a way that a secure evaluation of the production is possible

8 Reviewing the monitoring system by a test center named by the DVGW

8.1 Objective

The body responsible for the external monitoring has the task of reviewing on the basis of its organization and reports the manufacturer's internal monitoring system for the production of scale prevention equipment with the DVGW test mark.

8.2 Taking samples

Samples are taken by a representative of the test center – usually at the manufacturer's premises. If the sample is selected at a wholesaler, retailer or customer it must still be in the original packaging.

Tests are to be made on samples of this type at least from two items of equipment every two years.

9 DVGW test mark

Certification of the products listed in the subsection (scope) is carried out by the DVGW certification center according to the appropriate procedures and pursuant to the official orders and procedures for the national certification of water and gas supply products. The conformity of the product with the requirements of these orders and procedures will be evaluated.

Once the requirements of this worksheet have been met, the DVGW certification center will issue a certificate that authorizes the use of the DVGW test mark. The test mark and the corresponding test stamp may only be used for products that have been certified accordingly.

Information on these issues can be obtained from the DVGW, *Deutsche Vereinigung des Gas- und Wasserfaches* [German Association of Gas and Water Utilities].

Annex 1: Summary of the Tests

Tests by Section		Initial Test	In-house Monitoring	Monitoring by External Body
5.1.1	W512	x	once a year per type	–
5.1.2	Suitability for use	x	-	x ¹
5.2.1	Materials ²	x	x	x
5.2.2	Microbial contamination	x	–	x ³
5.2.3	Chemical tests	x	–	x ⁴
5.3	Tensile strength, watertight condition and resistance to high temperatures	x	x ⁵	–
5.4	Pressure loss	x	–	–
5.5	Water surge pressure	x	–	–
5.6	Noise	x	–	–
5.7	Maintaining safety of the equipment	x	–	x
5.8	Marking the direction of flow	x	–	x
5.9	Electrical safety	x	–	x
5.10	Connections	x	–	–
5.11	Installation, operating and maintenance instructions	x	–	x
5.12	Marking	x	–	x
The monitoring system and reviewing the monitoring system		–	–	x

¹ Tests only every four years

² W 270 test only for the input material

³ Tests only every four years

⁴ Tests only every four years

⁵ Tests pursuant to dynamic pressure fluctuation test on at least 2 pcs./batch for casing parts subject to pressure

Annex 2: Water Extraction Times Extended W 512 Test – Part I: Flow Rate 0 – 1.5 m³ /h

Time	Duration in seconds	Flow Rate liters/min	Water Vol in liters		Time	Duration in seconds	Flow Rate liters/min	Water Vol in liters
2:00	35	10	5.83		17:00	60	5	5.00
5:30	30	10	5.00		17:14	1	15	0.25
6:00	60	5	5.00		17:30	60	5	5.00
6:36	50	10	8.33		17:46	3	15	0.75
6:47	60	10	10.00		18:00	120	5	10.00
6:52	4	15	1.00		18:12	70	10	11.67
6:58	30	20	10.00		18:30	60	5	5.00
7:24	15	15	3.75		18:40	3	15	0.75
7:32	45	10	7.50		19:00	60	5	5.00
8:00	60	5	5.00		19:14	50	20	16.67
8:04	40	10	6.67		19:16	1	15	0.25
8:12	3	15	0.75		19:30	60	5	5.00
8:30	60	5	5.00		19:32	8	15	2.00
8:40	2	15	0.50		19:40	50	10	8.33
9:00	120	5	10.00		20:00	60	5	5.00
9:10	1	15	0.25		20:20	60	5	5.00
9:30	60	5	5.00		20:30	10	15	2.50
10:00	60	5	5.00		21:26	20	15	5.00
10:18	3	15	0.75		21:32	960	1	16.00
10:30	60	5	5.00		22:00	60	5	5.00
11:00	60	5	5.00		22:08	120	5	10.00
11:16	40	10	6.67		22:15	60	5	5.00
11:24	20	15	5.00		22:40	100	15	25.00
11:34	2	15	0.50				Total	375.33
12:00	60	5	5.00					
12:08	45	15	11.25					
12:30	60	5	5.00					
13:00	60	5	5.00					
13:16	2	15	0.50					
13:30	60	5	5.00					
13:40	2	15	0.50					
14:00	60	5	5.00					
14:24	60	10	10.00					
14:26	2	15	0.50					
14:38	50	10	8.33					
15:00	60	5	5.00					
15:16	1	15	0.25					
15:30	60	5	5.00					
15:40	16	15	4.00					
16:00	60	5	5.00					
16:20	190	5	15.83					
16:40	50	15	12.50					

Values shaded in gray obtained via drinking water extraction (W 512 extractions)

Annex 2: Water Extraction Times Extended W 512 Test – Part II: Flow Rate 1.51 – 3.0 m³/h

Time	Duration in seconds	Flow Rate liters/min	Water Vol in liters		Time	Duration in seconds	Flow Rate liters/min	Water Vol in liters
2:00	35	10	5.83		12:00	60	5	5.00
2:45	35	10	5.83		12:08	45	15	11.25
5:30	30	10	5.00		12:30	60	5	5.00
6:00	60	5	5.00		13:00	60	5	5.00
6:15	3	15	0.75		13:16	2	15	0.50
6:17	2	15	0.50		13:18	45	15	11.25
6:22	5	15	1.25		13:30	60	5	5.00
6:36	50	10	8.33		13:40	2	15	0.50
6:40	50	10	8.33		13:50	70	15	17.50
6:47	60	10	10.00		14:00	60	5	5.00
6:50	3	15	0.75		14:20	1	15	0.25
6:52	4	15	1.00		14:22	60	10	10.00
6:54	4	15	1.00		14:24	60	10	10.00
6:58	30	20	10.00		14:26	2	15	0.50
7:33 ⁶	3	15	0.75		14:38	50	10	8.33
7:10	20	15	5.00		14:44	50	10	8.33
7:13	60	10	10.00		14:50	180	5	15.00
7:24	15	15	3.75		15:00	60	5	5.00
7:32	45	10	7.5		15:10	2	15	0.50
7:49	60	20	20.00		15:16	1	15	0.25
8:00	60	5	5.00		15:20	3	15	0.75
8:04	40	10	6.67		15:30	60	5	5.00
8:12	3	15	0.75		15:32	1	15	0.25
8:20	60	5	5.00		15:33	1	15	0.25
8:30	60	5	5.00		15:40	16	15	4.00
8:40	2	15	0.50		15:44	40	20	13.33
9:00	120	5	10.00		15:50	1	15	0.25
9:10	1	15	0.25		16:00	60	5	5.00
9:30	60	5	5.00		16:02	300	5	25.00
10:00	60	5	5.00		16:20	380	5	31.67
10:14	45	15	11.25		16:36	1	15	0.25
10:18	3	15	0.75		16:40	50	15	12.50
10:22	60	10	10.00		16:43	150	10	25.00
10:24	16	15	4.00		17:00	60	5	5.00
10:30	60	5	5.00		17:04	60	10	10.00
10:54	12	15	3.00		17:14	1	15	0.25
11:00	60	5	5.00		17:20	1	15	0.25
11:10	45	15	11.25		17:30	60	5	5.00
11:16	40	10	6.67		17:46	3	15	0.75
11:20	4	15	1.00		17:50	70	10	11.67
11:24	20	15	5.00		18:00	120	5	10.00
11:34	2	15	0.50		18:04	2	15	0.50
11:40	1	15	0.25		18:06	1	15	0.25

Values shaded in gray obtained via drinking water extraction (W 512 extractions)

⁶ Translator's note: probably should be 7:03

Annex 2: Water Extraction Times Extended W 512 Test – Part II: Flow Rate 1.51 – 3.0 m³ /h

Time	Duration in seconds	Flow Rate liters/min	Water Vol in liters
18:10	16	15	4.00
18:12	70	10	11.67
18:20	70	10	11.67
18:30	60	5	5.00
18:40	3	15	0.75
18:50	1	15	0.25
19:00	60	5	5.00
19:06	90	15	22.50
19:14	50	20	16.67
19:15	1	15	0.25
19:16	1	15	0.25
19:20	1	15	0.25
19:30	60	5	5.00
19:32	8	15	2.00
19:40	50	10	8.33
19:50	30	10	5.00
20:00	60	5	5.00
20:08	40	15	10.00
20:20	60	5	5.00
20:26	60	5	5.00
20:30	10	15	2.50
20:40	40	15	10.00
20:46	45	15	11.25
21:02	2	20	0.67
21:04	3	20	1.00
21:06	2	20	0.67
21:14	210	5	17.50
21:26	40	15	10.00
21:28	10	15	2.50
21:30	3	20	1.00
21:32	960	1	16.00
22:00	60	5	5.00
22:08	120	5	10.00
22:15	60	5	5.00
22:40	100	15	25.00
		Total	750.17

Values shaded in gray obtained via drinking water extraction (W 512 extractions)

Annex 2: Water Extraction Times Extended W 512 Test – Part III: Flow Rate 3.01 – 6.0 m³ /h

Time	Duration in seconds	Flow Rate liters/min	Water Vol in liters		Time	Duration in seconds	Flow Rate liters/min	Water Vol in liters
2:00	35	10	5.83		12:00	60	5	5.00
2:45	35	10	5.83		12:08	90	15	22.50
5:30	30	10	5.00		12:30	60	5	5.00
6:00	360	5	30.00		13:00	60	5	5.00
6:00	60	5	5.00		13:06	360	1	6.00
6:15	300	15	75.00		13:16	20	15	5.00
6:22	5	15	1.25		13:18	90	15	22.50
6:36	50	10	8.33		13:30	60	5	5.00
6:40	50	10	8.33		13:40	20	15	5.00
6:47	120	10	20.00		13:50	70	15	17.50
6:50	3	15	0.75		14:00	60	5	5.00
6:52	4	15	1.00		14:20	1	15	0.25
6:54	4	15	1.00		14:22	120	10	20.00
6:58	60	20	20.00		14:24	60	10	10.00
7:03	3	15	0.75		14:26	30	15	7.50
7:10	20	15	5.00		14:38	50	10	8.33
7:13	300	10	50.00		14:44	50	10	8.33
7:24	15	15	3.75		14:50	180	5	15.00
7:32	45	10	75		15:00	60	5	5.00
7:49	120	20	40.00		15:10	60	15	15.00
8:00	60	5	5.00		15:16	1	15	0.25
8:04	40	10	6.67		15:20	3	15	0.75
8:12	30	15	7.50		15:30	60	5	5.00
8:20	60	5	5.00		15:32	1	15	0.25
8:30	60	5	5.00		15:33	180	15	45.00
8:40	20	15	5.00		15:40	16	15	4.00
9:00	120	5	10.00		15:44	40	20	13.33
9:10	180	15	45.00		15:50	1	15	0.25
9:30	60	5	5.00		16:00	60	5	5.00
10:00	5	15	1.25		16:02	600	5	50.00
10:00	60	5	5.00		16:20	380	5	31.67
10:14	90	15	22.50		16:36	60	15	15.00
10:18	30	15	7.50		16:40	100	15	25.00
10:22	60	10	10.00		16:43	300	10	50.00
10:24	16	15	4.00		17:00	60	5	5.00
10:30	60	5	5.00		17:04	60	10	10.00
10:54	12	15	3.00		17:14	100	15	25.00
10:58	2	15	0.50		17:20	1	15	0.25
11:00	60	5	5.00		17:30	4	15	1.00
11:10	90	15	22.50		17:30	60	5	5.00
11:16	40	10	6.67		17:46	30	15	7.50
11:20	4	15	1.00		17:50	70	10	11.67
11:24	20	15	5.00		17:56	6	15	1.50
11:34	180	15	45.00		17:58	2	15	0.50
11:40	1	15	0.25		18:00	120	5	10.00

Values shaded in gray obtained via drinking water extraction (W 512 extractions)

Annex 2: Water Extraction Times Extended W 512 Test – Part III: Flow Rate 3.01 – 6.0 m³ /h

Time	Duration in seconds	Flow Rate liters/min	Water Vol in liters
18:04	2	15	0.50
18:06	60	15	15.00
18:10	16	15	4.00
18:12	70	10	11.67
18:20	70	10	11.67
18:24	4	15	1.00
18:28	2	15	0.50
18:30	60	5	5.00
18:40	20	15	30.00
18:50	1	15	0.25
18:54	1	15	0.25
19:00	60	5	5.50
19:06	180	15	45.00
19:14	50	20	16.67
19:15	1	15	0.25
19:16	60	15	15.00
19:20	1	15	0.25
19:28	4	15	1.00
19:30	60	5	5.00
19:32	8	15	2.00
19:40	50	10	8.33
19:50	30	10	5.00
20:00	60	5	5.00
20:08	40	15	10.00
20:20	60	5	5.00
20:26	60	5	5.00
20:30	100	15	25.00
20:40	40	15	10.00
20:46	45	15	11.25
21:02	2	20	0.67
21:04	3	20	1.00
21:06	2	20	0.67
21:14	420	5	35.00
21:26	40	15	10.00
21:28	2	15	0.50
21:30	3	20	1.00
21:32	960	1	16.00
21:54	120	20	40.00
21:58	4	15	1.00
21:59	3	15	0.75
22:00	60	5	5.00
22:08	240	5	20.00
22:15	180	5	15.00
22:40	200	15	50.00
		Total	1499.67

Values shaded in gray obtained via drinking water extraction (W 512 extractions)

Annex 2: Water Extraction Times Extended W 512 Test – Part IV: Flow Rate 6.01 – 14.0 m³ /h

Time	Duration in seconds	Flow Rate liters/min	Water Vol in liters		Time	Duration in seconds	Flow Rate liters/min	Water Vol in liters
2:00	35	10	5.83		12:00	60	5	5.00
2:45	35	10	5.83		12:08	90	15	22.50
5:30	30	10	5.00		12:30	60	5	5.00
6:00	360	5	30.00		12:45	360	10	60.00
6:00	60	5	5.00		13:00	60	5	5.00
6:15	300	30	150.00		13:16	20	15	5.00
6:22	5	15	1.25		13:18	90	15	22.50
6:36	50	10	8.33		13:30	60	5	5.00
6:40	50	10	8.33		13:40	20	15	5.00
6:47	120	20	40.00		13:50	70	15	17.50
6:50	3	15	0.75		14:00	60	5	5.00
6:52	4	15	1.00		14:20	1	15	0.25
6:54	4	15	1.00		14:22	120	20	40.00
6:58	240	40	16.00		14:24	60	10	10.00
7:03	3	15	0.75		14:26	120	15	30.00
7:10	20	15	5.00		14:38	50	10	8.33
7:13	300	20	100.00		14:44	50	10	8.33
7:24	15	15	3.75		14:50	180	5	15.00
7:32	45	10	7.50		15:00	60	5	5.00
7:49	120	40	80.00		15:10	60	30	30.00
8:00	60	5	5.00		15:16	1	15	0.25
8:04	40	10	6.67		15:20	3	15	0.75
8:12	30	15	7.50		15:30	60	5	5.00
8:20	60	5	5.00		15:32	1	15	0.25
8:30	60	5	5.00		15:33	180	30	90.00
8:40	20	15	5.00		15:40	16	15	4.00
9:00	120	5	10.00		15:44	120	40	80.00
9:10	180	30	90.00		15:50	1	15	0.25
9:30	60	5	5.00		16:00	60	5	5.00
10:00	5	15	1.25		16:02	600	10	100.00
10:00	60	5	5.00		16:20	380	10	63.33
10:14	90	30	45.00		16:36	60	15	15.00
10:18	30	15	7.50		16:40	100	30	50.00
10:22	60	10	10.00		16:43	300	20	100.00
10:24	16	15	4.00		17:00	60	5	5.00
10:30	60	5	5.00		17:04	60	10	10.00
10:54	12	15	3.00		17:14	100	30	50.00
10:58	2	15	0.50		17:20	1	15	0.25
11:00	60	5	5.00		17:30	4	15	1.00
11:10	90	30	45.00		17:30	60	5	5.00
11:16	40	10	6.67		17:46	30	15	7.50
11:20	4	15	1.00		17:50	70	20	23.33
11:24	20	15	5.00		17:56	6	15	1.50
11:34	180	30	90.00		17:58	2	15	0.50
11:40	1	15	0.25		18:00	120	5	10.00

Values shaded in gray obtained via drinking water extraction (W 512 extractions)

Annex 2: Water Extraction Times Extended W 512 Test – Part IV: Flow Rate 6.01 – 14.0 m³/h

Time	Duration in seconds	Flow Rate liters/min	Water Vol in liters
18:04	2	15	0.50
18:06	120	30	60.00
18:10	16	15	4.00
18:12	70	20	23.33
18:20	70	20	23.33
18:24	4	15	1.00
18:28	2	15	0.50
18:30	60	5	5.00
18:40	120	30	60.00
18:50	1	15	0.25
18:54	1	15	0.25
19:00	60	5	5.00
19:06	180	30	90.00
19:14	50	40	33.33
19:15	1	15	0.25
19:16	60	30	30.00
19:20	1	15	0.25
19:28	4	15	1.00
19:30	60	5	5.00
19:32	8	15	2.00
19:40	50	20	16.67
19:50	30	10	5.00
20:00	60	5	5.00
20:08	120	30	60.00
20:20	60	5	5.00
20:26	60	5	5.00
20:30	300	30	150.00
20:40	120	30	60.00
20:46	45	15	11.25
21:02	300	40	200
21:14	420	10	70.00
21:26	40	15	10.00
21:28	2	15	0.50
21:30	60	40	40.00
21:32	960	10	160.00
21:54	120	20	40.00
21:58	4	15	1.00
21:59	3	15	0.75
22:00	60	5	5.00
22:08	240	15	60.00
22:15	180	5	15.00
22:40	600	30	300.00
		Total	3490.14

Values shaded in gray obtained via drinking water extraction (W 512 extractions)