SLOVENSKI STANDARD
SIST EN 14897:2006+A1:2007

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Oprema, ki se uporablja za pripravo pitne vode v stavbah - Naprave z ģivosrebrnimi nizkotlaļ nimi ultravijoliļ nimi sevalniki - Zahteve za delovanje, varnost in preskuģanje

Water conditioning equipment inside buildings - Devices using mercury low-pressure ultraviolet radiators - Requirements for performance, safety and testing

Anlagen zur Behandlung von Trinkwasser innerhalb von Gebäuden - Geräte mit Quecksilberdampf-Niederdruckstrahlern - Anforderungen an Ausführung, Sicherheit und Prüfung

Appareils de traitement d'eau a l'intérieur des bâtiments - Dispositifs utilisant des radiateurs a mercure et basse pression de rayonnement UV - Exigences de performance, de sécurité et essais

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13.060.20	Pitna voda	Drinking water
91.140.60	Sistemi za oskrbo z vodo	Water supply systems

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English Version

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This European Standard was approved by CEN on 10 May 2006 and includes Amendment 1 approved by CEN on 10 May 2007.

CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration. Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the CEN Management Centre or to any CEN member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CEN member into its own language and notified to the CEN Management Centre has the same status as the official versions.

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EUROPEAN COMMITTEE FOR STANDARDIZATION
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Foreword

This document (EN 14897:2006+A1:2007) has been prepared by Technical Committee CEN/TC 164 “Water supply”, the secretariat of which is held by AFNOR.

This document shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by December 2007 and conflicting national standards shall be withdrawn at the latest by December 2007.

This document includes Amendment 1, approved by CEN on 2007-05-10.

This document supersedes EN 14897:2006.

The start and finish of text introduced or altered by amendment is indicated in the text by tags [A1] [A1].

With respect to potential adverse effects on the quality of water intended for human consumption/caused by the product covered by this standard, the following is pointed out to the user of the standard.

1) This standard provides no information as to whether the product may be used without restriction in any of the Member States.
2) It should be noted that, while awaiting the adoption of verifiable European criteria, existing national regulations concerning the use and/or characteristics of this product remain in force.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Bulgaria, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland and United Kingdom.

1 Scope

This document specifies definitions, principles of construction, requirements and methods for testing the performance of UV devices for drinking water installations inside buildings which are permanently connected to the mains supply at the point of entry into a building or within the water distribution system inside the building.

UV devices in the sense of this standard are UV bactericidal treatment devices or UV disinfection devices.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

EN 1717, *Protection against pollution of potable water in water installations and general requirements of devices to prevent pollution by backflow*

3 Definitions

For the purposes of this document, the following terms and definitions apply.

3.1
absorption
decrease of the incident irradiance of a light beam including transformation into other forms suffered by radiant energy passing through a material substance (e. g. heat)

3.2
irradiance
measure of the UV light flux divided by the area that intercepts the radiation, in W/m^2

NOTE The irradiance measured in UV disinfection devices by the UV device sensor is mainly influenced by the lamp output, the transmittance of the water, and scaling/fouling of the protective quartz sleeves and the position of the lamps in the radiation chamber.

3.3
disinfection
action of killing or inactivating all types of pathogenic bacteria to a specified degree of at least 99,999 % and all types of pathogenic viruses to a degree of at least 99,99 % using a UV disinfection device

3.4
bactericidal treatment
action of inactivating or killing bacteria present in water to an unspecified degree using a UV bactericidal treatment device

3.5
fluence
dose
product of irradiance in W/m^2 and exposure time in s, in J/m^2

NOTE Fluence is the correct term from a strictly scientific point of view.

3.6
germicidal fluence
fluence weighted with the germicidal UV sensitivity, in J/m^2

3.7
reduction equivalent fluence (REF)
average germicidal fluence measured by the biodosimeter in accordance with 5.3 in the radiation chamber, in J/m^2

3.8
radiation chamber
part of the device that comprises the radiation zone and the connecting pipes

3.9
radiation zone
part of the radiation chamber whose volume is used for the calculation of the fluence

3.10
exposure time
time interval during which a specific volume of water within the radiation zone is exposed to the radiation, in s

3.11
microbiological dosimeter;
biodosimeter
test organism used to determine the equivalent fluence, whose UV inactivation behaviour has been determined in a standard collimated beam apparatus (see Annex B), e. g. *Bacillus subtilis* spores

3.12
minimum irradiance
value determined in the type test that ensures the required reduction equivalent fluence at a defined water flow rate and at a defined UV transmittance value, in W/m^2

3.13
flow rate (Q)
volume of water per unit time flowing through the UV device, in l/min or m^3/h

3.14
maximum flow rate (Q_{max})
highest flow at which, at a defined UV transmittance of the water and a defined irradiance, the required reduction equivalent fluence can be guaranteed, in l/min or m^3/h

3.15
permissible operation range
those limit values for the operation parameters (irradiance at the sensor or UV transmittance of the water) and flow rate where adequate bactericidal treatment or disinfection is assured

3.16
sensor
system for the measurement of the irradiance in UV disinfection devices

3.16.1
reference sensor
sensor used to countercheck the signal of the device sensor where national regulations apply.

NOTE The reference sensor should comply to national standards where existent, e.g. [2], [3].

3.16.2
selectivity
percentage of the sensor signal that is produced by radiation with a wavelength of 254 nm

3.16.3
device sensor
calibrated sensor monitoring device used for continuous measurement of the irradiance

3.17
attenuation
absorption and diffraction of radiation passing through an optical medium in a specific direction

3.18
lamp service life
service life of a UV radiator after which the irradiance that is necessary to guarantee the minimum fluence can no longer be reached under the mode of operation given by the manufacturer, and the lamp has to be replaced, in h

3.19
UV lamp
radiator which produces UV light

3.20
UV device
general expression for products using UV light to irradiate water flow through, with the purpose of inactivating microrganisms being present in the water

3.21
UV disinfection device
device designed to disinfect water

3.22
UV bactericidal treatment device
device designed for bactericidal water treatment

3.23
turbidity
reduction of optical transmittance of a liquid caused by the presence of undissolved matter

3.24
UV transmittance (% T_{100})
spectral transmission rate at a wavelength of 254 nm at an optical path length in the medium of 100 mm, in %

NOTE In general, the UV transmittance includes the influence of attenuation and absorption of the through passing medium. The UV transmittance is measured in the unfiltered sample in quartz cuvettes of at least 40 mm at a wavelength of 254 nm in a spectrophotometer and is given in %.

3.25
UV radiation (UV)
electromagnetic radiation according to Table 1

Table 1 — UV radiation

Type	Wavelength nm
UV-C	> 100 ≤ 280
UV-B	> 280 ≤ 315
UV-A	> 315 ≤ 400
NOTE For bactericidal and disinfection purposes, part of the UV-C range is used.	

4 Requirements

4.1 General

The treatment of water with the UV device shall yield a reduction equivalent fluence of at least 400 J/m^2 (40 mJ/cm^2), at a wavelength of 254 nm in the defined operational range.

4.2 Radiation chamber

The radiation chamber is made of corrosion resistant and UV resistant materials. Materials and substances used shall be suitable for contact with drinking water.

NOTE Product intended for use in water supply systems should comply, when existing, with national regulations and testing arrangements that ensure fitness for contact with drinking water. The Member states, relevant regulators and the EC Commission agreed on the principles of a future unique European Acceptance Scheme (EAS), which would provide a common testing and approval arrangement at European level. If and when the EAS is adopted, European Product Standards will be amended by the addition of an Annex Z/EAS under Mandate M/136, which will contain formal references to the testing, certification and product marking requirements of the EAS.

The mechanical design and the construction shall comply with the relevant requirements for the pressure present. Direct or indirect leaking of radiation from the radiation chamber to the environment with a wavelength below 400 nm shall be avoided.

Radiation chambers shall be constructed in a way that they are easily serviceable.

For UV disinfection devices, the radiation chamber shall be provided with a sensor for a representative irradiation measurement. The location of the sensor shall be designed so that the irradiation measurement is not disturbed by gas bubbles or sediment deposits.

4.3 Low-pressure mercury UV lamps

In order not to produce ozone, only lamps with a radiation range above 240 nm shall be used. [A1] At the mercury resonance line of 254 nm shall be 85 % of the total radiation intensity in the UV-C range. [A1]

Lamp(s) shall be marked with a designation of type. Only those lamps used for the type test shall be used in the UV device. The UV lamp(s) shall be approved for the device by the manufacturer or be equivalent to the approved type used at the type test.

4.4 Electrical

4.4.1 General

For the electrotechnical design of UV devices, the relevant EC Directives and CE marking requirements shall be accomodated. Compliance with these EC Directives is a requirement of this standard. [A1] *deleted text* [A1]

4.4.2 UV disinfection devices

4.4.2.1 Controller

The UV disinfection device shall be equipped with a controller, which provides the following functions:

— when switching on the device, the signal for the waterflow shall be delayed until the minimum irradiance is reached;

— operation and failure of the electrical function of each lamp shall be indicated;

— operation beyond the permissible limits of operation shall be indicated and a signal shall be provided which allows the waterflow to be stopped;

— general malfunction signal shall be provided;

— when shutting down the device or in case of a breakdown of the electric power supply, a signal shall be provided which allows the stop of waterflow.

The following functions shall be displayed:

— device in function;

— failure signal for each lamp;

— irradiance, in W/m^2;

— service time of the UV lamps;

— flow-related alarm point(s).

4.4.2.2 Sensor

For the measurement of the irradiation, a sensor shall be provided to ensure disinfection under consideration of possible changes in water UV transmittance and lamp performance. Requirements for the device sensor are given in Annex A. Where national regulations apply, a sensor and monitoring window may have to fulfil certain requirements.

NOTE An example for a monitoring window is shown in Annex C.

4.4.3 UV bactericidal treatment devices

The UV bactericidal treatment devices shall be equipped with a controller, which provides the following functions:

— operation and failure of the electrical function of the lamp(s) shall be indicated;

— general malfunction signal shall be provided.

The following functions shall be displayed:

— device in function;

— service time of the UV lamps.

4.5 Performance

The UV device shall apply a reduction equivalent fluence of at least 400 J/m^2 at the end of the lamp service life for the specified flow rates and UV transmittance values.

The performance is evaluated with a type test for which the manufacturer shall provide information in accordance with Annex D.

4.6 Labelling

The information to be given on a nameplate, which shall be permanently fixed to the UV device and be legible when installed, shall be in accordance with Annex E.

4.7 Manual

The manual shall describe operation, control, cleaning and service measures.

The manual shall also contain at least the following information:

— operating diagram: transmittance vs. maximum admissible flow;

— water resulting from sampling (rinsing) shall be adequately disposed of to the provisions of EN 1717;

— replacement intervals for UV lamp(s), sensor (only for UV disinfection devices).

5 Testing

5.1 General

The manufacturer shall provide the details and documentation described in Annex D. The device to be tested is checked for conformity to the documentation.

The purpose of the type test is to verify that the UV fluence delivered by the device under test meets a reduction equivalent fluence of 400 J/m^2 at the end of the lamp life, at the specified flow rates and transmittance values.

Parameters to be changed during the test are the flow rate of the water and the UV transmittance of the water for the test of UV bactericidal treatment devices and the flow rate, the transmittance and the lamp-output, for the test of UV disinfection devices.

For the type test of UV disinfection devices the UV device shall be equipped with a sensor or with a specified monitoring window and a specified sensor if national regulation for these apply. The testing in the test rig comprises of five steps:

— checking the compliance of the device to be tested with the specifications;

— data collection during the test (flow rate, water temperature, electrical power consumption, ...);

— radiation physics tests, i.e. determination of the irradiance (only for UV disinfection devices);

— microbiological test with the biodosimeter;

— evaluation of the UV device and specification of the operating range.

The manufacturer shall provide data (flow rate versus UV transmittance), that give the testing points at which the UV fluence (400 J/m^2) is reached at the end of the lamp service time and the percentage of UV output at the end of lamp service life (e.g. 70 %). The permissible operational range is determined by measurements of at least three test points which should cover the whole operational range.

The UV device to be tested shall have new lamps that have been in service for 100 h. The manufacturer shall provide an appropriate method to vary the output of the UV lamps.

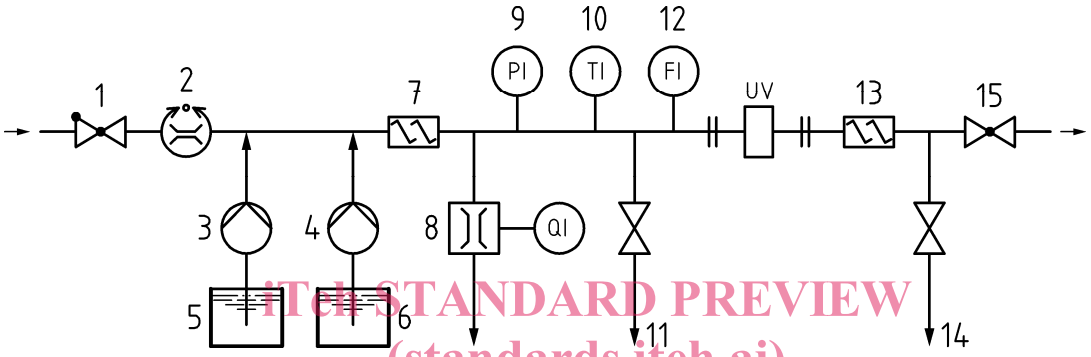
5.2 Test rig and installation

The test rig (see Figure 1) consists of a water supply with test water, wastewater removal, electrical equipment (voltage regulator), dosing device for the biodosimeter and the transmittance reducing solution, and static mixers.

The UV device is installed in the test rig and put into operation as specified by manufacturer or supplier. The UV device shall be attached to the water supply with respect to the length, configuration and nominal diameter of the inlet and outlet pipe defined by the manufacturer for the UV device.

The test water shall have a UV transmittance of at least 80 % to allow the regulation of the test conditions.

Calibrated registering measuring instrumentation for flow rate, pressure, water temperature, UV transmittance and electrical parameters (current voltage) are required.



Key

1 Water inlet with check valve
2 Flow adjustment valve
3 Dosing pump, sodium thiosulfate
4 Dosing pump, biodosimeter
5 Sodium thiosulfate solution
6 Biodosimeter
7 Static mixer before UV device
8 Measurement UV transmittance device in the flow
9 Pressure measurement device
10 Temperature measurement device
11 Sampling point before UV device
12 Flowmeter
13 Static mixer after UV device
14 Sampling point after UV device
15 Stopvalve

Figure 1 — Test rig (schematic)

5.3 Biodosimetric measurements

As soon as stable operating conditions for the test rig and the UV device at a test point are reached, the biodosimeter is added to the inlet flow. Optimum mixing is achieved by the static mixer (concentration of the biodosimeter after mixing about $10^6 l^{-1}$ to $10^7 l^{-1}$).

Take the samples after UV irradiation and also after a static mixer. During the test, there shall be continuous flow through the sampling ports.

For each test point and measuring cycle, five samples shall be taken before and after UV irradiation respectively.

The determination of the concentration of the biodosimeter as number of colony forming units (CFU) is done in triplicate using a decimal dilution series. Use the pour plate method with plate count agar. Incubate for (48 ± 4) h at (37 ± 1) °C. Use three agar plates (diameter 90 mm) of the dilution step that results in 20 to 200 colonies per plate. The arithmetic average of the three counts is multiplied by the dilution factor and converted into the decadic logarithm. This results in five lg-concentration before and five lg-concentration after UV irradiation, of which the arithmetic average is calculated (lg N_0: before irradiation, lg N_1: after irradiation). The standard deviation s of the five parallel samples shall not exceed ± 0,2. Otherwise the test conditions are not stable (hydraulics, dosing, mixing). By calculating lg(N/N_0), the reduction at the test point is determined. In