Český metrologický institut

# Type Approval Certificate

No. 0111-CS-A029-20

## Revision 1

Czech Metrology in accordance with the Law of metrology No. 505/1990 Coll. as amended

**approved**

**Radon volume activity monitor**
**type TSR series**

under observation of technical data referred to in Annex of this Certificate.
This revision replaces all previous versions in full wording.

Type approval mark: **TCM 442/20 - 5753**

Applicant: **TESLA Hloubětín a.s.**
**Poděbradská 186/56**
**198 00 Praha**
**Czech Republic**
**ID: 03896048**

Manufacturer: **TESLA Hloubětín a.s.**
**Czech Republic**

Valid until: **10 September 2030**

**Information on judicial remedies:**
The judicial remedies against this decision are available to the applicant through Czech Metrology Institute to Czech Office for Standardization, Metrology and Testing within 15 days since the receipt of this Certificate.

**Description:**
Essential characteristic, approved conditions special conditions, examination results including technical drawings and schemas are set out in the technical test report appertaining to this certificate. The certificate comprises the front page and the technical test report. Certificate has 4 pages.

Český metrologický institut
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RNDr. Pavel Klenovský
Director General

Brno, 19 February 2021

Technical Test Report

## 1 Device description

The TSR series of continuous monitor according to this type approval includes the following self-measuring probes: TSR3D, TSR3DNM, TSR4, TSR4M, TSR4A, TSR4S, TSRE1, TSRS, TSRS2, TSRG1.

These probes determine the metrological properties of the measuring system of which they may be a part. Each of these probes contains an alpha radiation detector (photodiode) and power supply circuits, circuits for signal processing from the detector and a processor evaluating the results (calculation of average values of radon volume activity - RVA). Radon penetrates the measuring chamber (by diffusion through an aerosol filter), in which an electrostatic field acts, which concentrates on the detector positively charged ions, created by the radioactive conversion of radon $^{222}Rn$. The volume activity of radon is calculated from the measured counts, using the spectrometric properties of the detector: both the activity of the daughters $^{218}Po$ (faster response) and the ratio of activities $^{218}Po$ + $^{214}Po$ (with a slower response, but better statistical uncertainty) are determined. For historical reasons, these measuring procedures are marked "RaA" and "RaA + RaC". The measured data are stored in the memory of the device, the indicated value of volume activity is a long-term average (smoothed value of short-term measurements). The results of instantaneous values and short-term averages are accessible only as informative values and as an input to the algorithm of averaging (smoothing) values. The measured value, to use for radiation protection, is the long-term average of the RVA.

The transfer of measured data does not affect the metrological properties. For commercial reasons, it is possible to use several options for communication with the meter probe. These variants differ only in access to data on inner memory and positioning options. An overview of variants is in Table 1.

Table 1: overview of variants:

| Probe type | Data access 1 | Data access 2 | Positioning | Display | More memory | Ventilation control |
|---|---|---|---|---|---|---|
| TSR 4 | USB | WLAN 868 MHz | | | | + |
| TSR 3DN | USB | WLAN 868 MHz | | + | | + |
| TSR 4M | USB | | | | + | |
| TSR 3DNM | USB | | | + | + | |
| TSR 4S | USB | SIGFOX | GPS | | | |
| TSRE1 | Ethernet | Wi-Fi | | | + | |
| TSRS | UART | RELAY | | | | + |
| TSRS2 | RS-485 | | | | | |
| TSR4A | analog voltage 0-10 V | | | | | + |
| TSRG1 | GSM/LTE | | GPS | | | |

## 2 Basic metrological characteristics

Table 2: stated metrological characteristics

| | |
|---|---|
| Sensitivity | 0,25 count/hod/Bq.m$^{-3}$ (RaA + RaC) |
| Measuring range | from MDA to 0,1 MBq.m$^{-3}$<br>MDA: 100 Bq.m$^{-3}$ (measuring time 1 hour)<br>20 Bq.m$^{-3}$ (measuring time 24 hours) |
| Uncertainty of measuring | ≤ 13% for 300 Bq. m$^{-3}$ and meas. interval 1 hour<br>≤ 3% for 300 Bq. m$^{-3}$ and meas. interval 24 hours |
| Response time | < 30 min (RaA)<br>< 3 hour (RaA + RaC) |
| Meas. chamber volume | 176 cm$^3$ |
| Sampling method | pasive diffusion to the measuring chamber |
| Method of detection | α spectrometry |
| Power supply | Li-Ion batery, 3,6 V |
| Correction for the environment | temperature, humidity |
| Indication RVA | fast (0,5 hour average)<br>slow (24 hour average) |
| Environment: | |
| Temperature | from -20 °C to + 60 °C |
| Humidity | from 10 % to 90 % |

## 3 Data on the device

All data must be placed on the probe, even if remote data access is used. The probe must be provided with a production label with the type designation, manufacturer's name, serial number, and with the type approval mark (its length must not be less than the production label length). The remote access device marking is optional.

## 4 Test

The test was performed in the laboratory of the State Institute of Nuclear, Chemical and Biological Protection, v.v.i .: AMS 113 (Kamenná 71, 262 31 Milín). The test was performed on standards of this metrological center (state standards of radon volume activity and equivalent volume activity of radon and daughter products) according to the requirements of technical standard IEC 61577-1 (2006) resp. IEC 61577-2 and according to approved AMS methodological procedures. TSR 4 probes with serial numbers 19086 and 19087 (without central unit - remote access) were tested. The results are given in the protocols File no. SÚJCHBO/1196/J-4.2.4/20/Vo and SÚJCHBO/1911/J-4.2.4/20/Vo.

In accordance with the above documents, the following tests were performed:

1) test of the influence of radon volume activity fluctuations on the result of measuring the averaged RVA value
2) test of the influence of the meter indication on the sampling time (averaging)
3) determination of diffusion rate (radon penetration into the measuring chamber)
4) verification of the independence of the measurement result on the relative humidity of the air
5) determination of the influence of factor F (imbalances of radon daughters) on the measurement result
6) test of measuring range and linearity of response
7) test of independence of response to external gamma radiation

The measuring device is designed for measurement of long-term averages of radon volume activity (the determined value of the minimum detectable volume activity of radon RVA is 150 Bq / m$^3$ for a measuring time of 1 hour). The minimum detectable volume activity is acceptable for use in checking compliance with radiation protection limit values (at least 100 Bq/m$^3$ for the all-day averaging). The upper limit of the measuring range was confirmed by the value given by the manufacturer. According to mandatory AMS test methodologies, the criterion of deviation is ≤ 20%. The correctness and accuracy of the measurement always depends on the measurement time used. Sampling times of 60 minutes were used for the tests.

**The device is able to perform the function for which it is intended.**

## 5 Verification

Verification of the device is confirmed by placing an verification mark in the area of the production label. If the measuring probe is located in an inaccessible place, the main verification mark will be placed in an accessible place in the system (evaluation unit) and another mark may be placed on the probe.

## 6 Verification period

The validity verification period is determined by the relevant decree of the Ministry of Industry and Trade.