



CH Type Examination Certificate No CH-K4-20002-00

<i>Applicant</i>	Fachhochschule Nordwestschweiz Institut für Sensorik und Elektronik FHNW/ISE Klosterzelgstrasse 2 5210 Windisch	
<i>Requirements</i>	Ordinance of 15 February 2006 on Measuring Instruments (OIMes, SR 941.210), Annex 2, Module B; Ordinance of the FDJP of 19 March 2006 on Exhaust Gas Analysers (OIGE, SR 941.242) Annexes 4 and 5.	
<i>Type of instrument</i>	Measuring instrument for nanoparticles from combustion engines	
<i>Type designation</i>	HEPaC	
<i>Characteristics</i>	Concentration Range	10 ³ – 5·10 ⁶ pt / cm ³
	Particle size:	23 to 200 nm
<i>Certificate valid until</i>	1 December 2030	
Notified body	Conformity Evaluation Body METAS-Cert No. CH01	

3003 Berne-Wabern, 2 December 2020

Approved by Gulian Couvreur, Head of sector
METAS-Cert



1 Name and type of instrument

Measuring instrument for nanoparticles from combustion engines, type HEPaC in the form of a handheld device.

2 Type description

The Type corresponds with the requirements of the Ordinance of the FDJP of 01 December 2018 on Exhaust Gas Analysers (OIGE, SR 941.242) Annexes 4 and 5.

2.1 Construction

2.1.1 Mechanical

The HEPaC is a hand-held, battery-powered instrument based on the partector2 by naneos (naneos.ch) to measure the number concentration of nanoparticles.

It is equipped with a detachable sampling tube. It displays the measured data on a graphical display, see figure 1.

The device can communicate with devices supporting Bluetooth LE. Main application is the measurement of particles emitted by diesel engines.

A Win10 Software package is supplied to monitor the measuring process on a PC or Tablet and to produce the test report. All the data processing is done in the HEPaC.

2.1.2 Electric

The instrument is equipped with a power supply 12 V and 4.5 A.

A Li-Ion battery is installed with a capacity of 48Wh. The battery autonomy is given with three hours.

2.1.3 Measuring principle

The sampled exhaust gas is first heated to a temperature of 195°C to evaporate volatile species. The whole sensor is heated up to 55°C to avoid renucleation. Particles are then charged by an uni-polar diffusion charger (Corona charger). The ion current in the charger is measured and kept constant by a feedback control loop. The charged particles enter in to an electrostatic precipitator, which is operated pulsed. The charge pulses, leaving the precipitator enter into a stage, where the charge, induced by the charge pulses is measured. Min. and Max. voltage of the precipitator pulses allow to tune the efficiency as function of diameter.

The flow is measured by the pressure drop over a nozzle and kept constant by controlling the pump.

An overview of the parts of the instrument can be seen in figure 1.

2.2 Software / Firmware

The system has two software parts. The firmware runs on the HEPaC handheld device, the actual measuring instrument. The software runs on a PC or a tablet and is used as indicator, controlling device and printer.

2.2.1 Software

The PC software is used to generate the legally relevant measurement reports (in all supported languages). It also displays the status and real time values of the sensor. The software communicates via a Bluetooth LE USB dongle with the sensor.

The PC software is preinstalled on a tablet / laptop and will start automatically after boot.

The software is a Java based program and therefore independent of the operating system. The current version is 1.02

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2.2.2 Firmware

Legally relevant functions and parameters can only be changed by changing the firmware. The cover of the case of the instrument needs to be removed. This will break the sealing sticker.

Afterwards, the Flash Programmer is connected to the to the communication port on the main board. The firmware is stored on a non-volatile flash memory.

The firmware version and the check sum are shown at start up on the display.

The approved software version and the corresponding checksums are:

Type	Firmware-Revision	Checksum	Revision certificate ¹	Valid ² Y/N
HEPaC	139	0x2EDB0450	00	Y

2.3 Permitted functions and devices

- Indicating of the measuring results in SI-Units
- Data storage device
- Error recognition: In start-up phase, all segments of the indicator are for some seconds on and off.
- Test devices for the recognition of significant faults may be installed. The error message is displayed in the indicator by "Err = XX" (XX= error code) or clearly designated
- Sending of the data to an external computer for data processing and creating of test report

3 Technical data

3.1 Measuring instruments for nanoparticles from combustion engines

Table 1

Diameter of particle	Limits of the efficiency E
23 nm	E < 50 %
41 nm	E >40 %
80 nm	70 % < E < 130%
200 nm	E < 300%
30 nm (drops consisting of Tetracontan, concentration to 10 ⁵ cm ⁻³)	E < 5 %

Table 2

Operating pressure range	860 – 1 060 hPa
Mechanical environment conditions	Class M2
Electromagnetic environment conditions	Class E2
Temperature range	5 °C / 40 °C

¹ Revision number of the type examination certificate

² Only valid software/firmware versions may be used.

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3.2 Documentation

All the descriptive documents and drawings used for the conformity assessment are deposited with METAS-Cert and listed in the document "*List of essential reference documents for type examination*".

4 Interfaces and peripheral devices

4.1 Interfaces

Following interfaces are/may be incorporated

- Bluetooth interface
- μ SD card, secured with sealing sticker
- USB interface, secured with sealing sticker

4.2 Connectable peripheral devices

- Any computing unit (Tablet or PC) can be connected by using the above-described software via Bluetooth.

5 Conditions for the market introduction

- The type examination certificate is valid only for measuring instruments for nanoparticles from combustion engines.
- For legal for trade application, the device is only to be used in battery modus
- Measuring values are only valid in above described ranges chapter 3.1

5.1 Legends

5.1.1 Type plate

- Manufacturer's mark or name
- Type designation
- Serial number of the instrument
- Metrological CH conformity marking
- Number of the type examination certificate (CH-K4-20002)
- Temperature range

Additional markings as required by OIGE, SR 941.242 annex 5 and OIMes, SR 941.210 annex 4.

The type plate consists in a support that is auto destructive or sealed by a securing sticker.

The number of Type Examination Certificate on the descriptive plate can be written without the revision number as follows: **CH-K4-20002**

6 Requirements for production, commissioning and utilization

- Documents required: CH type examination certificate, operating manual, declaration of conformity. Copies of the test certificates of modules and peripheral devices if applicable.
- The software and firmware are conforming as described in chapter 2.2
- The sealing is conforming to the description in chapter 8.1
- The type plate is conforming to the description in chapter 5.1.1
- The instrument, switched off, needs to be acclimated to the ambient temperature for at least 3 h before utilization.

6.1 Required equipment for conformity verification

Following equipment is required for verification

- Traceable and calibrated reference CPC.
- Differential Mobility Analyzer according to ISO 15900, 15901-X
- Dilution System
- Soot-Generator, e.g. CAST (Combustion Aerosol Standard)
- Tests are performed according to the most recent QM-Documentation of METAS.

7 Control of devices in operation

7.1 Test documents

See the assembly and operating instructions.

7.2 Identification

The type designation has to be taken from the type plate.

The name of the firmware version and the checksum is shown in the display during starting-up.

7.3 Metrological test

The metrological tests must be carried out according to national applicable regulations.

8 Official stamps and conformity markings

8.1 Securing the casing

Once sealed it is not possible to get inside the device without irreversibly damaging the casing components. In order to exclude repairs, neither the manufacturer nor a third party may place individual casing components onto the market.

The position of the sealing sticker is indicated in figure 5.

8.2 Securing the type shield

The type plate must be self-destructive, otherwise the type plate needs to be secured with a seal (self-adhesive sealing sticker).

9 CH conformity mark and descriptive plate

The type plate must be applied clearly visible on the back of the instrument containing the information listed in 5.1.

The mark of the metrological CH conformity (the CH-marking together with the metrology M-Marking signify conformity with the essential requirements of the OIMes) have to be placed on the type plate.

10 Certificate history

Issue	Date	Description
CH-K4-20002-00	02.12.2020	- First issue

Note: All revisions can be found on www.metas.ch/cs

11 Pictures and drawings

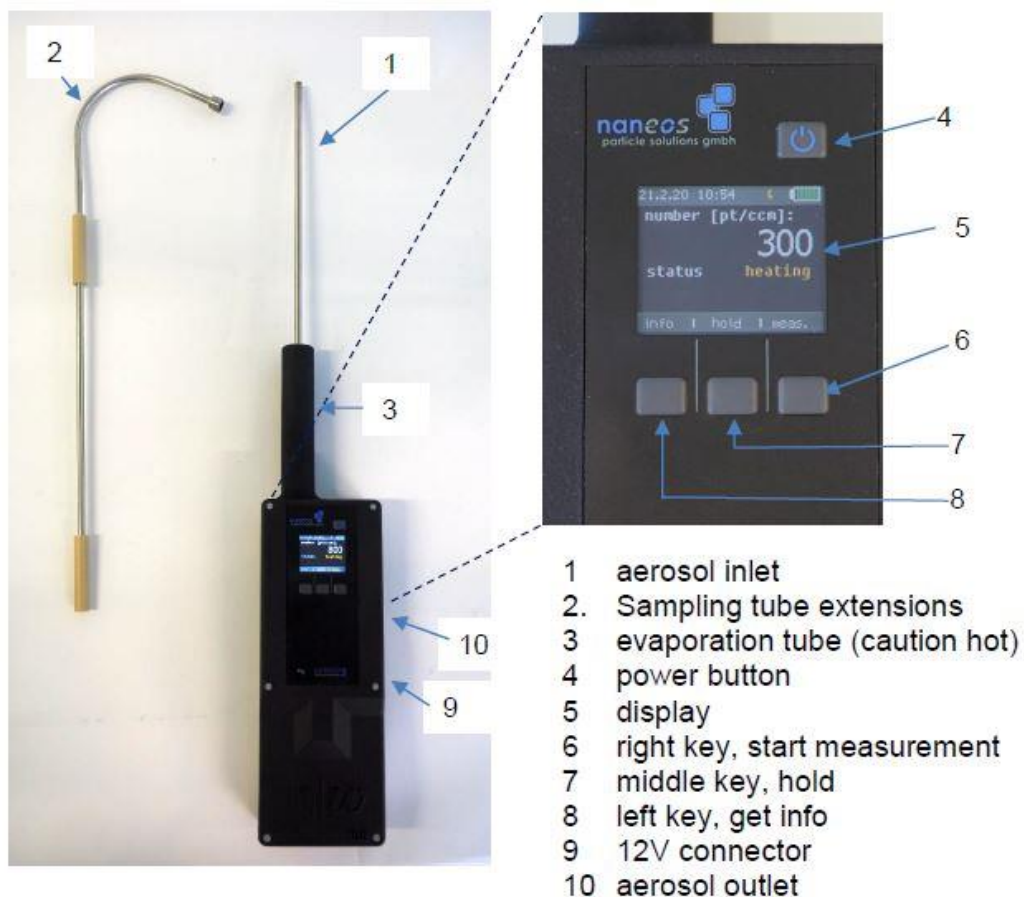


Figure 1 – Overview of HEPaC handheld device

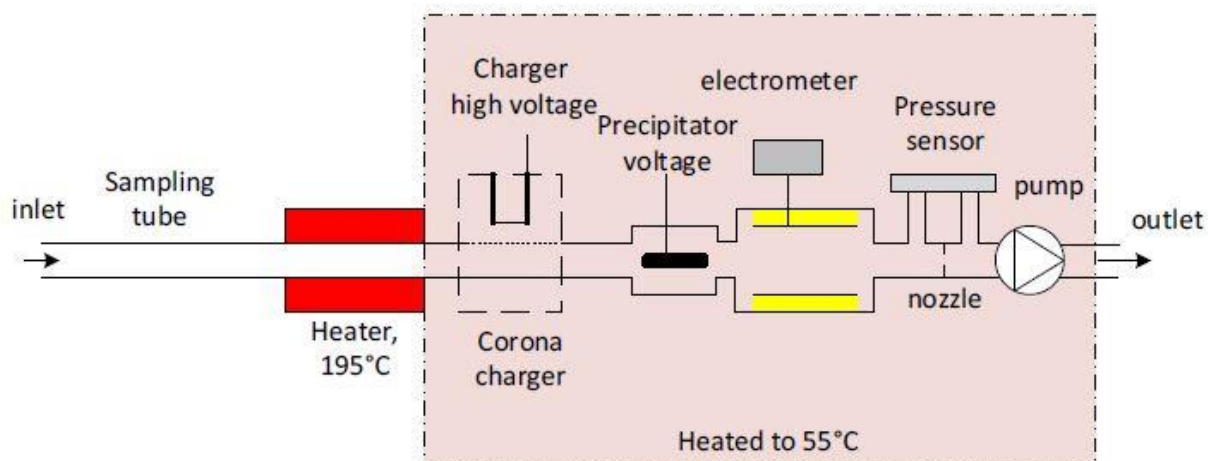


Figure 2 – Sensor flow chart



Figure 3 – PC Software, realtime indication, no current particle measurement

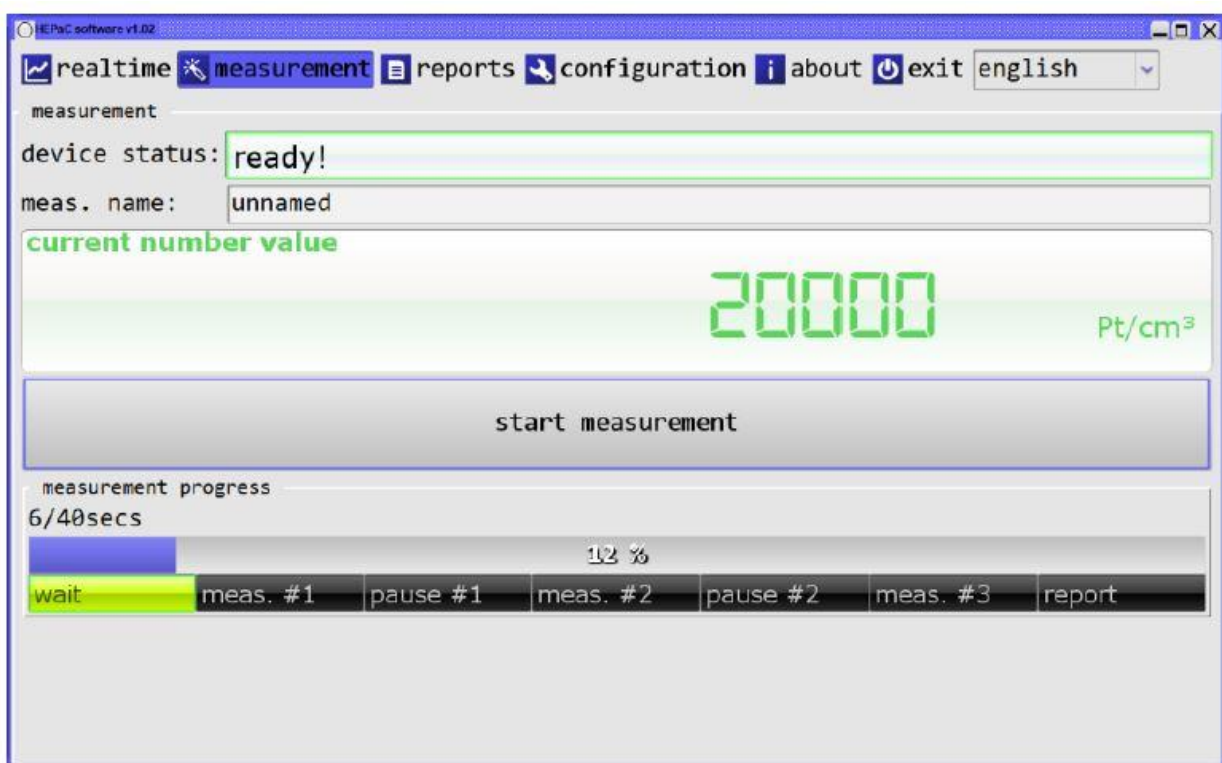


Figure 4 – PC Software, indication during particle measurement



Figure 5: Position of sealing sticker

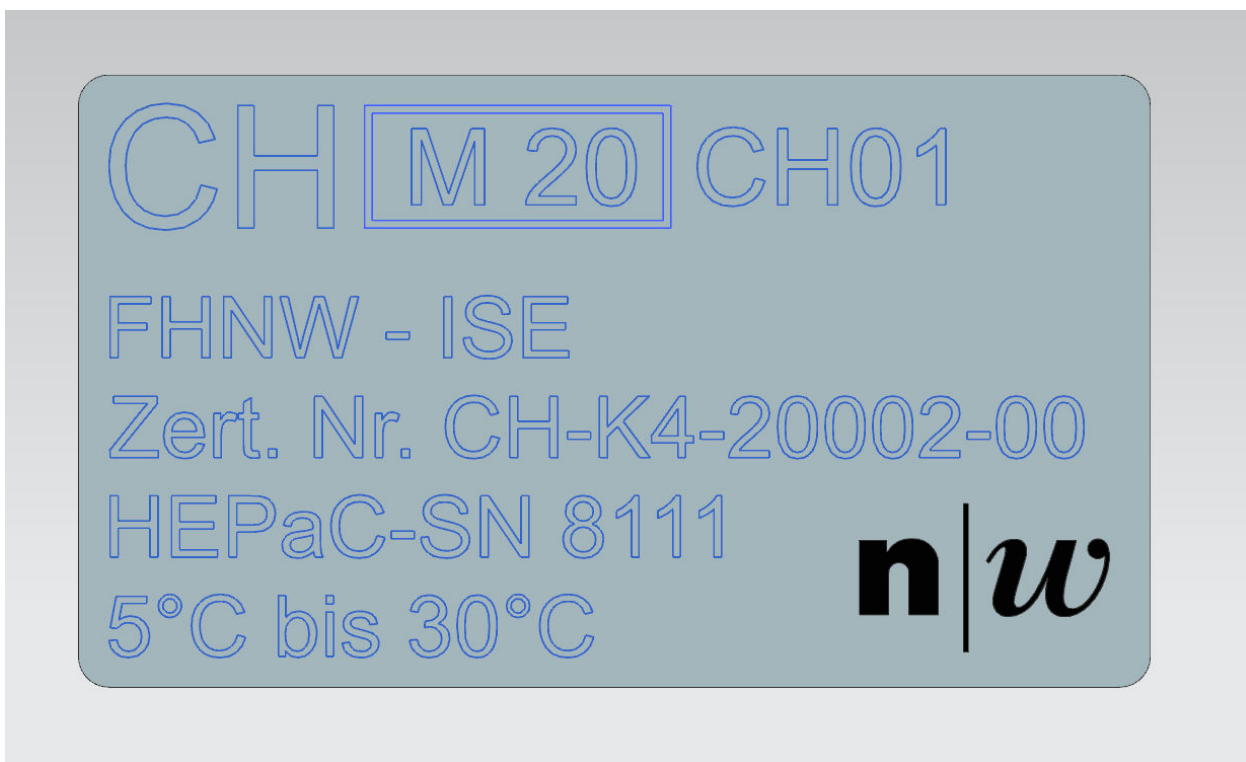


Figure 6: Example of type sign



Figure 7: Position of type plate on the back of the instrument