Test Report HALO P in situ

Tests conducted by ERLAB
In partnership with Fondation AUB Santé
17 and 18 August 2021

Tests conducted by :

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1 CONTEXT

Due to the ongoing COVID-19 pandemic, nurse executives at AUB Santé Dialysis centres have expressed concern about the air quality in the dialysis rooms. A number of these rooms do not have windows. Natural ventilation is, therefore, impossible. Rooms are equipped with a single flow controlled mechanical ventilation system (air extraction) or a dual flow controlled mechanical ventilation system, depending on the unit. Dialysis rooms may be used by two different patients over the course of a day. As a result, the AUB Santé team carried out a risk analysis on virus transmission across these two daily sessions, as well as the preventative solutions that might help to reduce the risk in the absence of natural ventilation through open windows. This led them to contact ERLAB and request the installation of one Halo P air purifier in a standard room to measure their impact on particle content.

1.1 Presentation of Halo P

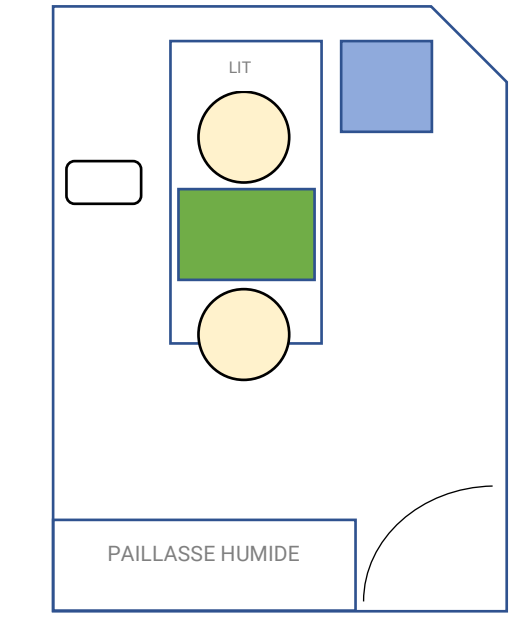
ERLAB specialises in air treatment solutions for chemical laboratories. Since 2015, ERLAB has manufactured and distributed Halo, an air purifier. More recently, ERLAB has launched Halo P, an air purification solution for both biological and non-biological particles. Halo P contains a HEPA H14 filter with a minimum efficiency of 99.995% according to MPPS (approximately 0.1 µm), as stated in standard EN 1822. Halo P filters the air in a given room, reducing particle concentration.

1.2 Test Environment : Standard Room

The surface area of an individual dialysis room generally measures between 10 and 12 m². It contains a door but not always a window, and is fitted with a sink unit, a hospital bed and a dialysis machine (see Figure 1). Halo P will be installed on the ceiling. The volume of the room with Halo P in operation should not exceed 75 m^3. Halo P was positioned as close as possible to the centre of the room. Their air vents faced the rooms' widest point.

Measurements of the ambient particle concentration were taken with the prior agreement of the AUB Santé nurse executives. A sampling point was chosen in the most central position possible, considering equipment already in the room equipment and the accessibility of the patient by nursing staff (see Figure 2).

Figure 1 : Photos of typical dialysis rooms



Dialysis machine
Light fixture
HALO P
Table of material

Figure 2 : Representative Diagram of Test Room

1.3 Pollution Monitoring

Two factors were measured during the tests: the specific concentrations of particles according to their size and the concentration of CO_2, representing the performance of the ventilation system in relation to the number of people present in the room. These two factors were measured as close as possible to the centre of the room at a height of 90 cm. This is representative of the height of the patient's airways.

Complementary in situ measures were undertaken to expand ERLAB's research and development (R&D) experience, which are not included in this report.

Please note that with a H14 particle filter, Halo P is adapted to reduce particle concentrations but has no effect on CO_2 content.

2 TESTING PROCESS

Tests were carried out on a typical dialysis day. Real constraints were respected and efforts were made to limit disturbance to medical staff and patients. As a result, the door to the room remained open for the duration of the tests.

2.1 Test phases

Testing took place over two days in different configurations described in Tableau 1.

Date	Room Occupancy	HALO P Status
Tuesday 17/08		
16 :30 -17 :30	Installation of measuring equipment and calibration of HALO P settings	
17 :30 – 19 :27	Control Test without patient	Halo P switched off Halo P switched on
Mercredi 18/08		
7 :42 – 12 :10 : First dialysis session	Measurements taken with patient from 08:20	Halo P switched off
12 :10-13 :30 : Between session	Measurements taken without patient but with cleaning staff present	Halo P switched off
13 :30 – 17 :53 : Second dialysis session	Measurements taken with patient	Halo P switched on
17h55 – 18h36 : Between session	Measurements taken without patient but with cleaning staff present	Halo P switched on

Tableau 1 : Description of difference test phases

2.2 HALO P Settings

Halo P was set to the 24-7 mode at 2,000 rpm, ensuring a workflow of 300 m^3/h. Halo P was equipped with both a prefilter and HEPA H14 filter series 50532.

2.3 Materials Used

The particle concentration was measured using a portable KANOMAX optical particle counter (model 3889). This allowed for particle measurement on six channels: 0.3, 0.5, 1.0, 3.0, 5.0 and 10.0 µm. Calibrated on 14/05/2021 (certificate n° 38892105003).

CO_2 concentration was monitored using a TESTO 440 analyser. Calibrated on 18/12/2020 (certificate in appendices).

2.4 Sampling Pattern

The measurement points were positioned to the left of the bed so as to not disturb the patient or hospital staff (see Figure 3).

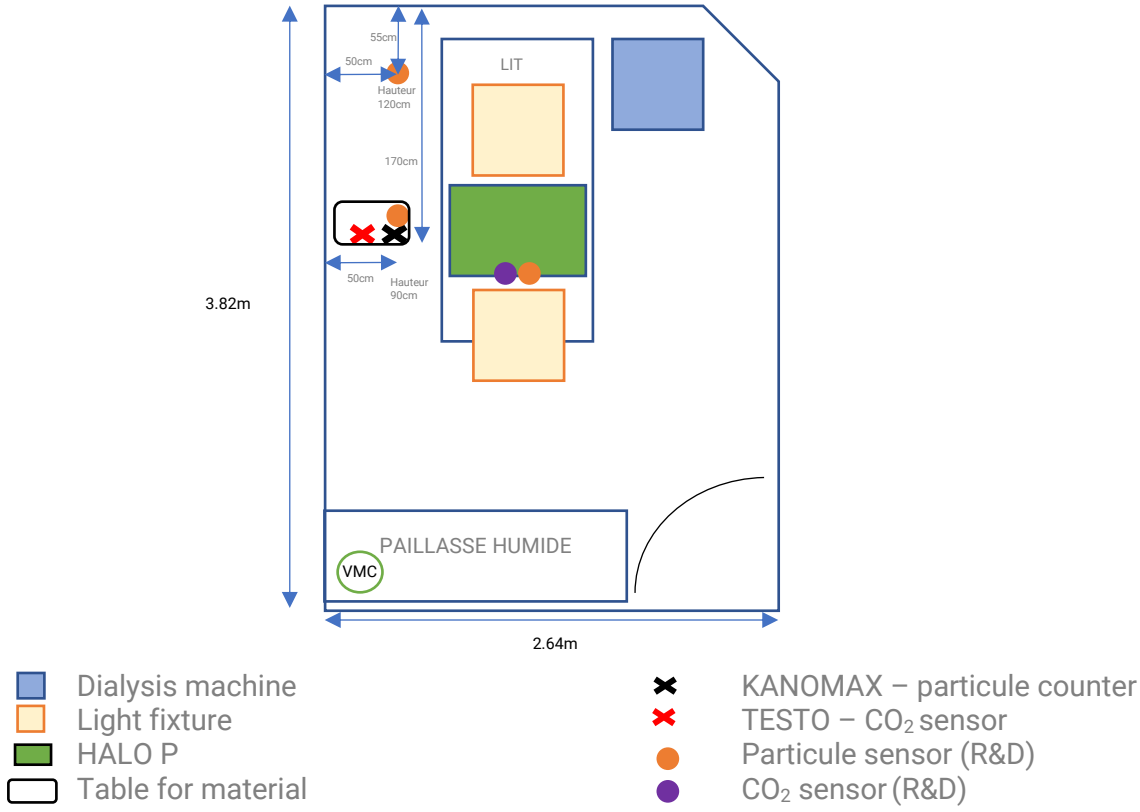


Figure 3 : Placement of sampling points

3 RESULTS

3.1 Introduction

Measurement of particle concentration took place in a medical facility and, as a result, concentrations are expected to be relatively low.

ISO standard 14644-1 will be used to classify the air cleanliness by particle concentration in the room.

Reminder :

Particles per metre cubed (maximum admissible concentrations of particles of a size equal or superior to those specified below)	
Class	**0,5 µm**
ISO 1	d
ISO 2	d
ISO 3	35
ISO 4	352
ISO 5	3 520
ISO 6	35 200
ISO 7	352 000
ISO 8	3 520 000
ISO 9	35 200 000

d : Both the sampling and statistical limits of such low concentrations make them unsuitable for classification.

Table 2 : Classification of air cleanliness by particle concentration according to ISO standard 14644-1

3.2 Sampling Implementation

Figure 4 : Position of material in patient's room

Figure 5 : Particle counter positioned close to bed

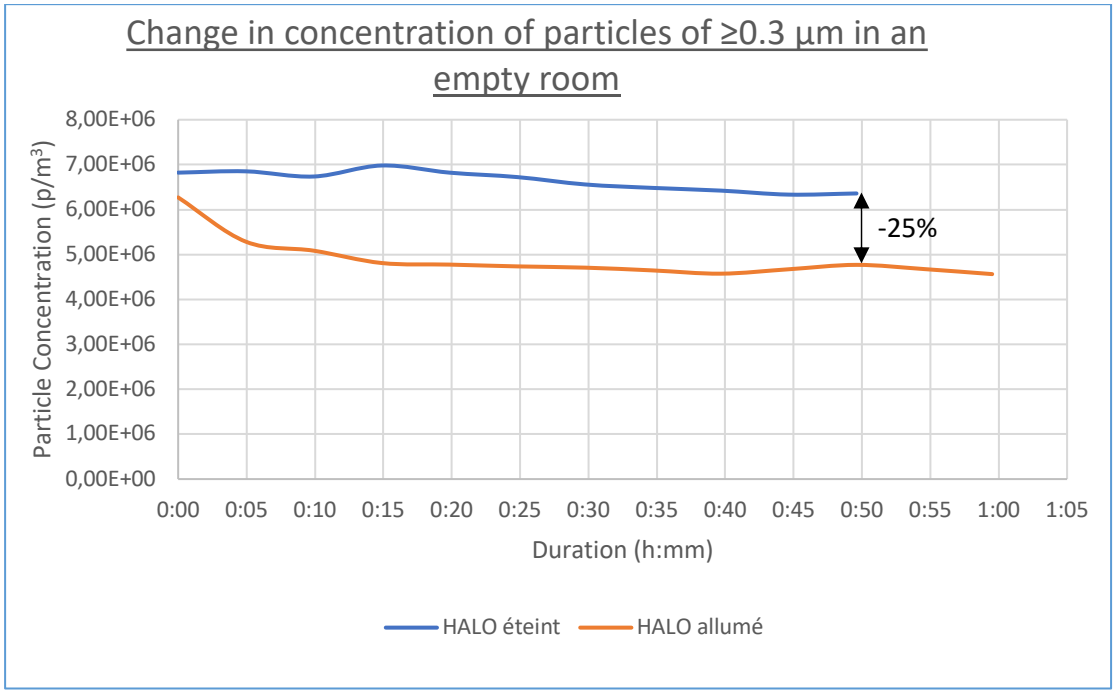
The door to the room remained open throughout the duration of sampling. When additional precautions were being taken, such as with an infected patient, the door to the room remained closed. This should increase the effectiveness of Halo P. Without additional air coming in from outside, air recirculation in the room should improve.

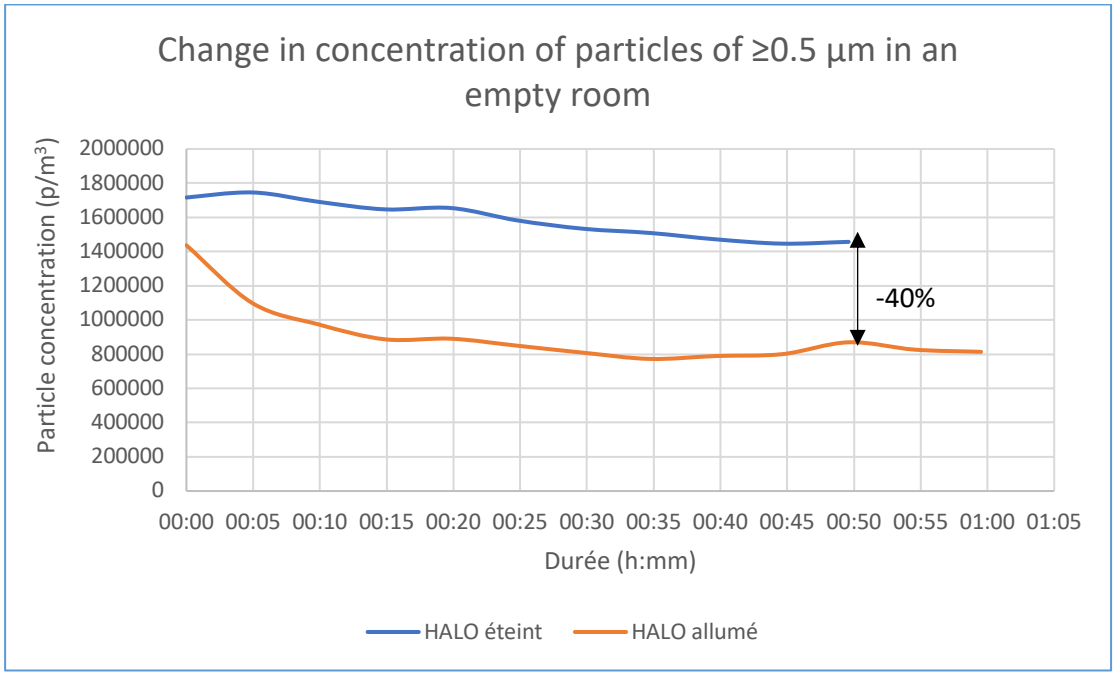
Patients wore a mask throughout the dialysis session, aside from during of a light meal.

For these tests, we have chosen to only consider particles of between ≥0.3 and ≥0.5 µm. These are the particles that are least likely to settle. Instead they form an aerosol generated by respiration, speaking, coughing, spitting and sneezing etc.

The volume of the room using for testing was 26.4 m^3, which meant that Halo P filtered the air 11 times per hour. As a result, the output of Halo P could be reduced to reduce noise. For example, switching from 2,000 rpm (300 m^3/h) to 1,800 rpm (260 m^3/h) will lower the noise produced by one machine by a factor of two.

3.3 Control test without Patient

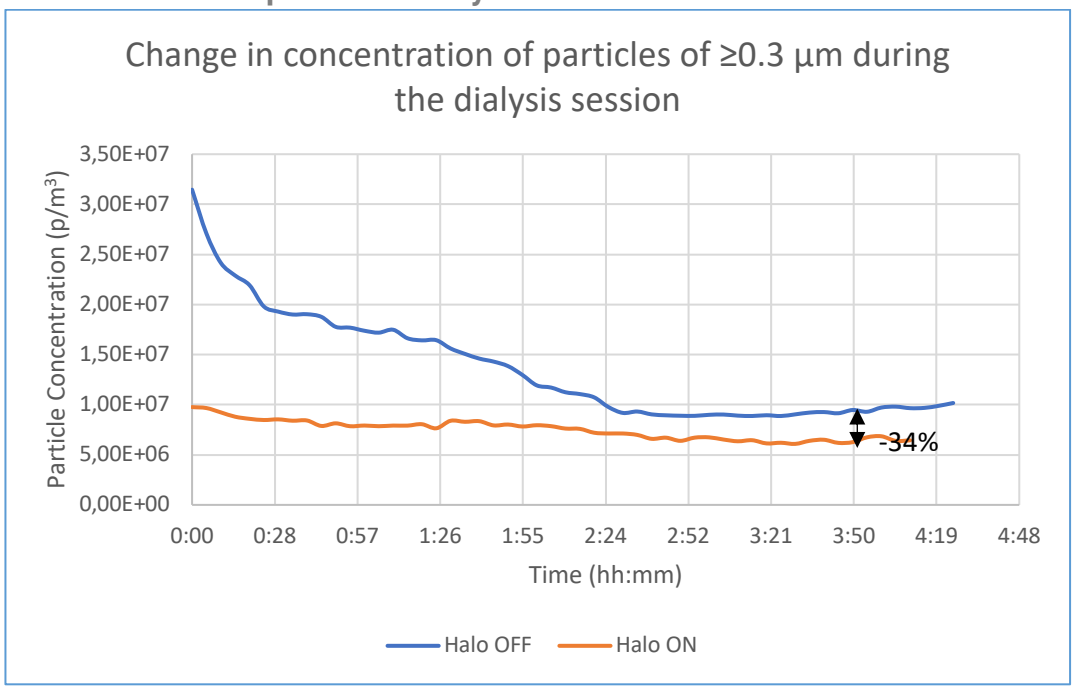


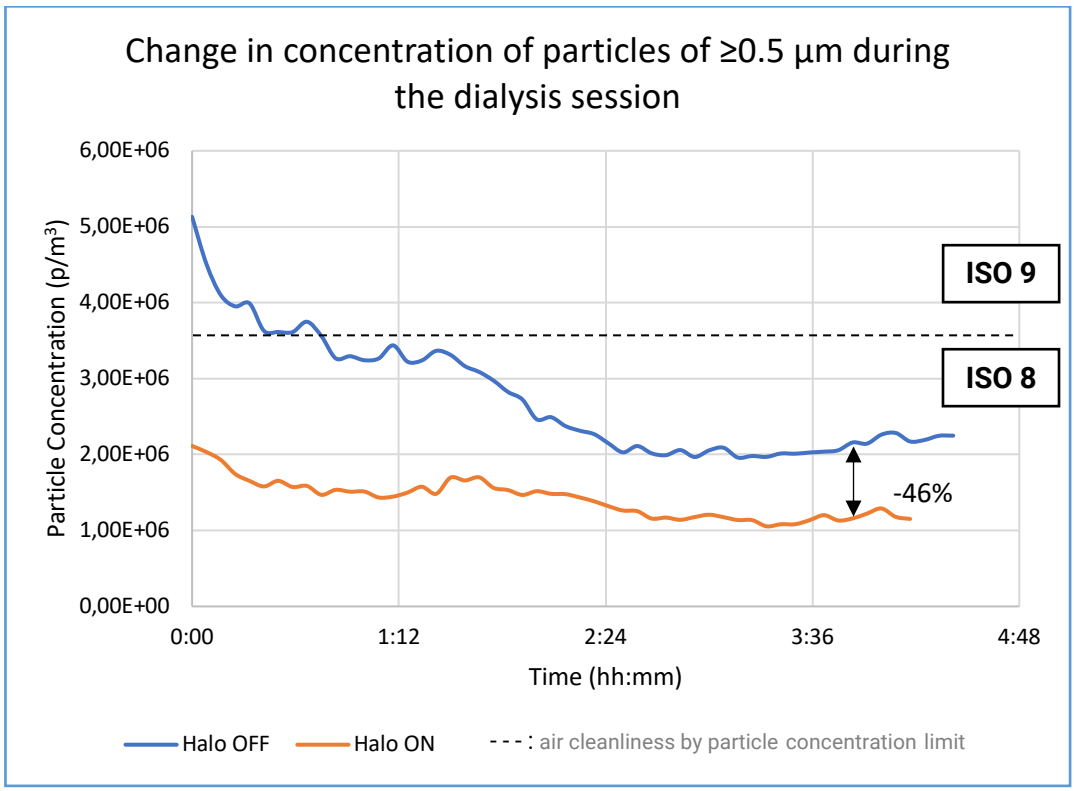


The effectiveness of Halo P in an empty room is clear:

After 50 minutes, particles of ≥0.3 µm are reduced by 25%, while those of ≥0.5 µm are reduced by 40%.

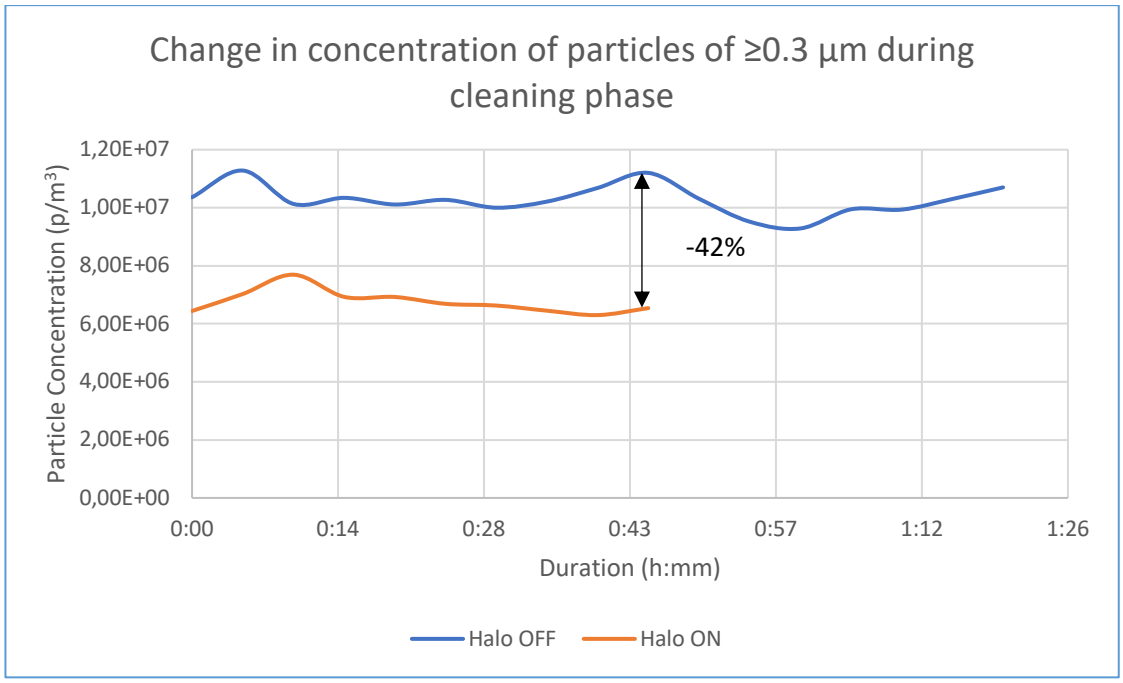
3.4 Room with patient on dialysis

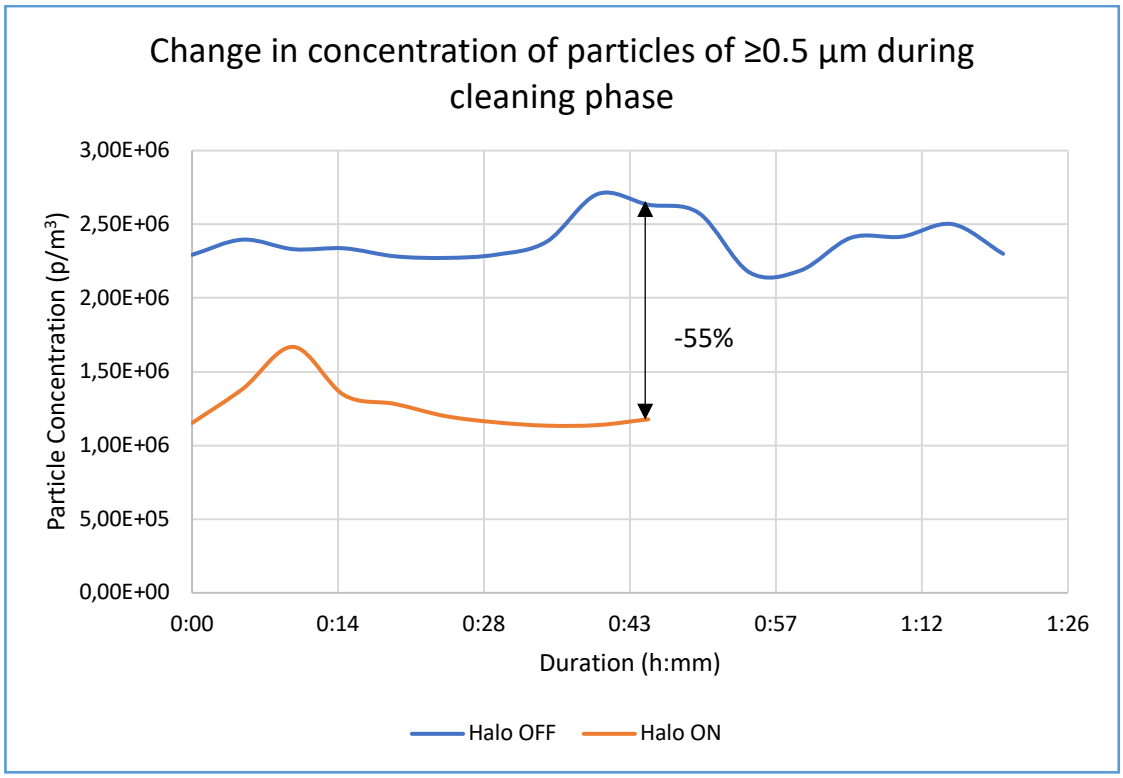




The level of dust accumulation in the room at the beginning of testing differs according to whether Halo P is switched on or off. This is because measurements were taken continuously; first with Halo P switched off, then switched on. We see, however, that particle concentration levels stabilise over the course of a dialysis session, showing a drop of more than 45% in particle pollution of ≥0.5 µm when Halo P is switched on. Particles of ≥0.3 µm were reduced by 34%. It should also be noted that, without Halo P, this concentration gradually rises at the end of a session. This phenomenon is less noticeable when Halo P is running.

3.5 Cleaning Phase

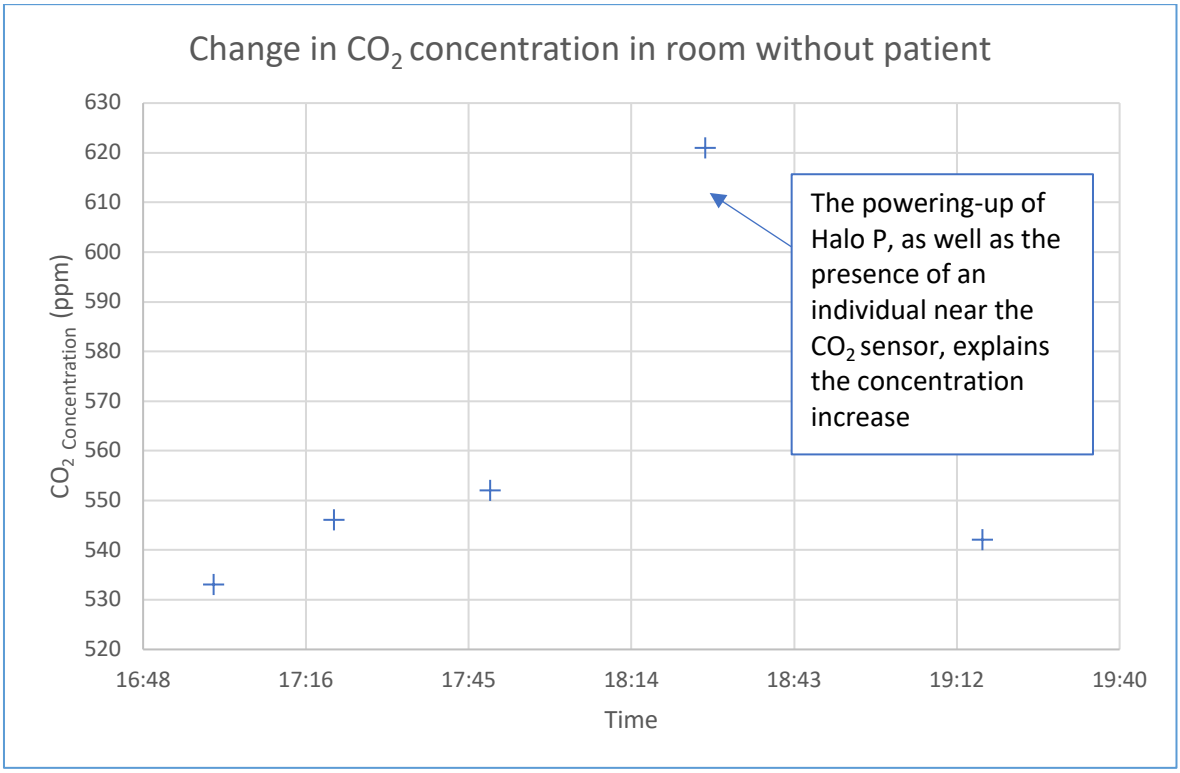


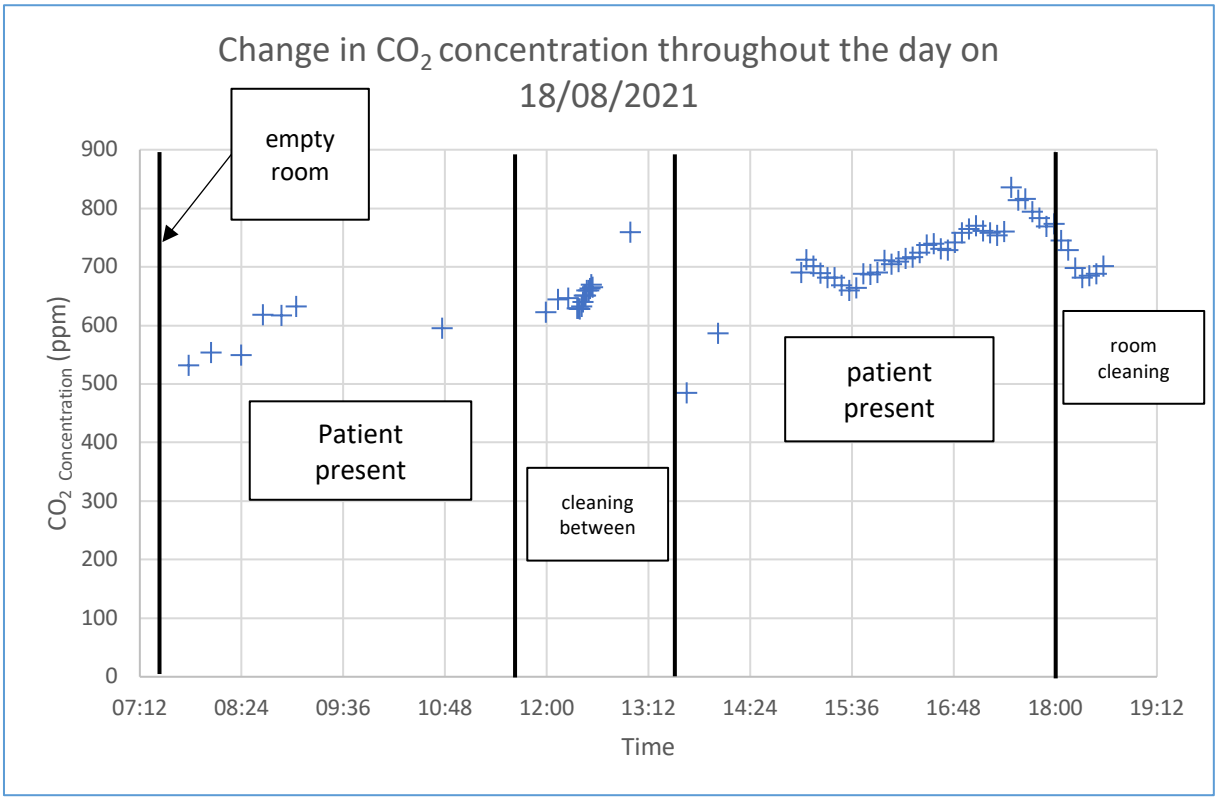


Within 45 minutes, Halo P causes a reduction of 55% in particles of ≥0.5 µm and 42% in particles of ≥0.3 µm.

As a result of the previous dialysis session, Halo P was in operation before the first measurements were taken. This explains the initially low concentration.

3.6 CO_2 Concentration





CO_2 concentration increased as the day went on. This is due to the presence of people within the building and not only in the room itself. Concentrations remained below 800 ppm. This is below the threshold recommended by the French High Council for Public Health (Haut Conseil de la Santé Publique) in its publication of 14 and 21 May 2021, on the use of mobile air purification units in combatting the spread of SARS-CoV-2 in enclosed spaces. The only exception was at the end of the second dialysis session when the nurse was with the patient. The concentration passed 800 ppm for around ten minutes but remained below the 1300 ppm stated in French High Council for Public Health recommendations published on 28/08/2021.

4 CONCLUSION

During the tests, the level of particle pollution was already low, even without Halo P. For scale, this level corresponds to ISO class 8 according to ISO standard 14644-1 (see Table 2) for particles of ≥0.5 µm in size. This is testament to the effectiveness of pre-existing ventilation systems. Although in this situation the potential of Halo P is somewhat less evident, there was still a decrease of 40 to 50% in the concentration of particles of ≥0.3 µm and ≥0.5 µm for a few hours.

Today, standard air quality indicators rely essentially on CO_2 content. With an increased number of individuals comes a proportional increase in CO_2. We also see an increase in the number of particles in suspension, particularly the viral load.

It is evident that the concentration of CO_2 increases over the course of a day. It could, therefore, be assumed that the quantity of particles suspended in the air would also have increased. Thanks to Halo P, however, the particle concentration decreased. Thanks to Halo P, however, the particle concentration decreased. This reversed the trend and calls into question CO_2 monitoring as the principal indicator of air quality. Monitoring particle concentration seems to us to be equally important. This is especially true in an approach that relates specifically to viral transmission.

Alongside natural ventilation, safety precautions and cleaning, Halo P can therefore play a significant role in controlling airborne transmission of viruses and other particles, such as allergens, dust, and fine particles.

5 APPENDICES

5.1 Particle Counter Calibration Certificate

CALIBRATION
DUE DATE

JUL 07 2022

KANOMAX

Test Sheet

Kanomax USA Inc
219 US Hwy 206, Andover NJ 07821
973-786-6386

Product Name Handheld Particle Counter
Model Name 3889
Serial Number 850770
Test Date 2021/05/14
Temperature/Humidity 23.6 ℃ / 45.0 %RH
Atmospheric Pressure 1007.0 hPa

Item	Procedure/Standard	Result	Judgement
Sampling air flow rate	The flow rate shall be within 2.83 L/min±5%	2.89 L/min	OK
False count level	The count value measured for 5 minutes should be 1 or less when zero filter is put onto LPC inlet.	0 COUNTS	OK
Computer Threshold voltage	The PSL standard particle threshold voltage for each particle size is 10V or less, and also there is a signal waveform distribution.	$V_{0.3}$ = 0.855 V $V_{0.5}$ = 0.460 V $V_{1.0}$ = 1.211 V $V_{3.0}$ = 3.545 V $V_{5.0}$ = 5.781 V $V_{10.0}$ = 7.806 V	OK
Counting efficiency	For the 0.3μm PSL standard and 0.5μm PSL standard, the particle counts in the 0.3μm range of the instrument to be calibrated should be within 50±20% and within 100±10% of the standard unit.	0.3μmPSL 42.8 % 0.5μmPSL 97.7 %	OK
Particle resolution	In the 0.3μm PSL standard particles, its value should be below 15% .	7.4 %	OK

	Particle resolution(μm)	Particle size(μm)	Manufacturer	Type
PSL standard	0.30	0.303	Thermo	3300A
	0.50	0.496	Thermo	3495A
	1.00	0.994	Thermo	4009A
	3.00	3.007	Thermo	4203A
	5.00	5.049	Thermo	4205A
	10.0	10.02	Thermo	4210A

The procedures and the standards in the above are compliant with ISO 21501-4:2007 and JIS B 9921:2010.

Approved by

Tested by

KANOMAX INSTRUMENT (SHENYANG) INC.
No.9 Zhengkun Road Shenbei new district Shenyang city Liaoning China
TEL +86 (024) 89730178

erlab
Vous pouvez respirer.

KANOMAX

Certificate of Calibration

Handheld Particle Counter

Issue Date: 2021/05/14

Model Name	3889
Serial Number	850770
Calibration Date	2021/05/14
CERT No.	38892105003

This is to certify that above instrument was calibrated to following standard units on our operation standard. This calibration complies with ISO 21501-4. The standard units used for the calibration are traced to the national standard regularly based on our traceability chart.

Standards Used:

Particles

Manufacturer	*Particle Size*	*Standard Deviation*	*Lot No.*	*Expiration Date*
Thermo	0.303 µm	0.003 µm	223077	2023.04
Thermo	0.496 µm	0.004 µm	231219	2023.09
Thermo	0.994 µm	0.006 µm	234756	2023.12
Thermo	3.007 µm	0.007 µm	226956	2023.06
Thermo	5.049 µm	0.049 µm	235600	2024.01
Thermo	10.02 µm	0.020 µm	233796	2023.12

Flowmeter

Type	*Manufacturer*	*Serial Number*	*Calibration Date*	*Calibration Due*
Gilibrator2	SENSIDYNE	0801038/1804060-S	2020.06	2021.06

Reference Unit

Type	*Manufacturer*	*Serial Number*	*Calibration Date*	*Calibration Due*
CR LPC3782-06	Kanomax Japan Inc	No.003	2020.07	2021.07

KANOMAX INSTRUMENT (SHENYANG) INC.
The Quality Assurance Div.

Certified by:

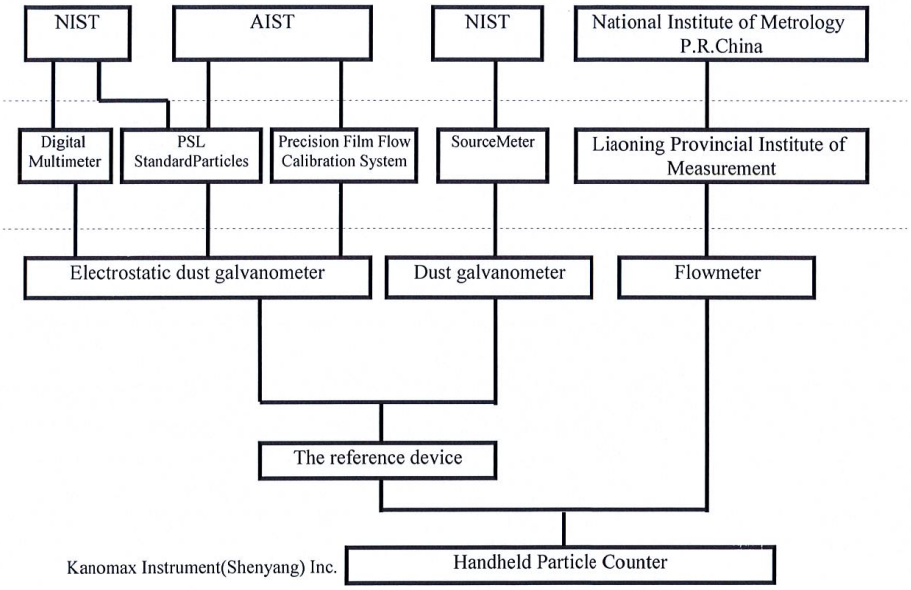
TRACEABILITY CERTIFICATE

KANOMAX INSTRUMENT (SHENYANG) INC.
No.9 Zhengkun Road Shenbei new district Shenyang 110136 Liaoning China

Product Name	Handheld Particle Counter
Model Name	3889
Serial Number	850770
Test Date	2021/05/14

It prove that the product above is calibrated according to our company production standards. And the standards are based on ISO21501-4. The standard units used for the calibration are traced to the national standard regularly based on our traceability chart.

1. Traceable using Kanomax Calibrating system



2. Standard Component

Product Name	Model	Serial Number	Calibrate By	Test Sheet No.
Electrostatic dust galvanometer	3071	82	Kanomax Japan Inc	A026-20210317
Dust galvanometer	3068	65	Kanomax Japan Inc	A025-20210318
Flowmeter	Gilibrator2	0801038/1804060-S	Liaoning Provincial Institute of Measurement.	20020403935
The reference device	CR LPC3782-06	No.003	Kanomax Japan Inc	003-20200731

5.2 CO_2 Analyser Calibration Certificate

Kalibrier-Protokoll
Certificate of conformity • Protocole d'étalonnage
Certicifato di taratura • Informe de calibración

Be sure. testo

Gerät / Module type /
Modèle / Modelo: **0560 4401**

Messbereich / Measuring range /
Etendue de mesure / Rango de medición: **-200...+1370°C**
-40...+150°C

Serien-Nr. / Serial no. /
N°. de série / Número de serie: **83222709**

Messwerte / Measured values /
Valeurs mesurées / Valores medidos:

Sollwert / Reference / Référence / Referencia:	Zulässige Toleranz / Permissible tolerance / Tolérance admise / Tolerancia permitida:	Istwert / Actual Value / Valeur réelle / Valor medido:
Temperature:		
80.0°C	**+/-0.5°C**	**80.1°C**
25.0°C	**+/-0.5°C**	**25.0°C**

Datum / Date
Date / Fecha: **15.01.2021**

Prüfer / Inspector /
Responsable / Verificad **349**

Kalibrier-Protokoll
Certificate of conformity • Protocole d'étalonnage
Certicifato di taratura • Informe de calibración

Be sure. testo

Gerät / Module type /
Modèle / Modelo: **0632 1550**

Serien-Nr. / Serial no. /
N°. de série / Número de serie: **58613303**

Messwerte / Measured values / Valeurs mesurées / Valores medidos:		
Sollwert / Reference / Référence / Referencia:	Zulässige Toleranz / Permissible tolerance / Tolérance admise / Tolerancia permitida:	Istwert / Actual Value / Valeur réelle / Valor medido :
CO2		
1002.0 ppm	± 80.0 ppm	1008.3 ppm
4994.0 ppm	± 350.0 ppm	4988.9 ppm
Temperatur / Temperature / Température / Temperatura (NTC)		
23.2 °C	±0.5 °C	23.2 °C
Relative Luftfeuchte / Relative humidity / Humidité relative / Humedad relativa		
44.4 %RH	±2.0 %RH	44.3 %RH
Absolutdruck / Absolute pressure / Pression absolue / Presión absoluta		
1016.6 hPa	±3.0 hPa	1016.6 hPa

Datum / Date / Date / Fecha:
18.12.2020

Prüfer / Inspector /
Responsable / Verificador
J. Yeung