

Cutting-edge *in vitro* Exposure Technologies for Conventional and E-cigarettes

IIVS Workshop

In Vitro Exposure Systems and Dosimetry Assessment Tools for Inhaled Tobacco Products

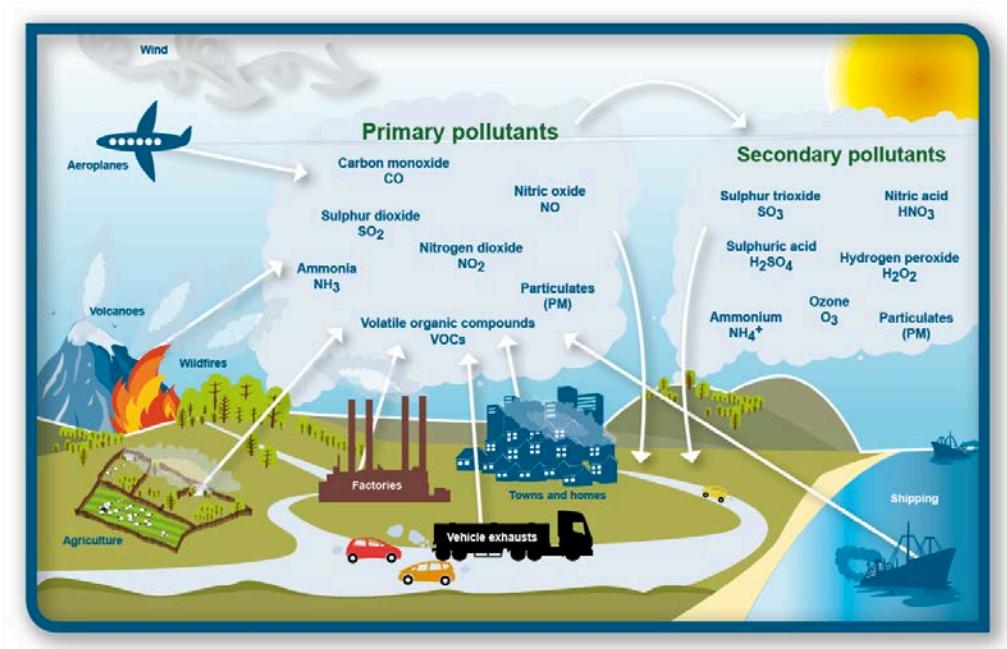
April 4-6, 2016



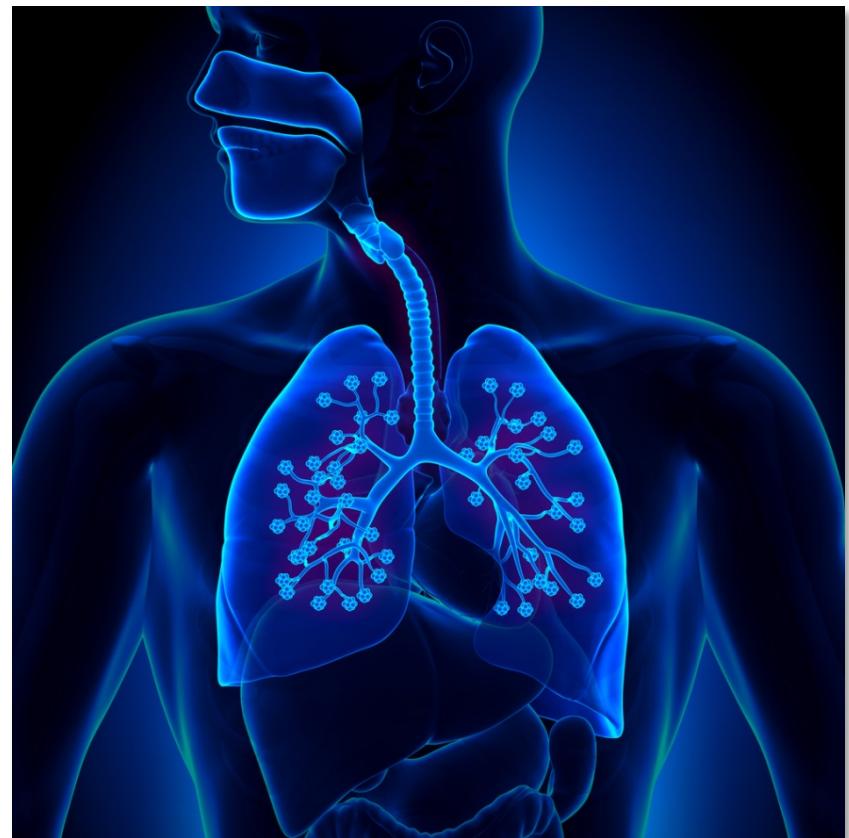
VITROCELL® Exposure Systems for *in vitro* Analysis of Airborne Pollutants



Gases Complex Mixtures Airborne Particles (Nano Particles)



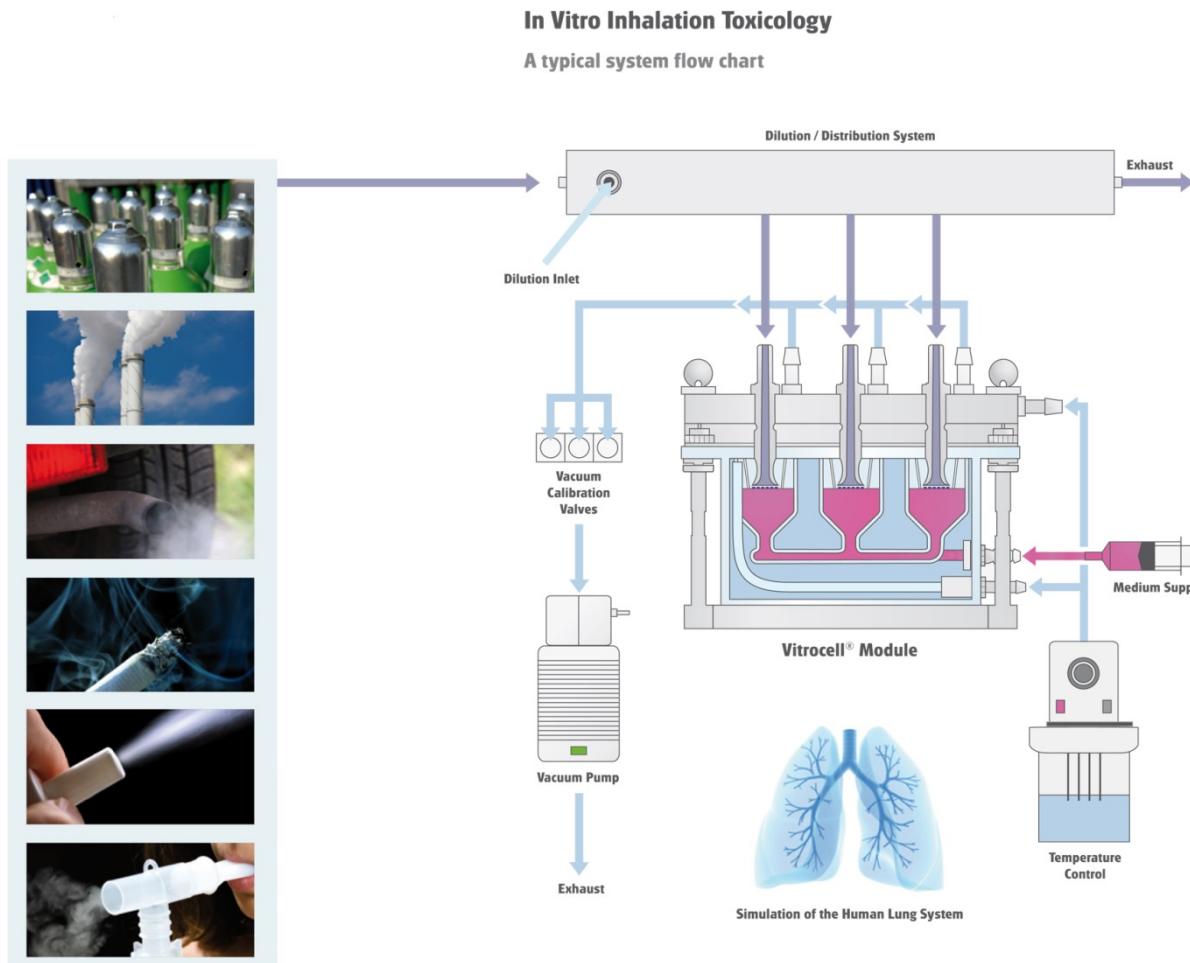
source: environment.scotland.gov.uk



source: cysticfibrosisnewstoday.com

Our mission: to provide turnkey *in vitro* exposure systems incl. online dosimetry tools

VITROCELL® Continuous Flow System

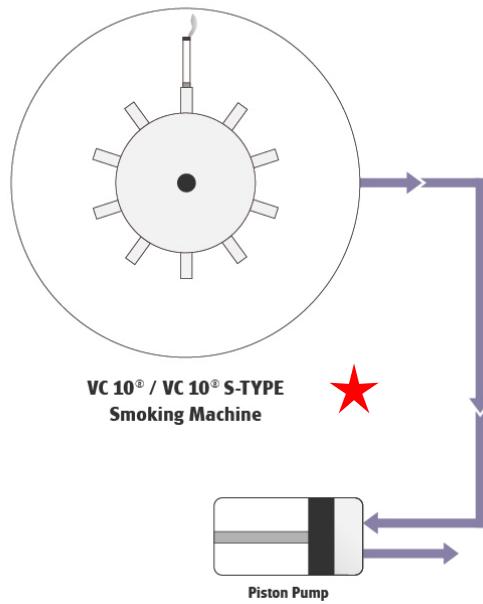


Critical System Elements for *in vitro* Exposure to Conventional and E-cigarettes



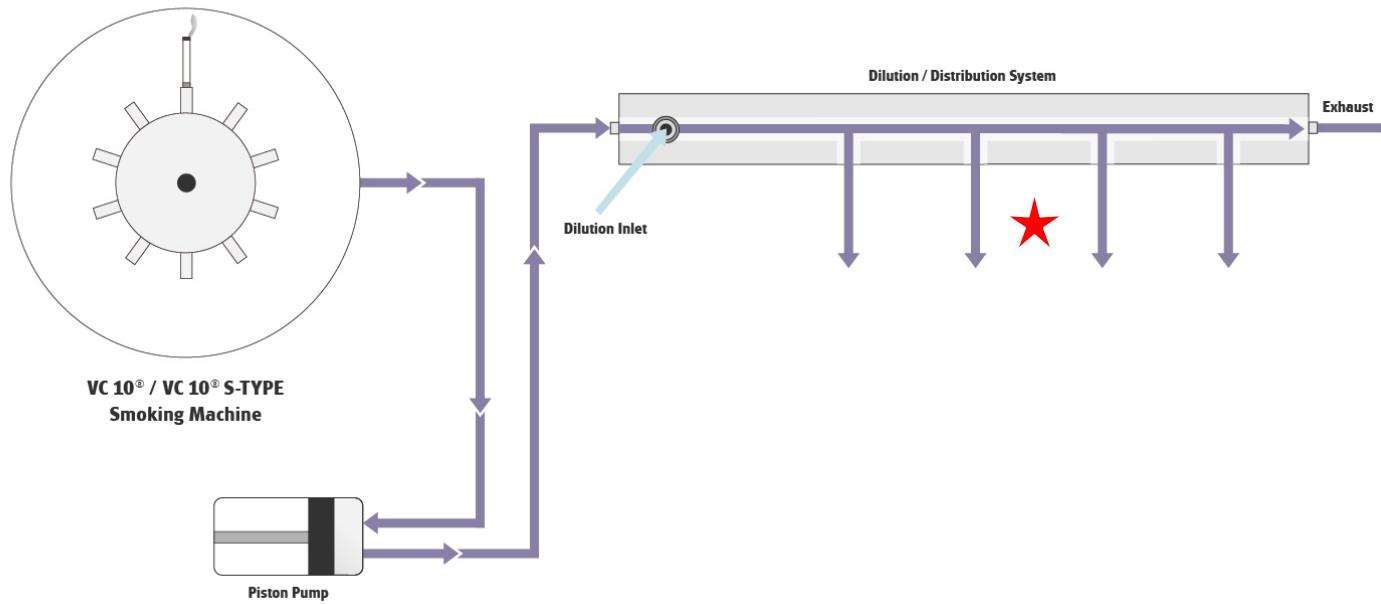
• Smoke / Vapor generation	<u>Conventional</u>	<u>E-cigarette</u>
– Smoking regimen	ISO/HCl Bell	55/70 mL 30s/3s Square
– Actuation	Lighter	Draw / Button
• Dilution for dose / response	5 - 50% Smoke	30 – 80% Aerosol
• Exposure system		same
• Auxiliary equipment	ISO Lab Conditions	Evtl. Heated Chambers
• Dosimetry tools	Chemical Analysis CO TOF-MS	Chemical Analysis - TOF-MS
– Gas phase		
– Particle phase	Chemical Analysis Photometer Microbalance	Chemical Analysis Photometer Microbalance

System Element: Smoke / Vapor Generation



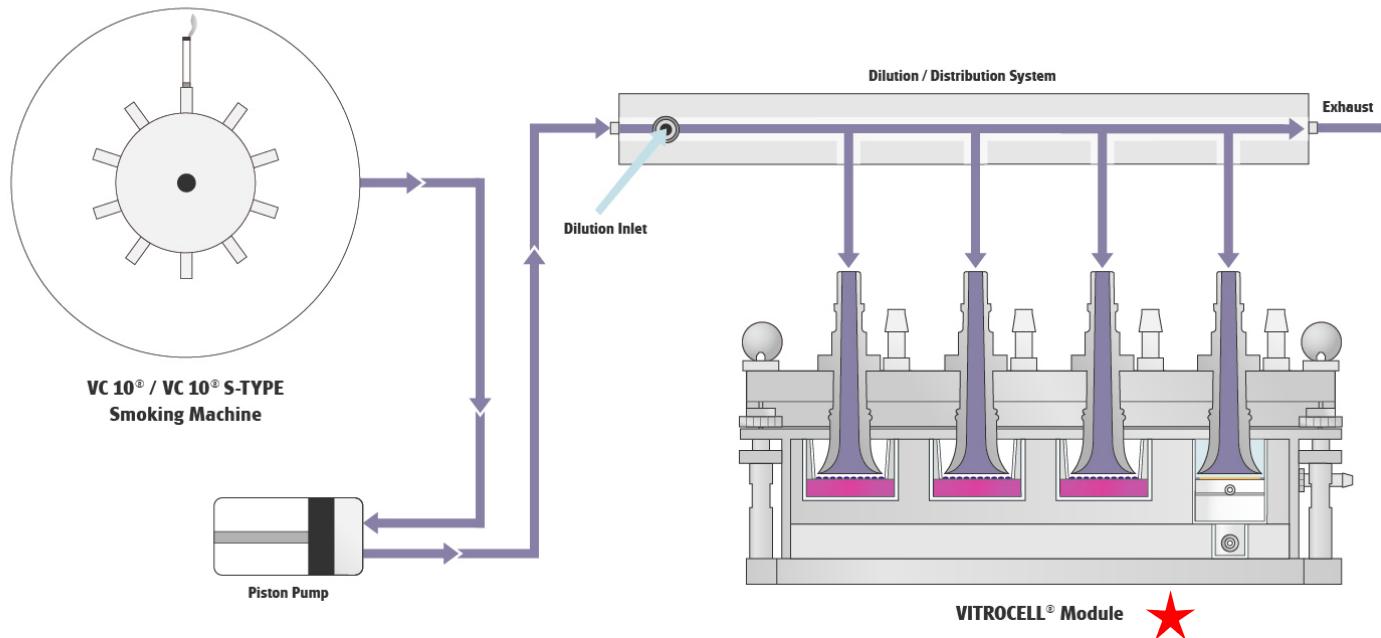
- Hotspot:**
- Reproducible aerosol generation with smallest dead volumes
 - Avoidance of cross-contamination when testing different products
 - Fast and easy cleaning

System Element: Dilution System



- Hotspot:**
- Reproducible dynamic dilution with smallest dead volumes
 - „Fresh aerosol“ with quick delivery to test system
 - Easy cleaning

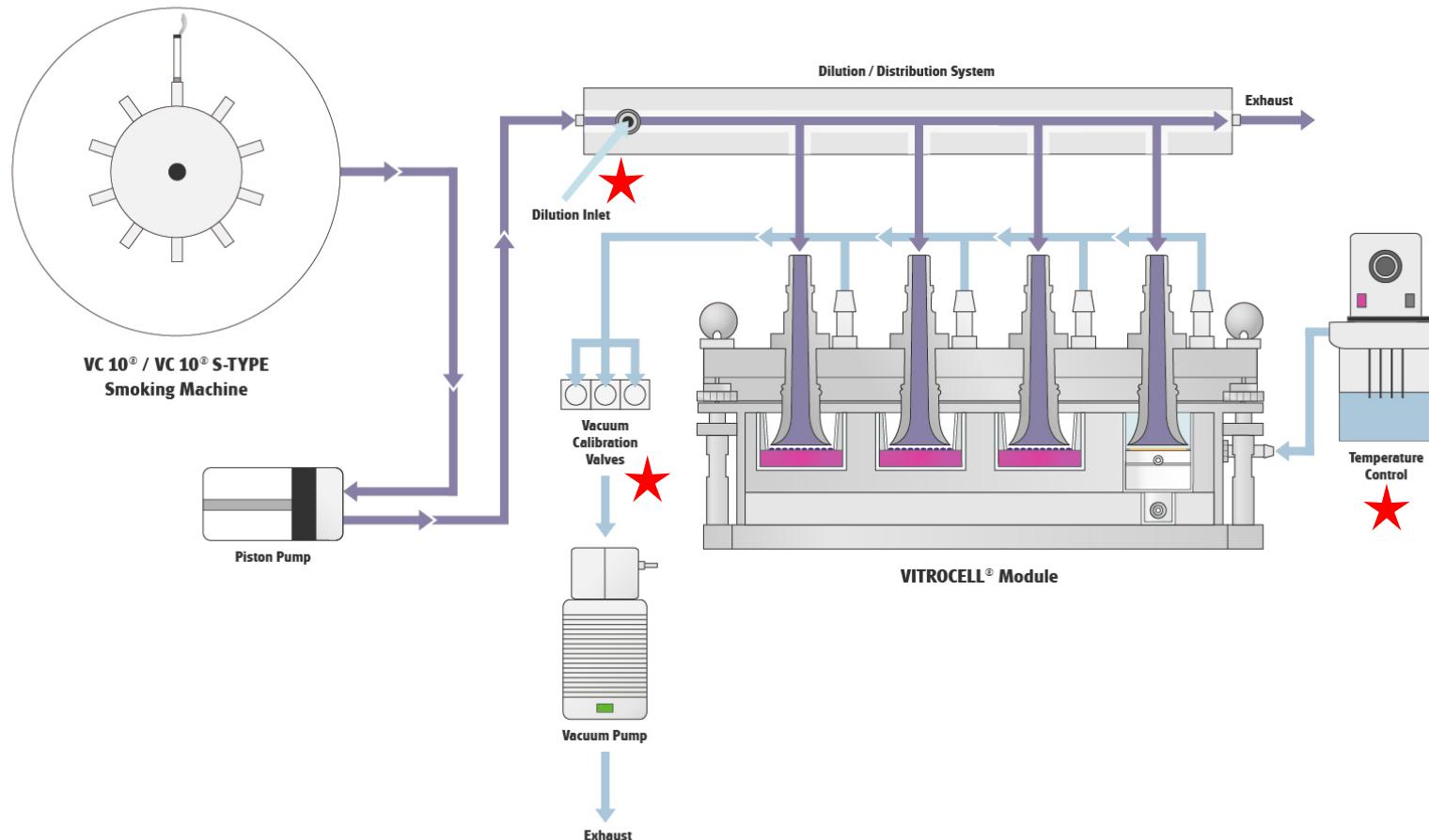
System Element: Exposure Module



Hotspot:

- Receipt of fresh aerosol / Air-Liquid Interface
- Uniform particle deposition
- Easy cleaning and reliable operation

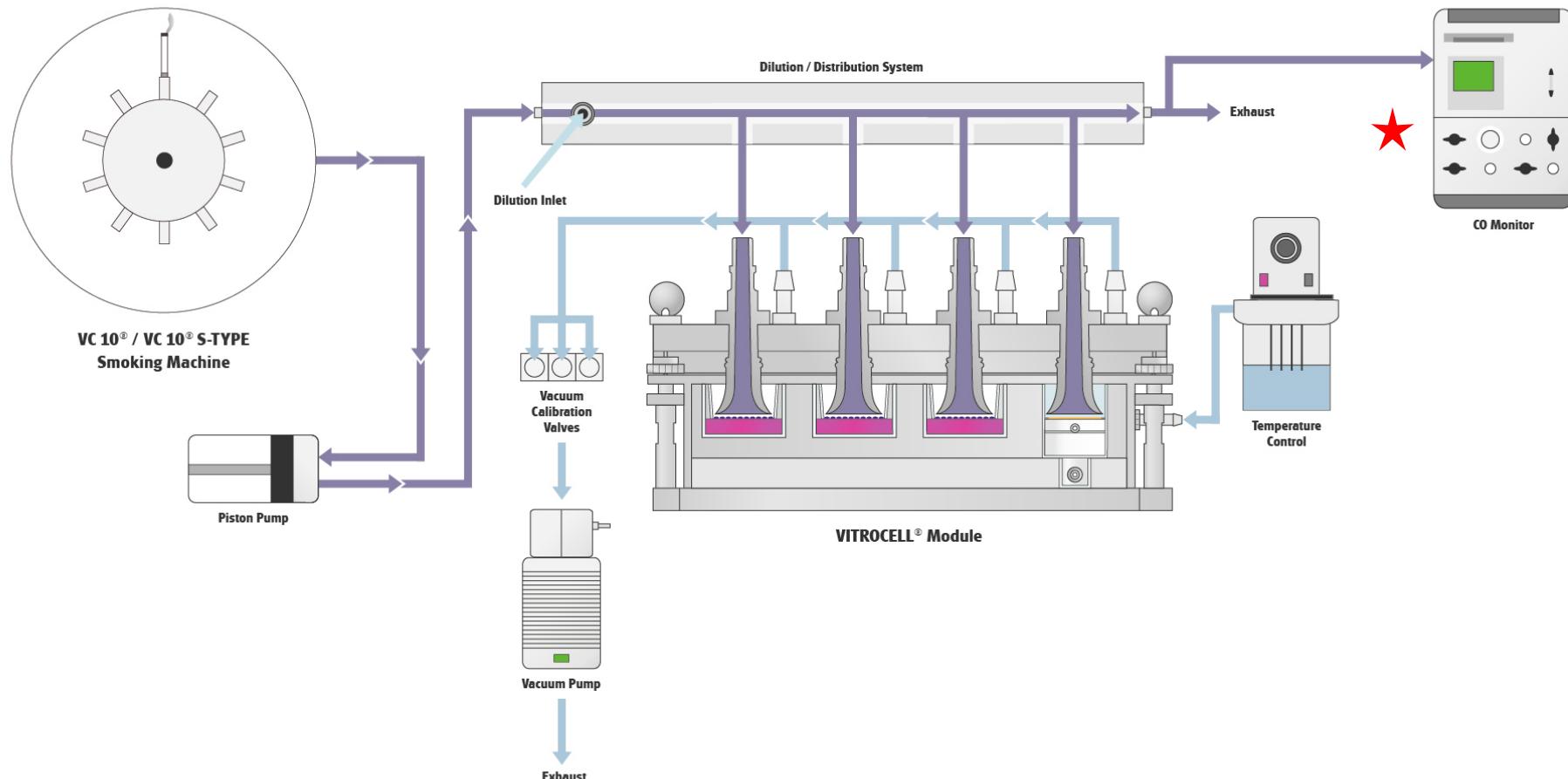
System Element: Auxiliary Equipment



Hotspot:

- Heating / maintain constant exposure conditions
- Manage constant dilution air flow rates
- Manage constant vacuum flow rates

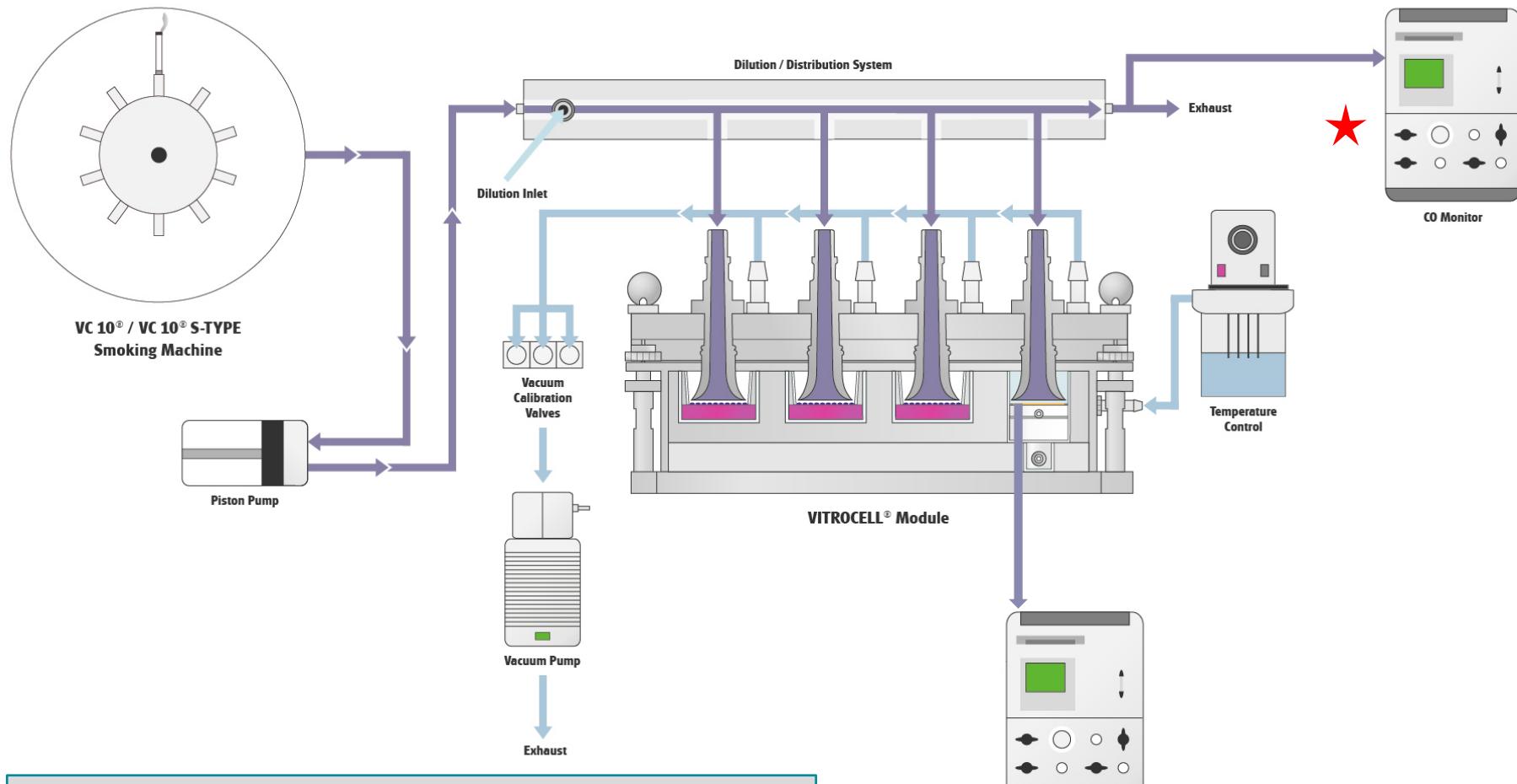
System Element: Online Gas Phase Dosimetry Tools



Hotspot:

- Monitor Dose
- Evaluate Dose
- No disturbance of exposure process

System Element: Online Gas Phase Dosimetry Tools

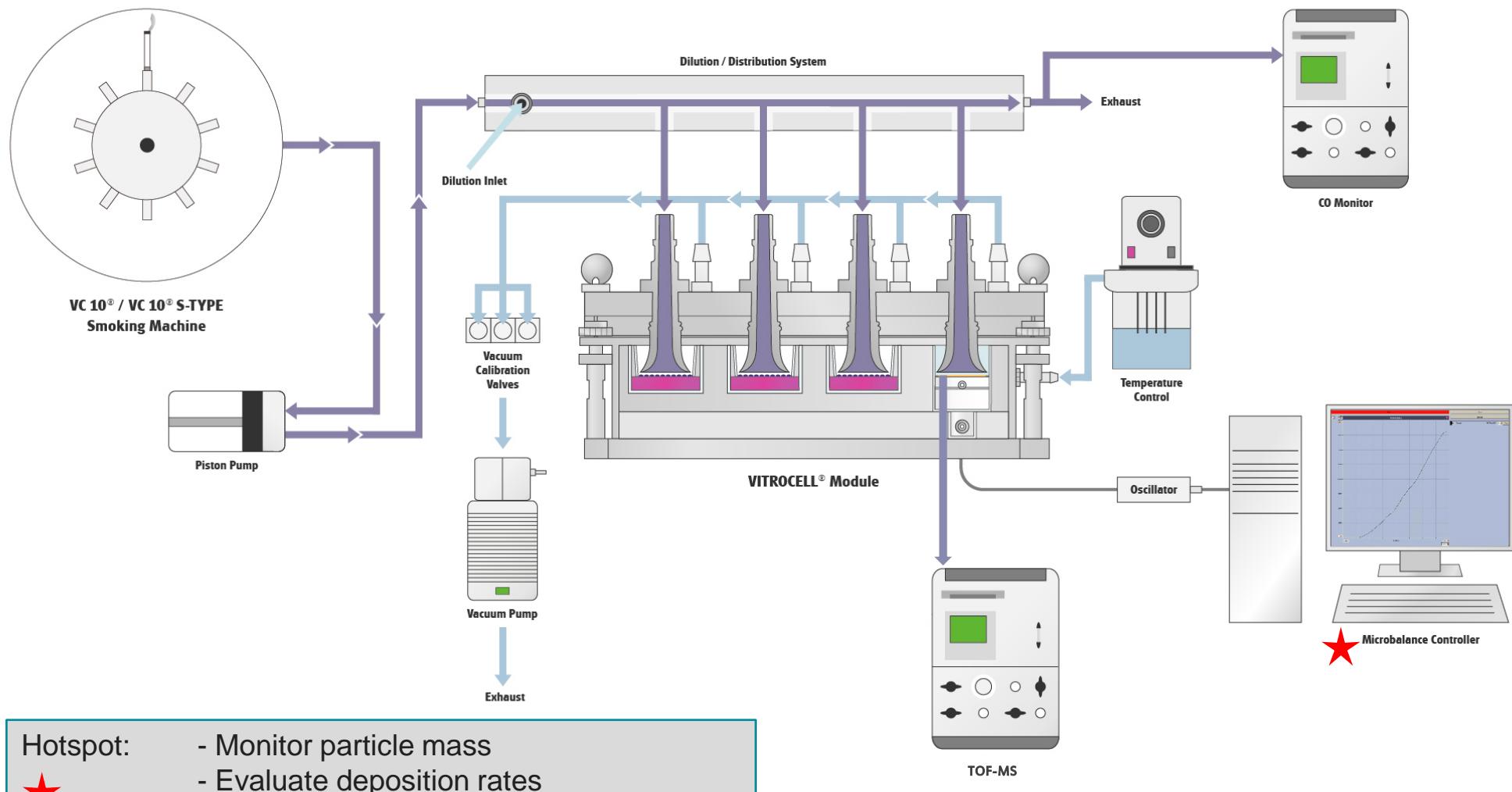


Hotspot:

- Monitor dose
- Evaluate constituents
- No interference with exposure process

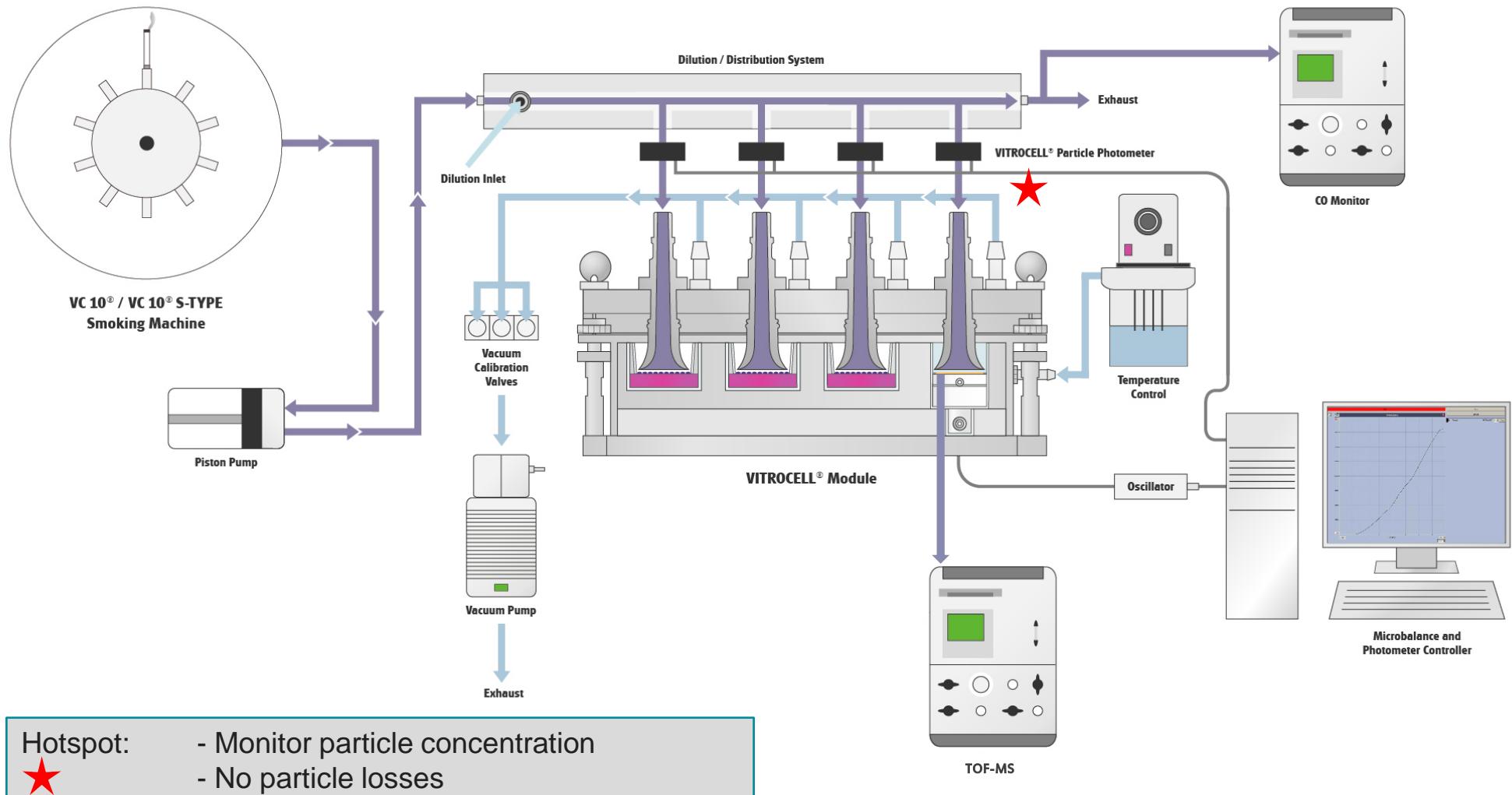
System Element: Dosimetry Particle Deposition via Quartz Crystal Microbalances

VITROCELL®
S Y S T E M S

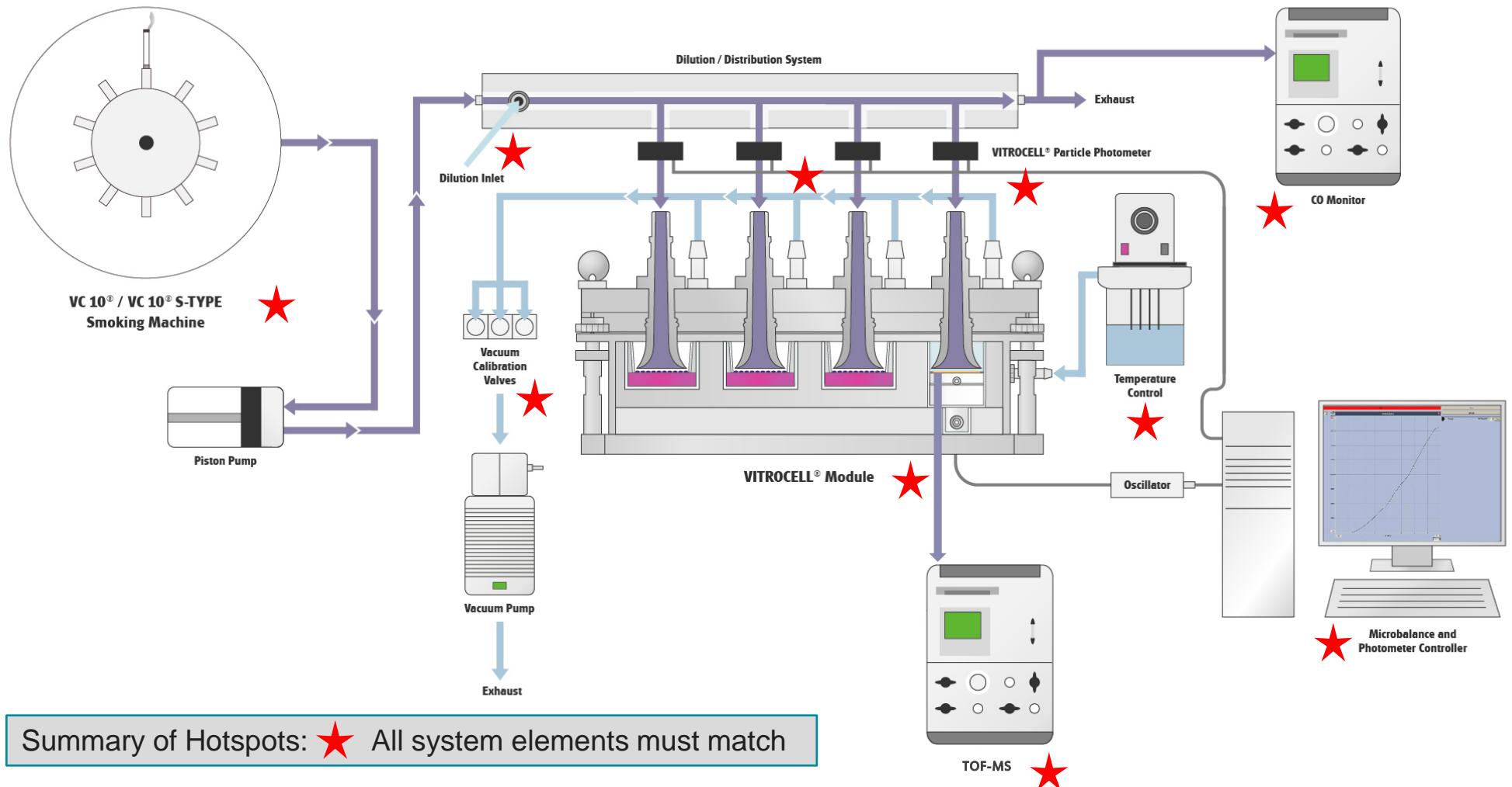


System Element: Dosimetry Particle Concentration via Inline Photometers

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S Y S T E M S

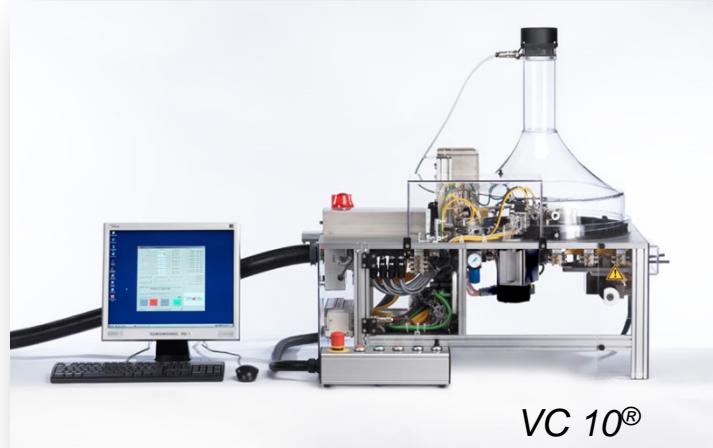


The Complete Exposure System



System Element: Smoke / Vapor Generation

Automatic
Robots



VC 10®



VC 10® S-TYPE

Manual
Machines



VC 1



VC 1 Linear Type



Vapestarter

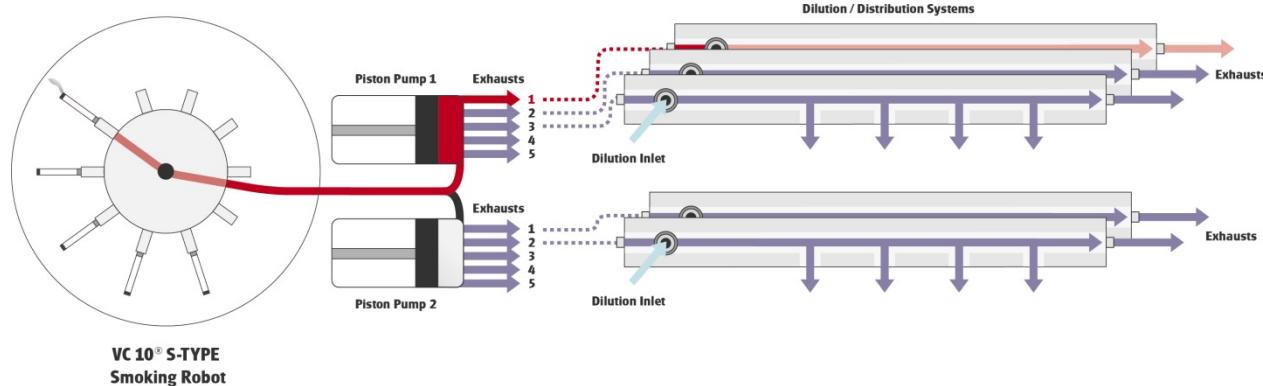
System Element: Smoke / Vapor Generation Automatic Robots

VITROCELL®
S Y S T E M S

VC 10® S-TYPE



- Smallest dead volume
- Conventional and e-cigarettes
- Fast and easy cleaning
- Product change in < 10 min. (exchange parts)
- Increased capacity via multiple pumps



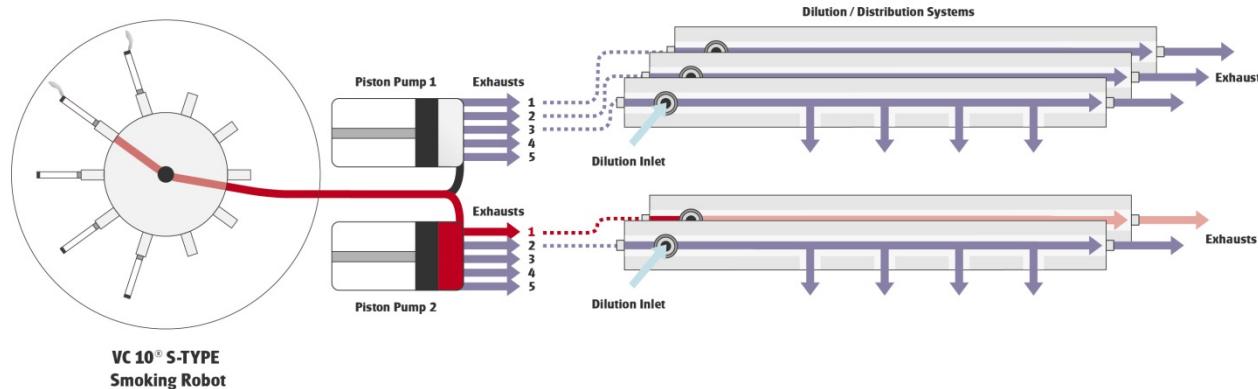
System Element: Smoke / Vapor Generation Automatic Robots

VITROCELL®
S Y S T E M S

VC 10® S-TYPE



- Smallest dead volume
- Conventional and e-cigarettes
- Fast and easy cleaning
- Product change in < 10 min. (exchange parts)
- Increased capacity via multiple pumps



System Element: Smoke / Vapor Generation Manual Machines

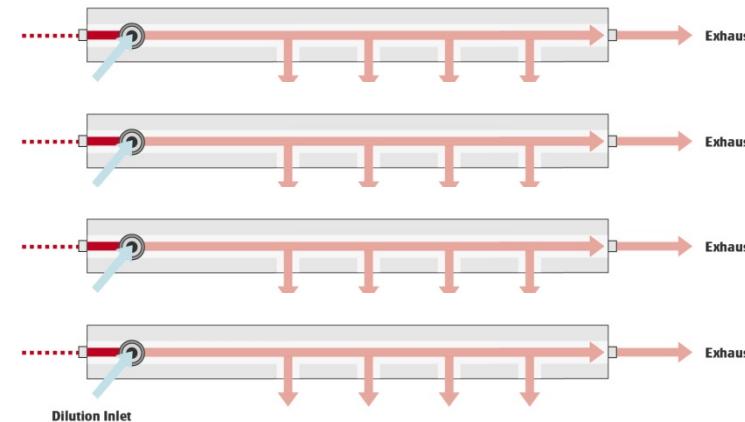
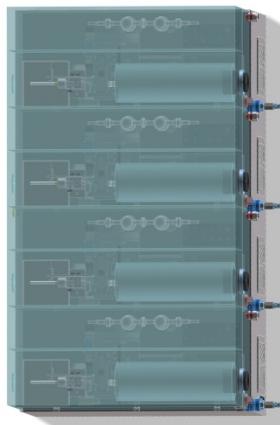


Vapestarter



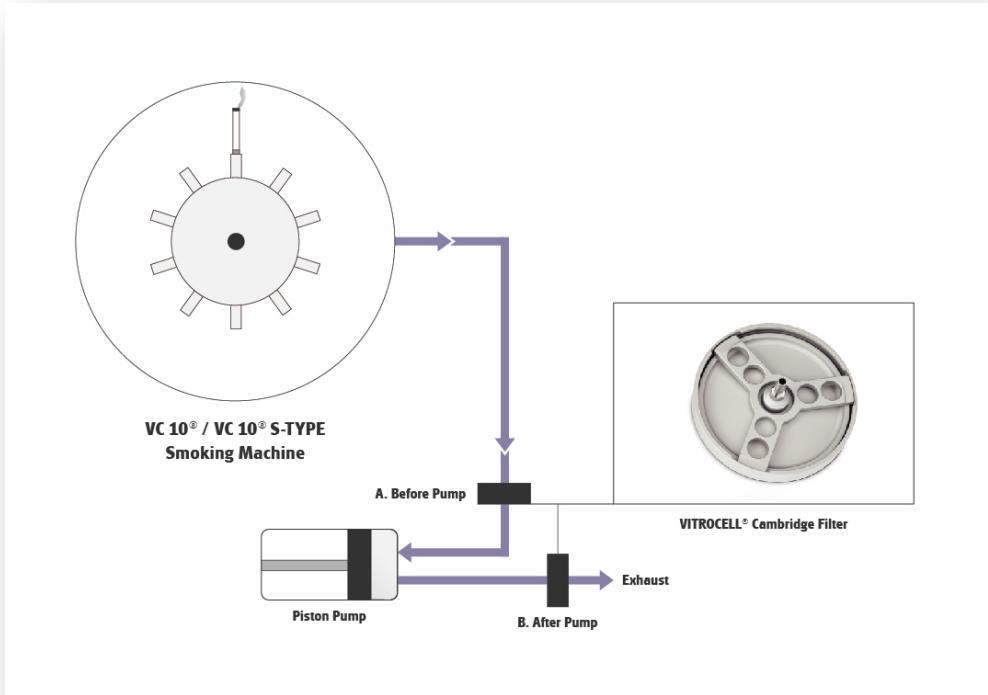
VC 1 Linear Type

- Smallest dead volumes
- (Conventional) and e-cigarettes
- Fast and easy cleaning
- Increased capacity via multiple pumps
- Run positive control in same experiment



System Element: Smoke / Vapor Generation

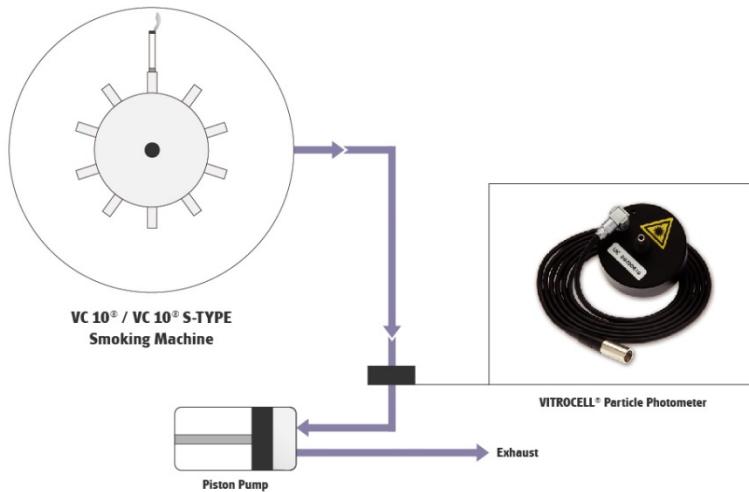
TPM Collection on 92 mm Cambridge Filter Pad before and after Syringe Pump



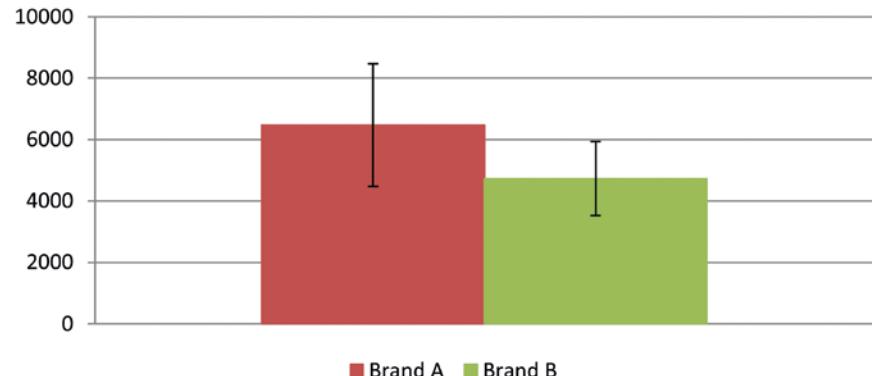
- VC 10 S-TYPE
- 20 cigarettes 3R4F/run
- ISO regime, 8 puffs

System Element: E-cigarette Vapor Generation

Detection of aerosol concentration

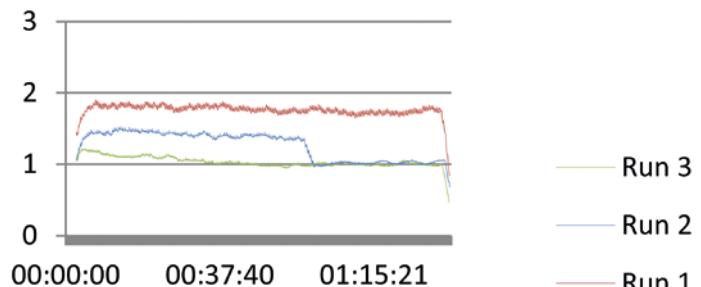


Area under Curve

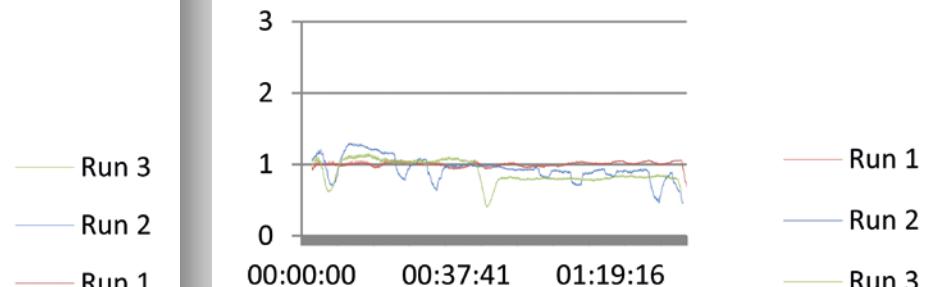


- VC 10 S-TYPE
- Draw actuated product
- 3 runs, 180 puffs,
- 50 mL square profile
- 3 s duration
- 30 s frequency

Product A



Product B



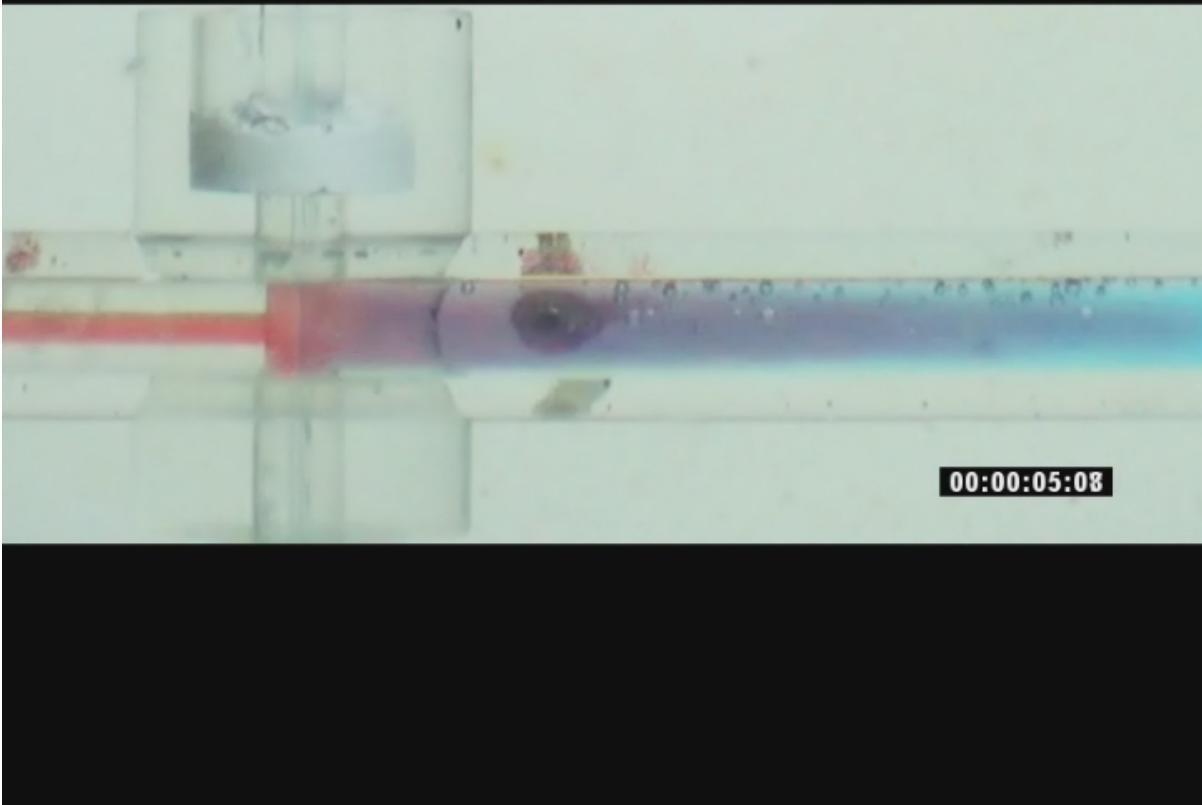
System Element: Dilution System

Model-1

2 side air-jets with 1 mm Dia., 1 smoke jet with 2 mm Dia.

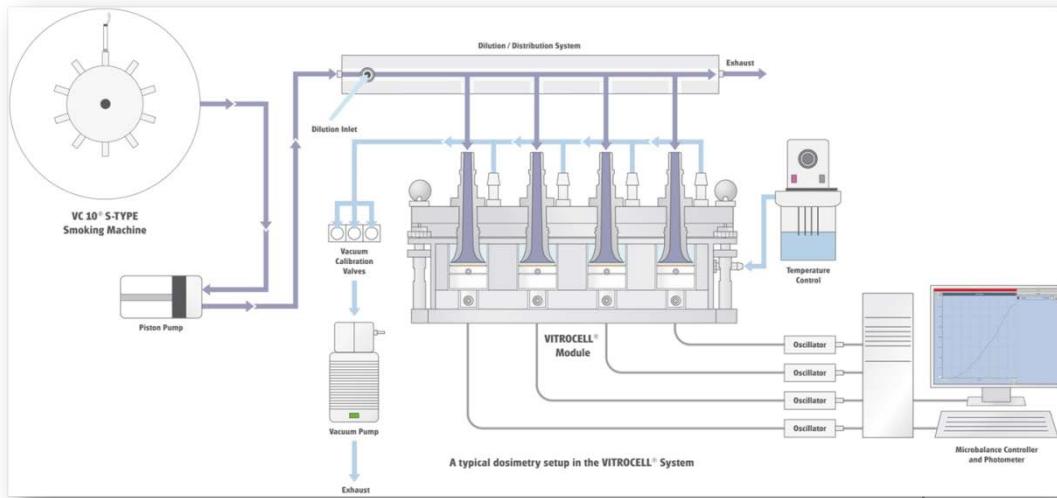
Air flow rate=1.0 l/min

Re=234



System Element: Smoke / Vapor Generation & Dilution Systems

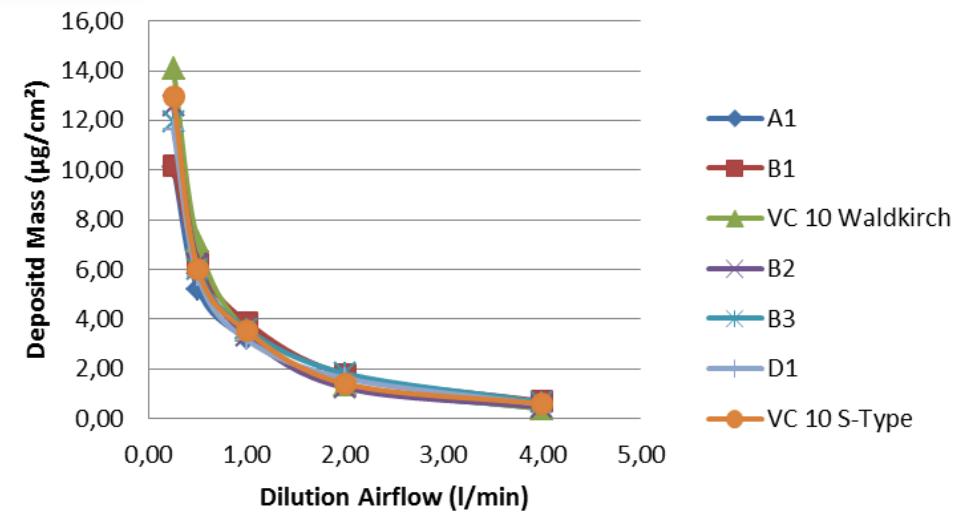
Smoking machine, dilution and exposure system validation via Quartz Crystal Microbalances



- Average of 5 runs 20 cigarettes 3R4F
- ISO regime, 8 puffs

Standard Deviation in $\mu\text{g}/\text{cm}^2$					
Dilution Flow (l/min)	0,25	0,5	1	2	4
VC 10 S-Type	2,72	0,47	0,15	0,01	0,02
VC 10 Average	2,68	0,64	0,35	0,18	0,09
A1	1,72	0,5	0,37	0,22	0,06
B1	1,02	0,46	0,21	0,12	0,12
VC 10 Waldkirch	4,55	1,32	0,55	0,24	0,08
B2	2,68	0,62	0,34	0,2	0,13
B3	3,42	0,3	0,27	0,12	0,07
D1	1,15	0,54	0,18	0,11	0,1

Interlab Comparison



Smoking Robot VC 10®

The most characterised smoking machine for *in vitro* applications



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Effects of smoking regimens and test material format on the cytotoxicity of mainstream cigarette smoke

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ABSTRACT

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Keywords:
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Total particulate
Whole smoke
Smoking regimen



Open Access

Characterisation of a Vitrocell® VC 10 *in vitro* smoke exposure system using dose tools and biological analysis

David Thorne¹*, Joanne Kilford², Rebecca Payne², Jason Adamson¹, Ken Scott¹, Annette Dalrymple¹, Clive Meredith¹ and Deborah Dillon¹

TIV 3136
13 July 2013

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No. of Pages 5, Model 5G

Abstract

Background: The Vitrocell® VC 10 is a smoking robot used to expose *in vitro* systems to cigarette smoke aerosol. To date, the characteristics of the deposition of cigarette smoke (whole smoke or monoxide) have not been fully described.

Results: Six different smoking regimens were used to deposit cigarette smoke onto the chamber walls of the Vitrocell® VC 10. The amount of smoke deposited onto the chamber walls was measured using quartz crystal microbalances (QCMs). The amount of smoke deposited onto the chamber walls increased with increasing smoking time and decreased with increasing smoking rate.

Conclusion: The Vitrocell® VC 10 is a reliable tool for the characterisation of cigarette smoke delivery and deposition.

Keywords:

Comet assay and air-liquid interface exposure system: A new combination to evaluate genotoxic effects of cigarette whole smoke in human lung cell lines

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5 July 2014
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journal homepage: www.elsevier.com/locate/toxinvit



ELSEVIER



5

6

3 An inter-machine comparison of tobacco smoke particle deposition
4 *in vitro* from six independent smoke exposure systems

7 Q1 J. Adamson ^{a,*}, D. Thorne ^a, G. Errington ^a, W. Fields ^b, X. Li ^c, R. Payne ^d, T. Krebs ^e, A. Dalrymple ^a,
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Dosimetry
In vitro exposure system
Vitrocell

ABSTRACT

There are several whole smoke exposure systems used to assess the biological and toxicological impact of tobacco smoke *in vitro*. One such system is the Vitrocell® VC 10 Smoking Robot and exposure module. Using quartz crystal microbalances (QCMs) installed into the module, we were able to assess tobacco smoke particle deposition in real-time. We compared regional deposition across the module positions and doses delivered by six VC 10s in four independent laboratories: two in the UK, one in Germany and one in China.

Gauge R&R analysis was applied to the total data package from the six VC 10s. As a percentage of the total, reproducibility (between all six VC 10s) and repeatability (error within an individual VC 10) accounted for 0.3% and 7.4% respectively. Thus Gauge R&R was 7.7%, less than 10% overall and considered statistically fit for purpose.

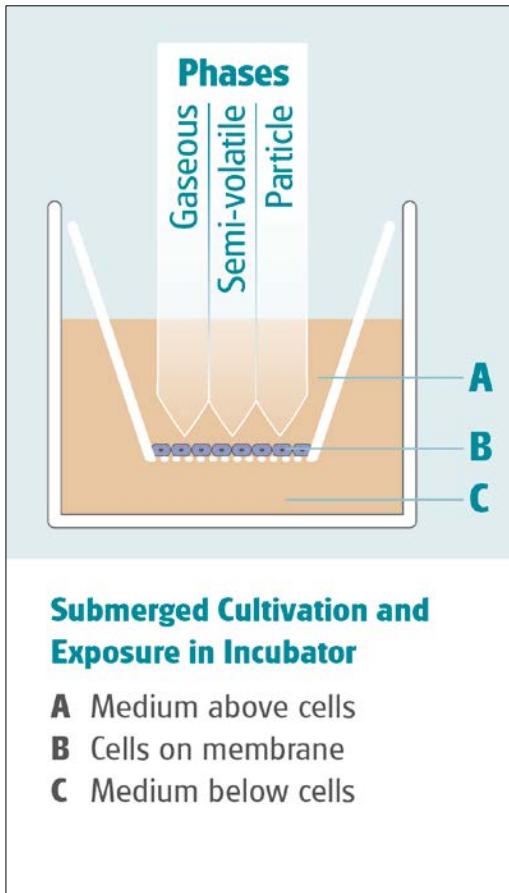
The dose-response obtained from the six machines across the four different locations demonstrated excellent agreement. There were little to no positional differences across the module at all airflows as determined by ANOVA (except for one machine and at three airflows only). These results support the on-going characterisation of the VC 10 exposure system and suitability for tobacco smoke exposure *in vitro*.

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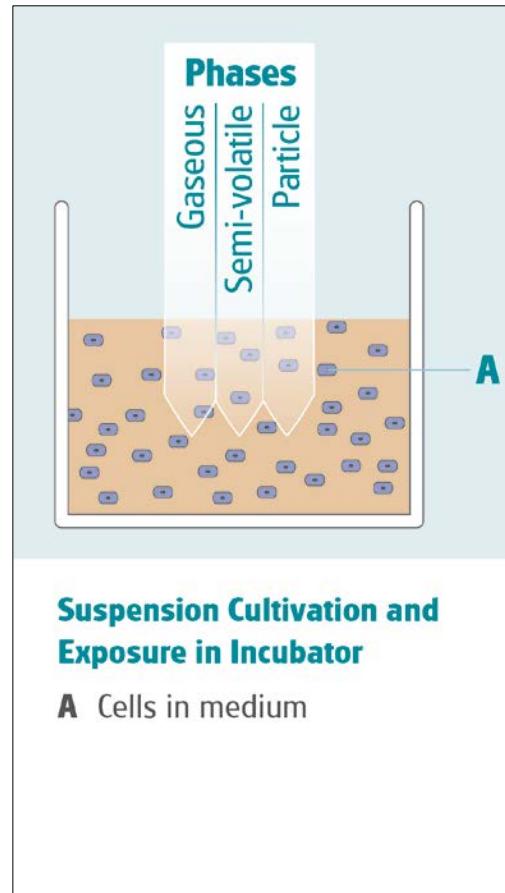
A few sample publications

System Element: Exposure Module

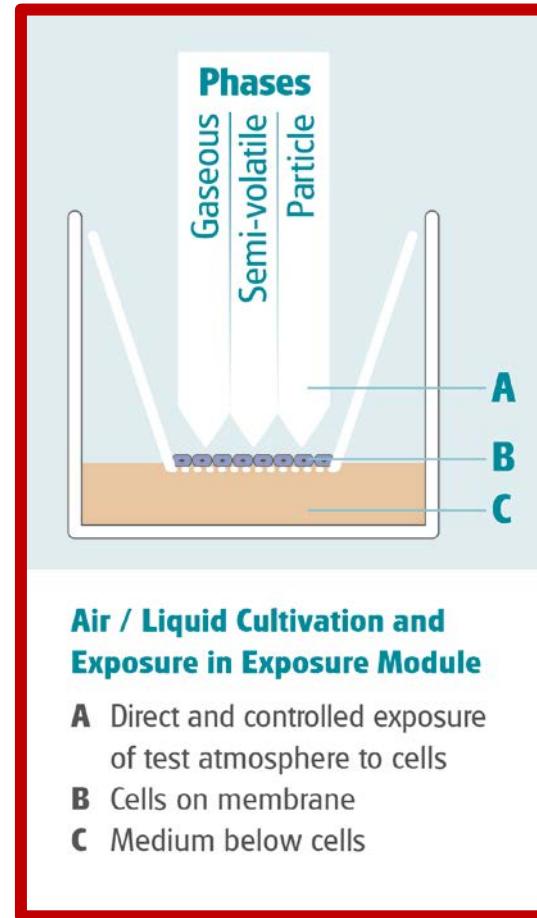
Advantages of exposure at the Air/Liquid Interface (ALI)



Submerged Exposure
Low Sensitivity
Undefined Dose



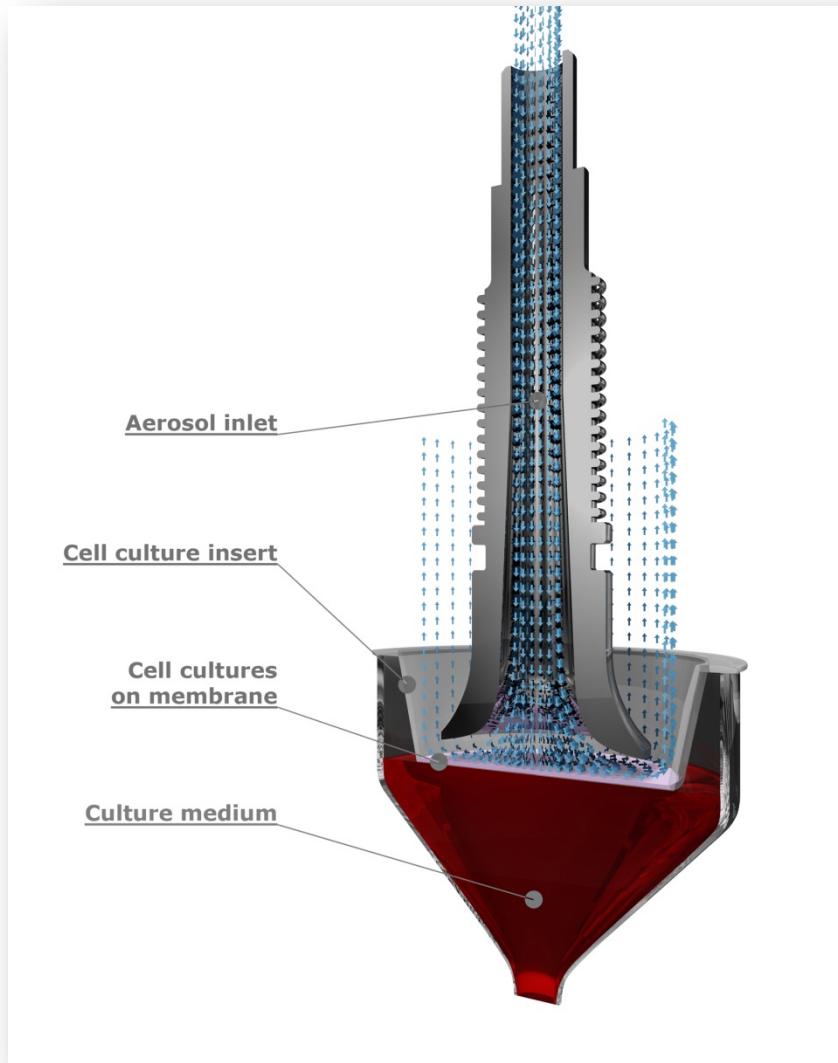
Exposure in Suspension
Low Sensitivity
Undefined Dose



Air/Liquid Interface
High Sensitivity
Defined Dose

System Element: Exposure Module

Puff-by-Puff flow of diluted smoke to cell cultures



Choice of Exposure Module

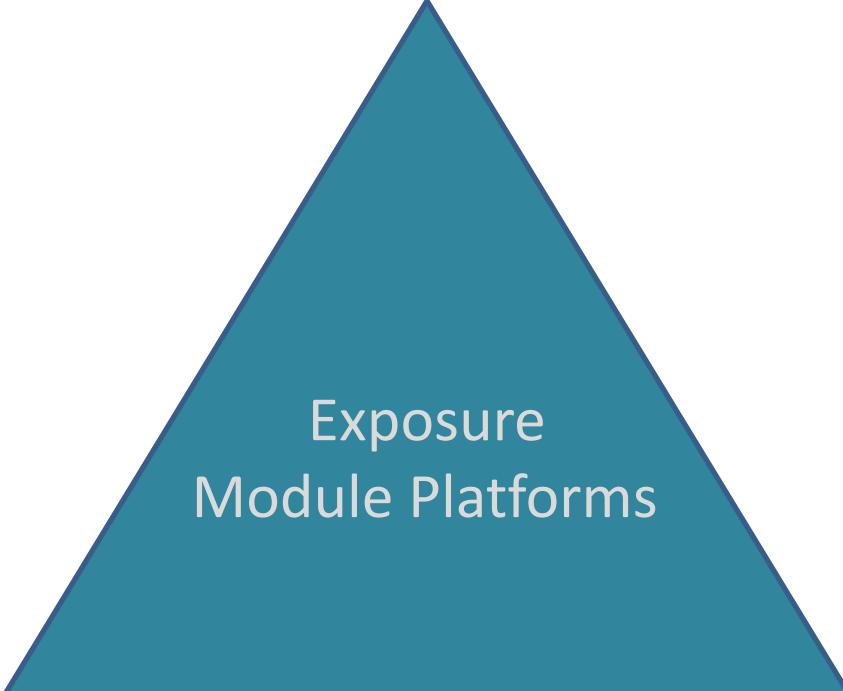
VITROCELL® Exposure Module Platforms



**Number of Doses/
Throughput**

- VC 96
- VC 6/48
- VC 24/48
- VC 12/12
- VC 12/6

↑



Exposure
Module Platforms

Membrane Insert Size
6, 12, 24, 96 wells

Type of Assay
Mammalian cells
AMES
Suspension Cells

VITROCELL® Assay Guide

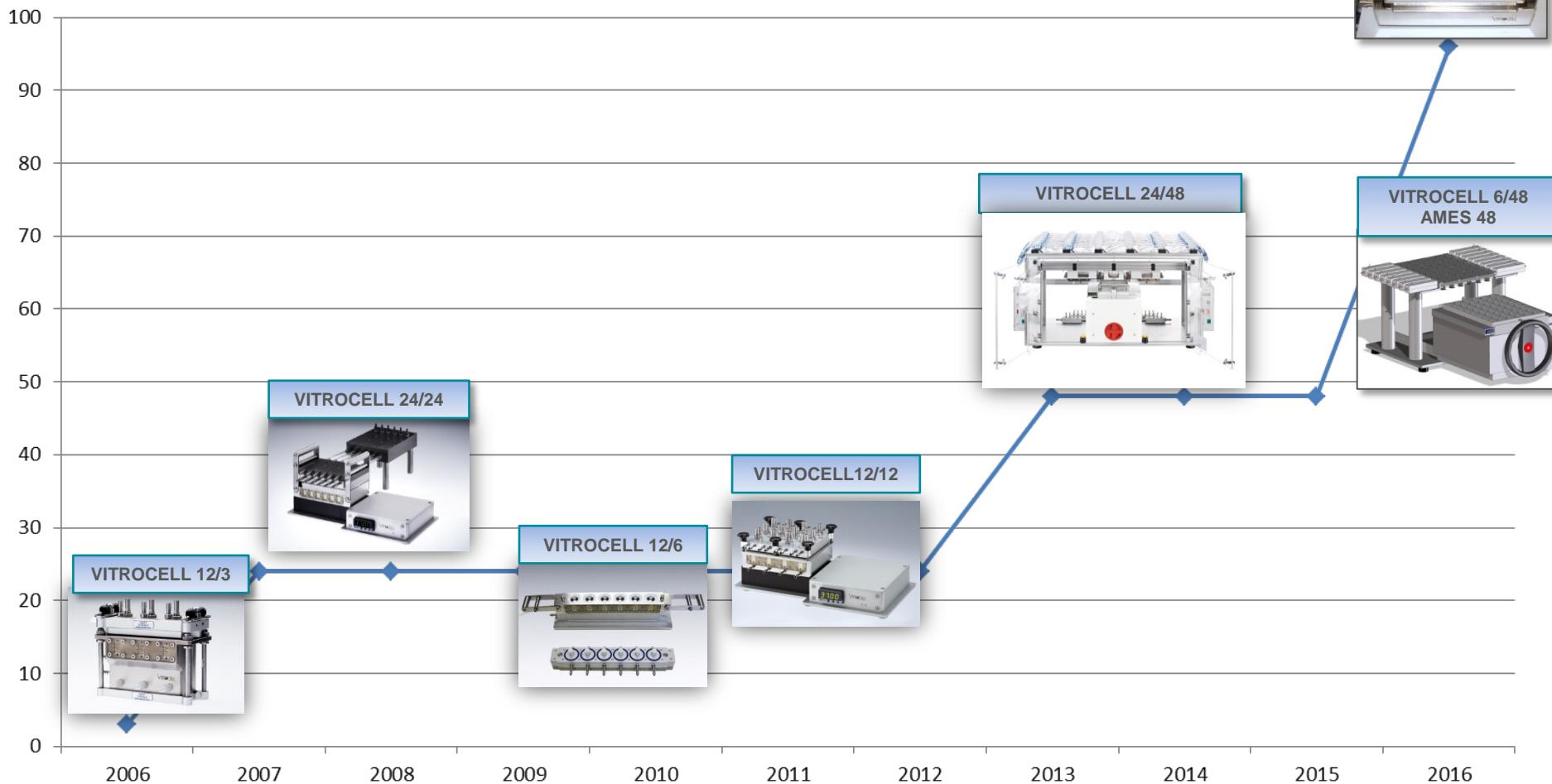
Category	Module type	VITROCELL 6 CF	VITROCELL 6/6 Cloud 6	VITROCELL 12 CF	VITROCELL 12/6	VITROCELL 12/6 CF	VITROCELL 12/12 Cloud 12	VITROCELL 24/24 Cloud 24	VITROCELL AMES	VITROCELL SC
	Number of inserts	3, 4 or 6	6	3 or 4	6	6	12	24 or 48	3 or 4	3 or 4
	Insert type (size)	6-well	6-well	12-well	12-well	12-well	12-well	24-well	35 mm Petri Dish	35 mm Petri Dish
	Culture Medium Supply	Continuous	Static	Continuous	Static	Continuous	Static	Static	--	--
Cytotoxicity	Number of viable cells	x	x	xx	xx	xx	xx	xx	-	-
	LDH release	xx	xx	xx	xx	xx	xx	x	-	-
	NRU uptake	x	x	xx	xx	xx	xx	xx	-	-
	MTT	x	x	xx	xx	xx	xx	xx	-	-
	XTT	x	x	xx	xx	xx	xx	xx	-	-
	MTS	x	x	xx	xx	xx	xx	xx	-	-
Proliferation	WST-1	x	x	xx	xx	xx	xx	xx	-	-
	Protein level	x	x	xx	xx	xx	xx	xx	-	-
Cellular Stress	ATP	xx	xx	x	x	x	x	x	-	-
	Cellular ATP/ADP ratio	xx	xx	x	x	x	x	x	-	-
	GSH	xx	xx	x	x	x	x	x	-	-
	GSSG	xx	xx	x	x	x	x	x	-	-
	GSSG/GSH	xx	xx	x	x	x	x	x	-	-
Oxidative Stress	Lipid peroxidation (MDA test)	xx	xx	x	x	x	x	x	-	-
Inflammation	Cytokines like IL8, IL6, IL12	x	x	xx	xx	xx	xx	x	-	-
Genotoxicity	Comet assay	x	x	xx	xx	xx	xx	-	-	-
	AMES/number of revertants	-	-	-	-	-	-	-	xx	-
"omic" technologies	ARN Sample for microarray	xx	xx	-	-	-	-	-	-	-
	ARN Sample for QRT PCR	xx	xx	-	-	-	-	-	-	-
Molecular Biology	Protein Sample for Western Blot	xx	xx	-	-	-	-	-	-	-
Assays for Suspension Cells		-	-	-	-	-	-	-	-	xx
Legend:		x = well suited xx = particularly well suited								

VITROCELL® Exposure Modules

Trend for higher throughput

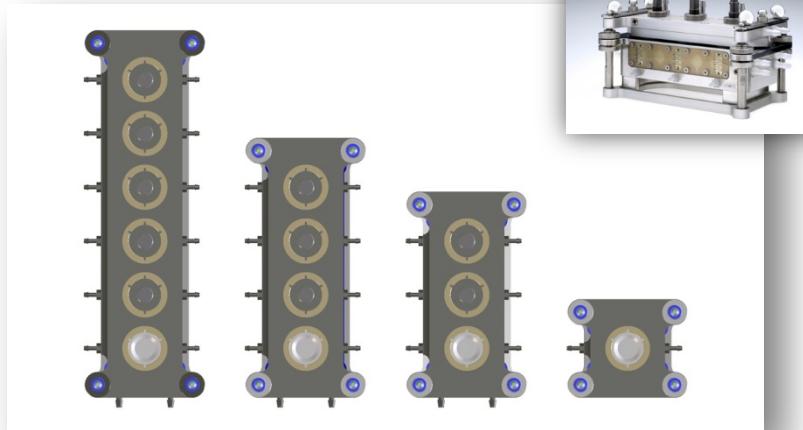


Inserts per Exposure Module



VITROCELL® Universal Module Platforms

VITROCELL® 6



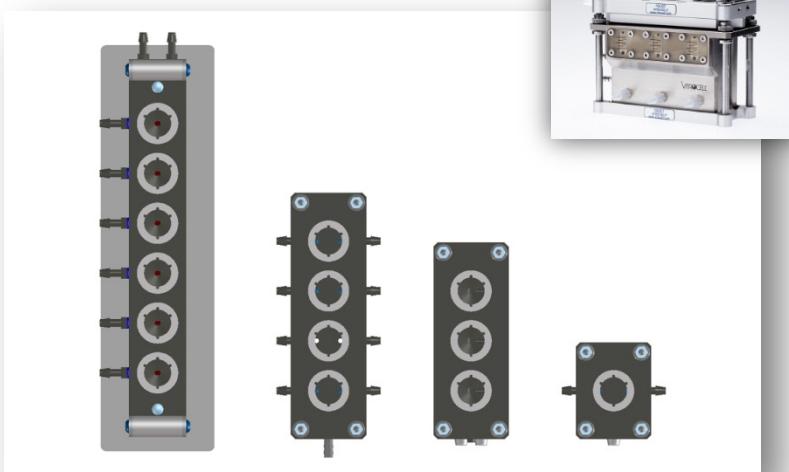
Insert Size

- 6-well
- 12-well
- 24-well
- Petri dishes AMES

Features

Medium reduction adaptors
Microbalance

VITROCELL® 12



- 12-well
- 24-well

Microbalance

Universal Modules for normal to medium throughput

Typical VC 1 and VITROCELL 12/6 Installation

Module system for 6 x 12- or 24-well sized cell culture inserts



- 1 dose @ 3 replicates
- 1 clean air control @ 3 replicates

VITROCELL® VC 1 for Electronic Cigarettes

MatTek CORPORATION

APPLICATION NOTE / VITROCELL

Using EpiAirway and EpiAlveolar with the VITROCELL® VC1 Smoking Machine and 12/6 CF Exposure Module

OBJECTIVE
To evaluate the effects of whole tobacco smoke or electronic cigarette vapor using the EpiAirway and EpiAlveolar in vitro human airway models and the VITROCELL® exposure system.

ENDPOINTS

- Toxicity
- TEER
- Gene Expression
- Oxidative Stress
- Beating Cilia
- Mucus Secretion

Typical setup of VITROCELL® exposure system utilized to expose EpiAirway or EpiAlveolar cultures to T-cig smoke or E-cig vapor. Inset shows E-blu E-cig in smoking chamber.

EpiAirway in vitro human tissue model. Stained histology 40X magnification

EpiAlveolar in vitro human tissue model. Stained histology 40X magnification

Quantitative PCR of CYP1A1 shows significant increases in expression after exposure of EpiAirway to TCIG smoke (48 puffs) and ECIG vapor (400 puffs).

Condition	CYP1A1
T-Cig	~1.0
E-blu E-cig 400	~0.8
E-blu E-cig 200	~0.7
E-blu E-cig 100	~0.5
E-blu E-cig 50	~0.6
Air Control	~0.2

8-Iso Assay

Condition	8-Iso Assay
T-Cig	~300
Ecig 400	~150
Ecig 200	~100
Ecig 100	~80
Ecig 50	~60
Average Air	~40

8-Isoprostane in EpiAirway culture medium is significantly increased after both TCIG and ECIG exposure. 8-Isoprostane significantly increased after TCIG smoke exposure (48 puffs), or exposure to ECIG vapor (400, 200, 100 and 50 puffs).

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Toxicology in Vitro logo

Development of an *in vitro* cytotoxicity model for aerosol exposure using 3D reconstructed human airway tissue; application for assessment of e-cigarette aerosol

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Human airway

ABSTRACT

Development of physiologically relevant test methods to analyse potential irritant effects to the respiratory tract caused by e-cigarette aerosols is required. This paper reports the method development and optimisation of an acute *in vitro* MTT cytotoxicity assay using human 3D reconstructed airway tissues and an aerosol exposure system. The EpiAirway™ tissue is a highly differentiated *in vitro* human airway culture derived from primary human tracheal/bronchial epithelial cells grown at the air–liquid interface, which can be exposed to aerosols generated by the VITROCELL® smoking robot. Method development was supported by understanding the compatibility of these tissues within the VITROCELL® system, in terms of airflow (L/min), vacuum rate (mL/min) and exposure time. Dosimetry tools (QCM) were used to measure deposited mass, to confirm the provision of e-cigarette aerosol to the tissues. EpiAirway™ tissues were exposed to cigarette smoke and aerosol generated from two commercial e-cigarettes for up to 6 h. Cigarette smoke reduced cell viability in a time dependent manner to 12% at 6 h. E-cigarette aerosol showed no such decrease in cell viability and displayed similar results to that of the untreated air controls. Applicability of the EpiAirway™ model and exposure system was demonstrated, showing little cytotoxicity from e-cigarette aerosol and different aerosol formulations when compared directly with reference cigarette smoke, over the same exposure time.

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1. Introduction

E-cigarettes¹ are increasing in popularity throughout the world. Whilst the devices themselves are subject to some regulation, e.g. CE marking, there are no standard regulations relating to character-

been done. Desk-based risk assessment of the ingredients contained within e-liquids has highlighted a specific requirement to understand the potential for irritant effects to the respiratory tract caused by e-cigarette aerosols.

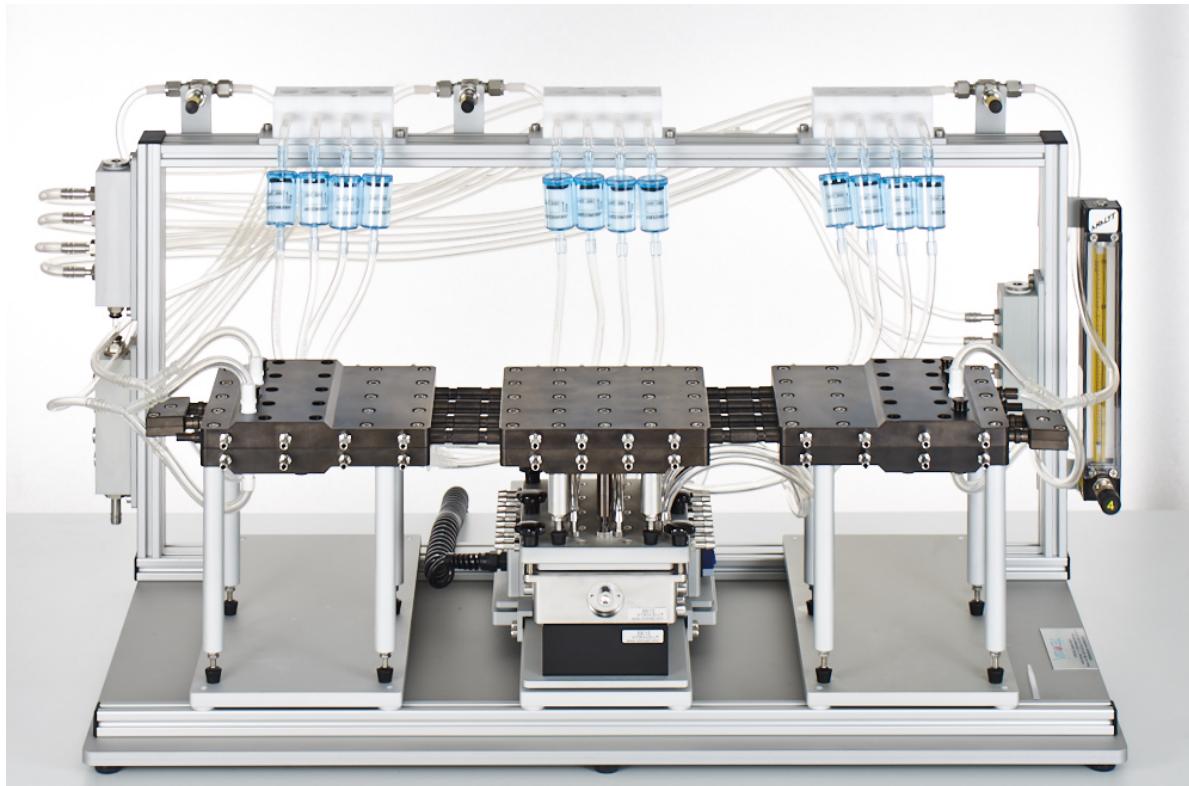
A number of *in vitro* tests, largely been based on cytotoxicity

VITROCELL® 12/12

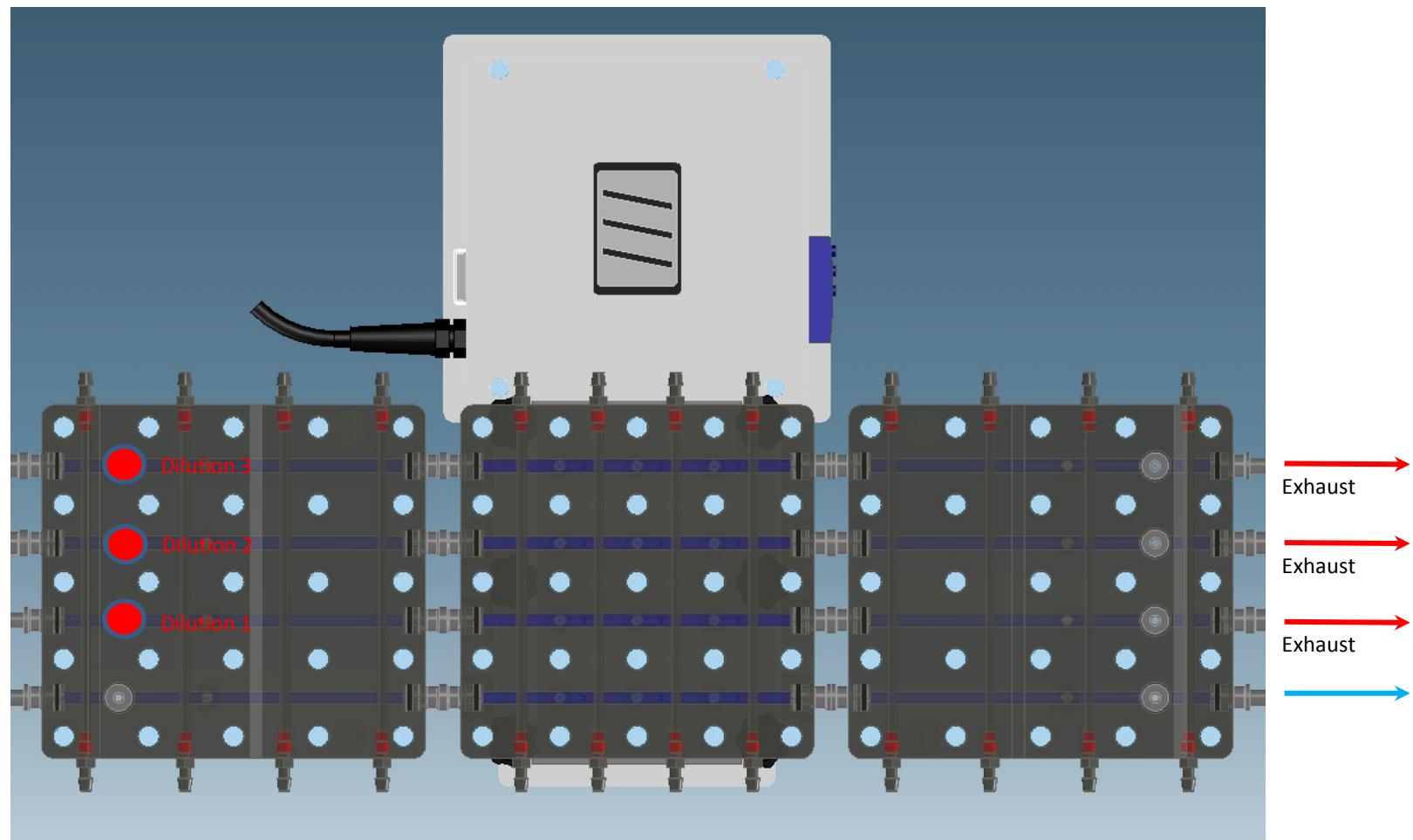
Module system for 12 x 12- and 24-well sized cell culture inserts

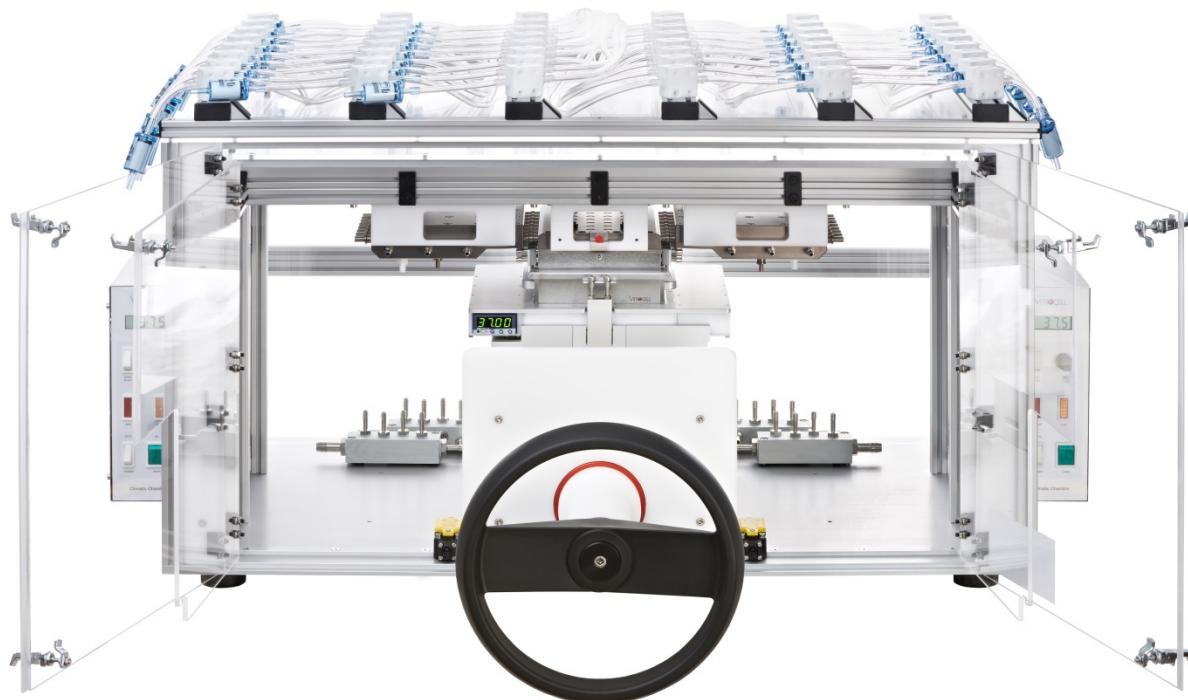


VITROCELL® 12/12 Quick-Connect Station



- 3 doses @ 3 replicates
- 1 clean air control @ 3 replicates
- Integrated dynamic dilution systems





7 doses @ 6 replicates
1 clean air control @ 6 replicates
Integrated dynamic dilution systems



- 7 doses @ 6 replicates
- 1 clean air control @ 6 replicates
- Integrated dynamic dilution systems

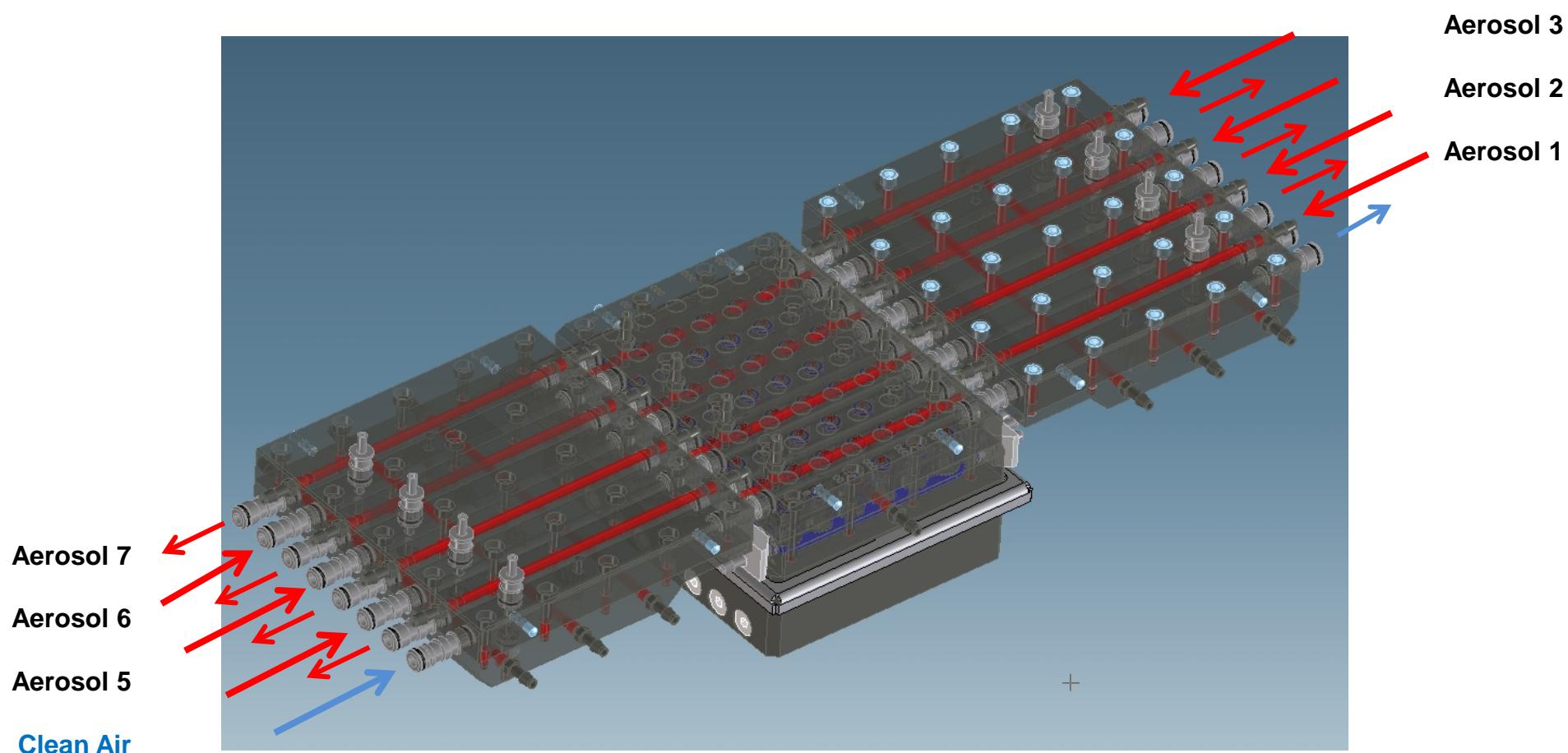


- Exposure Top with VITROCELL® 24 /24 technology
- Base module with 8 rows @ 6 replicates
- Rack with unique locking device

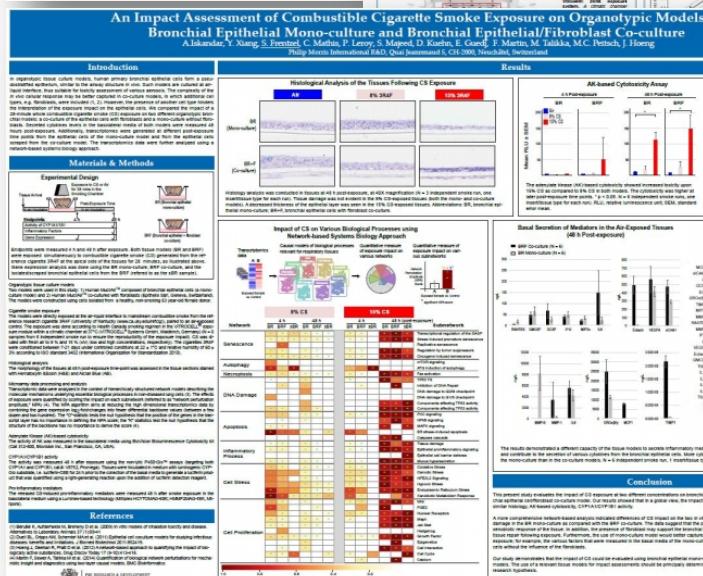
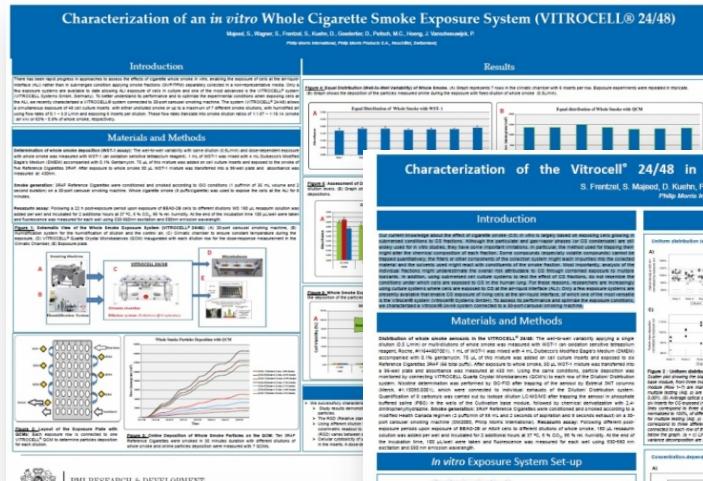


Module system for higher throughput

- 7 doses @ 6 replicates
- 1 clean air control @ 6 replicates
- Integrated dynamic dilution systems



VITROCELL® 24/48 Publications



Characterization of the Vitrocell® 24/48 *in vitro* aerosol exposure system using mainstream cigarette smoke

S. Frentzel, S. Maged, D. Kuehn, P. Leroy, P.A. Oly, A. Kneifl, A.K. Kuczaj, M. Nordlund, J. Hoeng, M.-C. Peitsch
Philip Morris International Research & Development, Neuhausen, Switzerland

Introduction

Our current knowledge about the effect of cigarette smoke on cells is largely based on measuring effects in living organisms. To better understand the mechanism of action of cigarette smoke, it is important to study the effect of cigarette smoke on cells. In this study, we characterized the Vitrocell® 24/48 system to assess the effect of cigarette smoke on cells.

Materials and Methods

Determination of whole smoke deposited onto culture plates. The total smoke deposited onto a 25 mm diameter culture plate was measured using the Vitrocell® 24/48 system. The smoke was collected from a single cigarette and delivered to the exposure chamber at a rate of 0.5 L/min. The amount of smoke deposited onto the culture plate was determined by measuring the mass of the culture plate before and after exposure.

Results

Concentration of nicotine and different carbonyls inside the exposure chamber

Figure 1 shows the concentration of nicotine and different carbonyls inside the exposure chamber. The concentration of nicotine and different carbonyls was determined by measuring the concentration of nicotine and different carbonyls in the exposure chamber. The concentration of nicotine and different carbonyls was determined by measuring the concentration of nicotine and different carbonyls in the exposure chamber.

Discussion

The results show that the concentration of nicotine and different carbonyls inside the exposure chamber is similar for all smoke components. The concentration of nicotine and different carbonyls is approximately 10% higher than that of tar and water-soluble smoke components.

Conclusion

The Vitrocell® 24/48 system can be used to predict the effect of cigarette smoke *in vitro*. The results show that the Vitrocell® 24/48 system can be used to predict the effect of cigarette smoke *in vitro*.

Keywords: Cigarette smoke, Nicotine, Carbonyl, *In vitro* exposure system, Vitrocell®

Background

Cigarette smoke (CS) is a complex heterogeneous mixture of over 4000 compounds, of which at least 200 have known toxicological effects and are associated with various smoking-related diseases, including respiratory

Advanced *in vitro* exposure systems

INHALATION TOXICOLOGY | **SKIN EXPOSURE** | **AUXILIARY EQUIPMENT** | **INFORMATION CENTER**

INTERNATIONAL JOURNAL OF TOXICOLOGY (October 8, 2014)

Authors

Madjid Taklaie¹, Radim Kotekotkova¹, Ying Wang¹, Corinne Matthei¹, Alain Sevier¹, Shadi Maledi¹, Diana Kuehn¹, Stefan Frentzel¹, Celine Hoeng¹, Maicol Geertz¹, Fabien Martin¹, Nikolai V. Iakovov¹, Manuel C. Peitsch¹, Julia Hoeng¹
¹Philip Morris International R&D, Philip Morris Products S.A., Neuhausen, Switzerland

Abstract

Background: Only a few exposure systems are presently available that enable *experiments* simple exposure of living cells in the *air-liquid interface*, of which one of the most versatile is the Vitrocell® system (Vitrocell® Systems GmbH). To assess its performance and optimize the exposure conditions, we characterized a Vitrocell® 24/48 system connected to a 30-port custom smoking machine. The Vitrocell® 24/48 system allows for simultaneous exposure of 48 cell culture inserts using dilution airflow rates of 0.30 L/min and exposing six inserts per dilution. These flow rates represent cigarette smoke concentrations of 7–100%.

Results: By characterizing the Vitrocell® 24/48, we verified that (i) the cigarette smoke aerosol distribution is uniform across all inserts, (ii) the utility of Vitrocell®-based quantification for determining the particle distribution of particle mass on the inserts, and (iii) the amount of particles deposited per surface area and the amounts of trapped nicotine and nicotine were concentration dependent. At a fixed dilution airflow of 0.5 L/min, the results showed a coefficient of variation of 12.9% between inserts of the Vitrocell® 24/48 module, excluding variations caused by off-set runs. Although nicotine and carbonyl concentrations were linear over the tested dilution range, particle deposition increased non-linearly. The observed effect on cell viability was well-correlated with increasing concentration of cigarette smoke.

Conclusions: Overall, the obtained results highlight the suitability of the Vitrocell® 24/48 system to assess the effect of cigarette smoke on cells under air-liquid interface exposure conditions, which is closely related to the conditions occurring in human airways.

Keywords: Cigarette smoke, Nicotine, Carbonyl, *In vitro* exposure system, Vitrocell®

Categories

- Exhibitions (5)
- Product News (34)
- Publications (105)
- User Group Meeting (4)

Tags

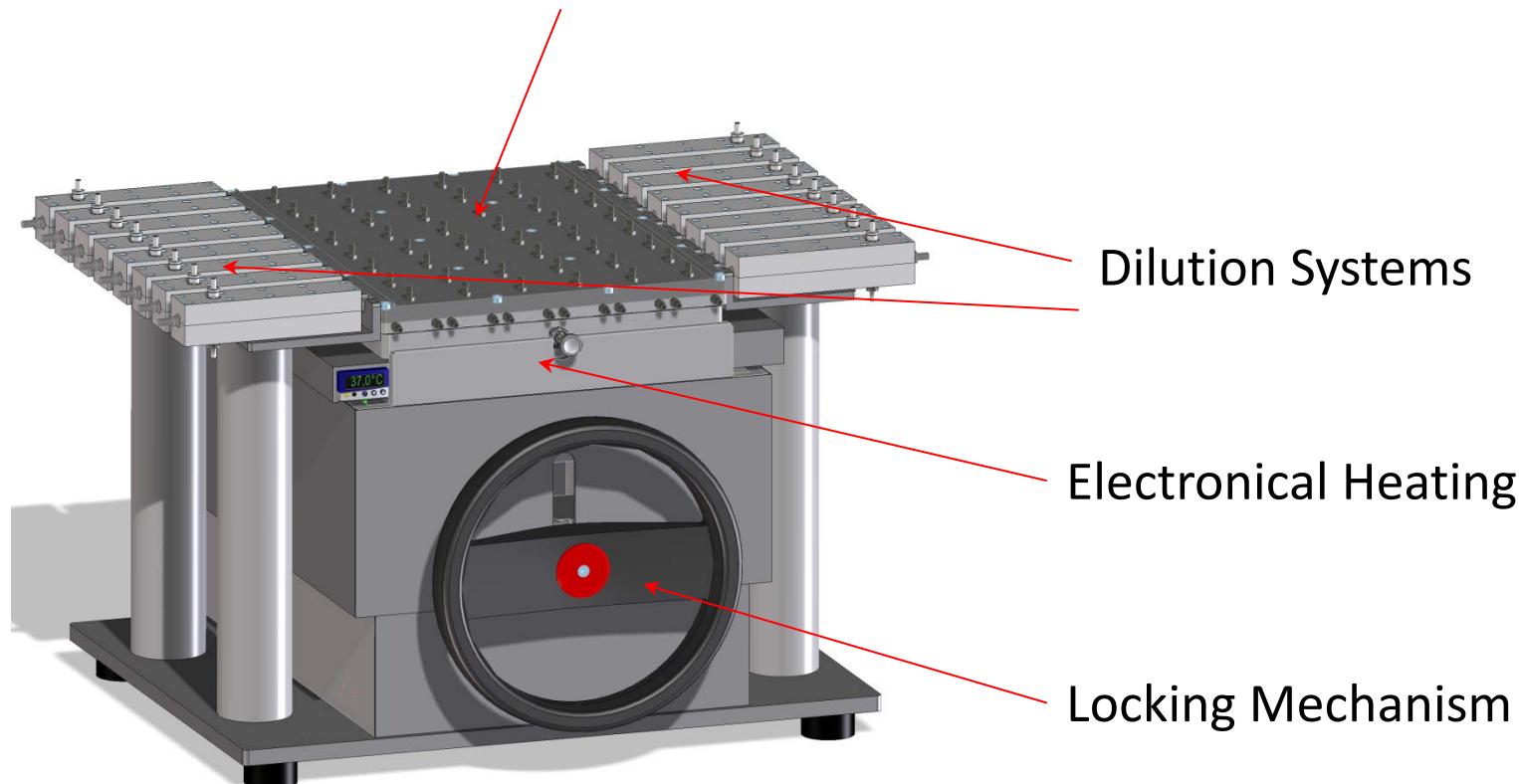
- air-liquid interface
- AMES
- cigarette smoke exposure station
- e-cigarettes
- exposure station
- inhalation exposure
- liquid aerosol
- measuring
- microtiter plate
- photometer
- nanoparticles
- smoke
- skin cell sailing system
- toxicology
- VO 1 smoking machine
- VO 10 smoking machine
- VITROCELL 24
- VITROCELL 24/48
- VITROCELL 6
- VITROCELL Cloud

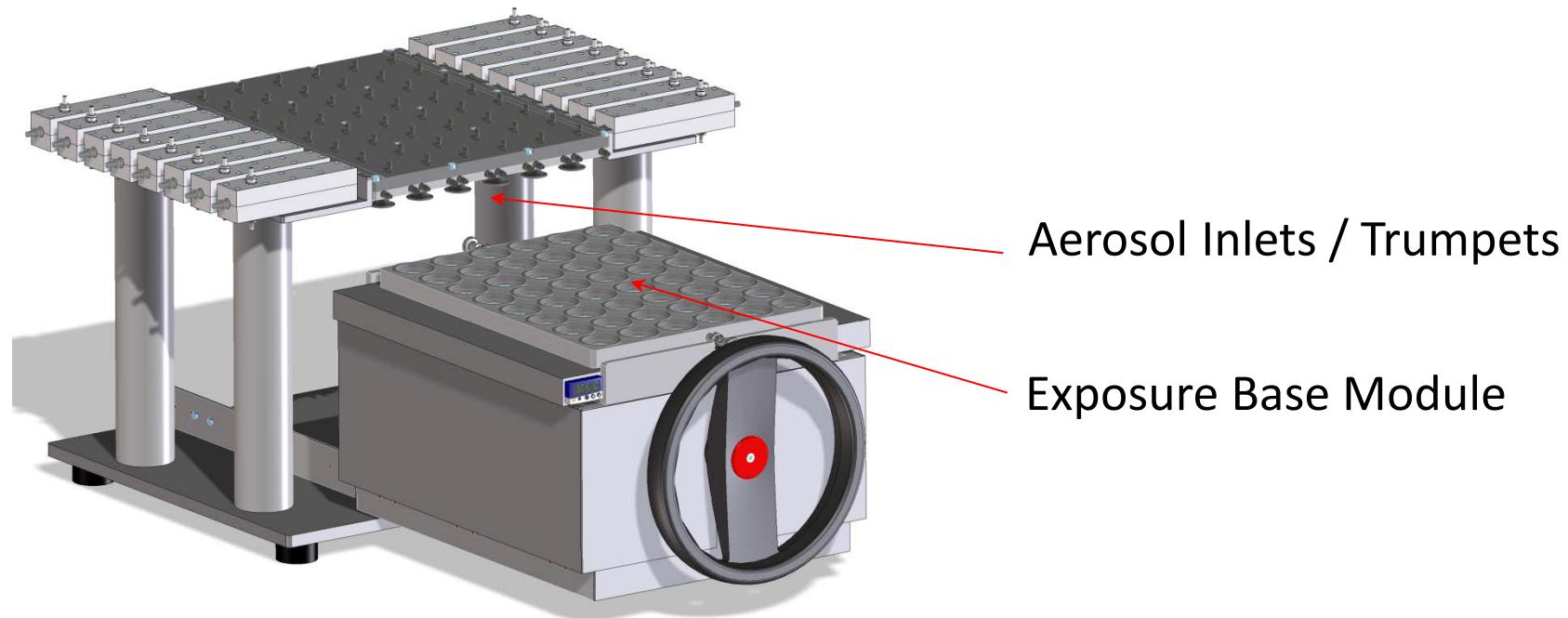
SEARCH

Search

Q Search

Exposure Top / Distribution System



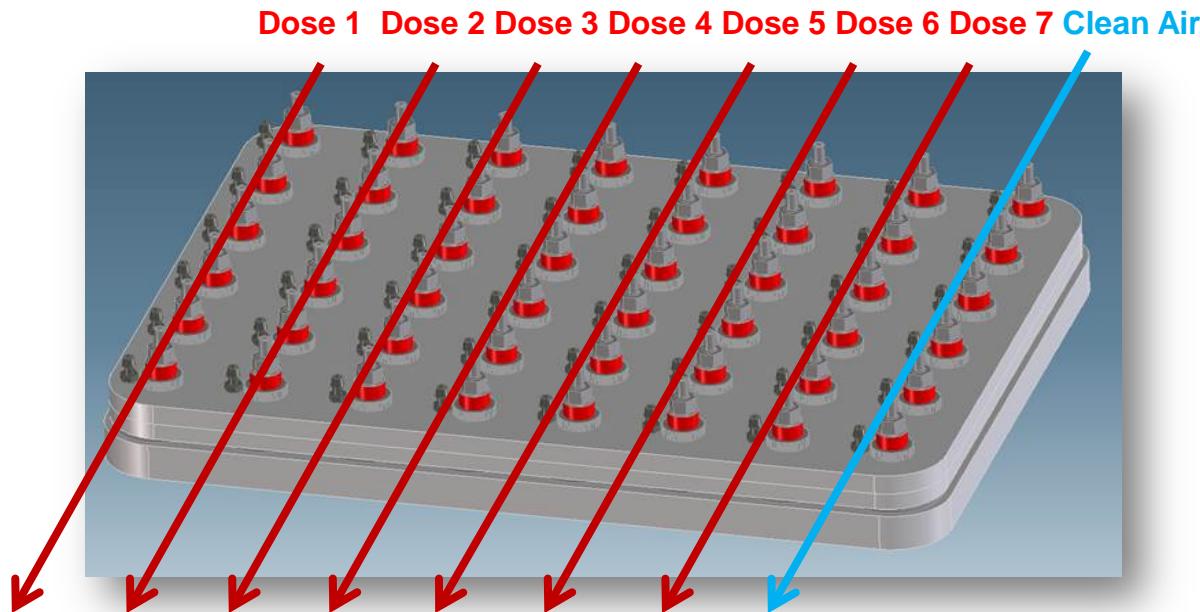


VITROCELL® 6/48 and AMES 48

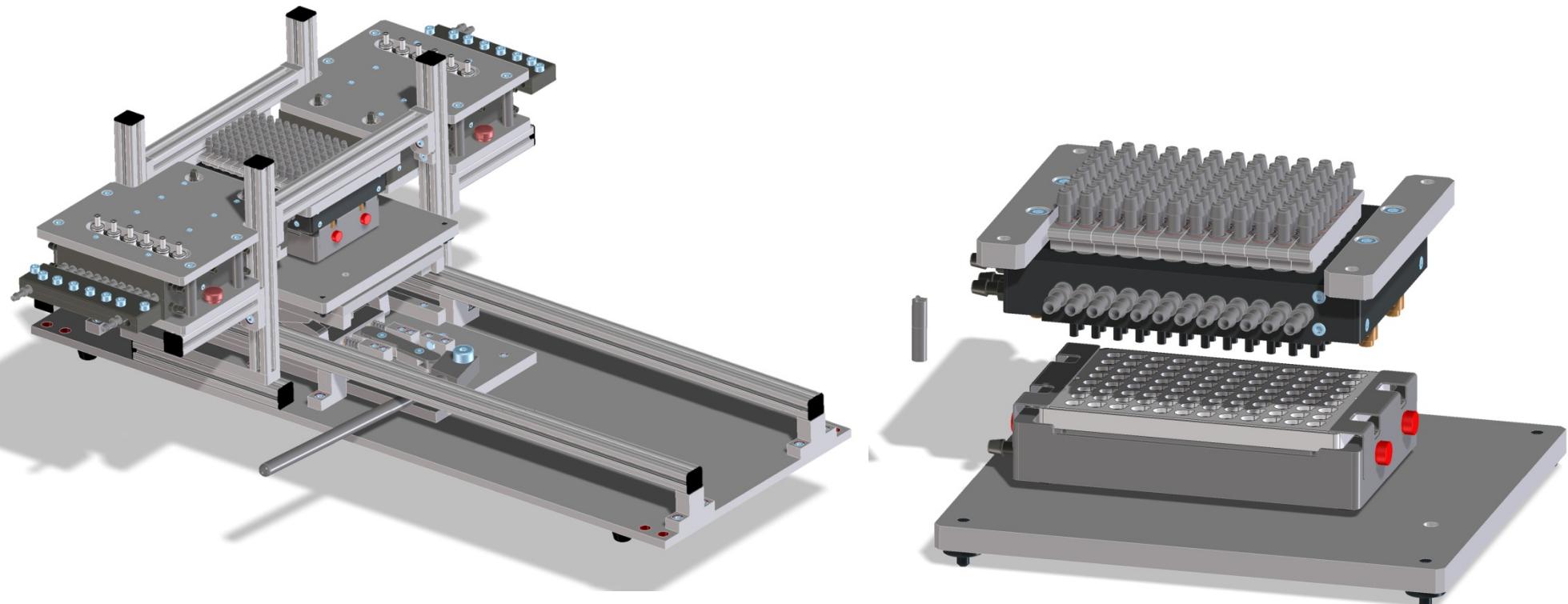
Dilution System – 7 aerosol entries / 1 clean air



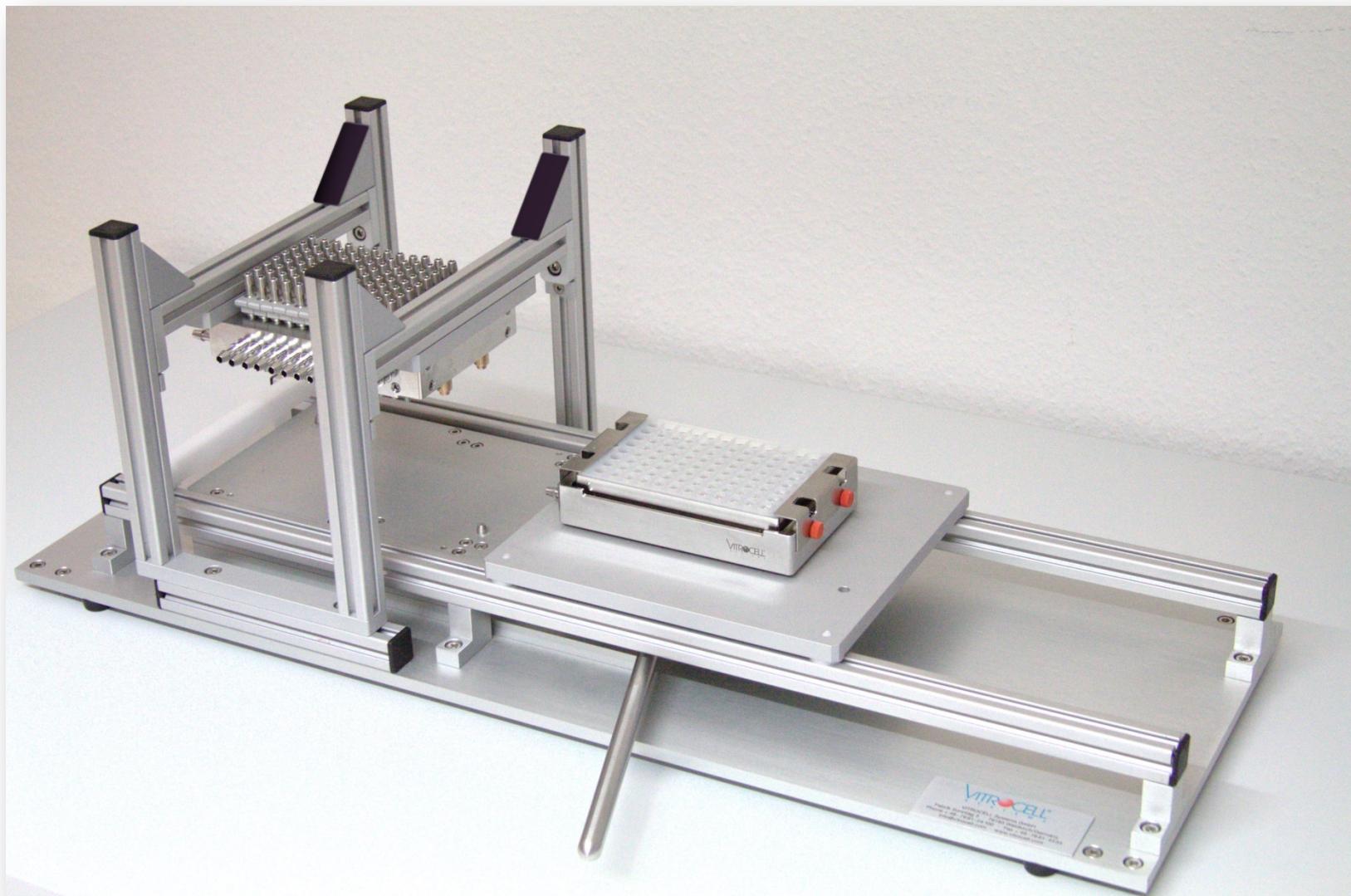
- Increase of capacity, in a compact design
- 7 Doses @ 6 replicates
- 1 clean air control @ 6 replicates
- Flexible design, AMES and 6-well compatibility



- 11 doses @ 8 replicates
- 1 clean air control @ 8 replicates
- Integrated dynamic dilution system



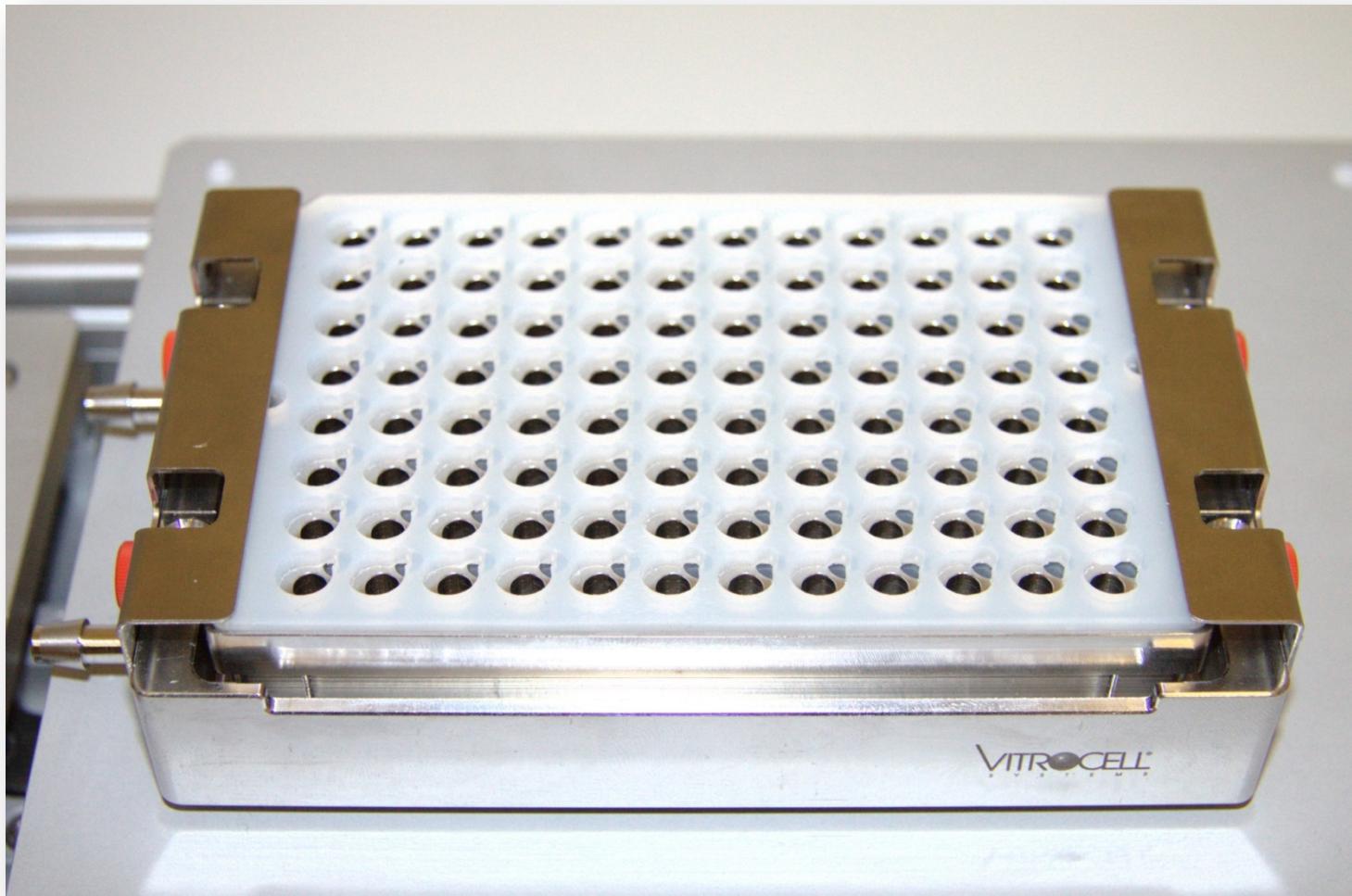
VC 96 Rack System



VITROCELL® 96

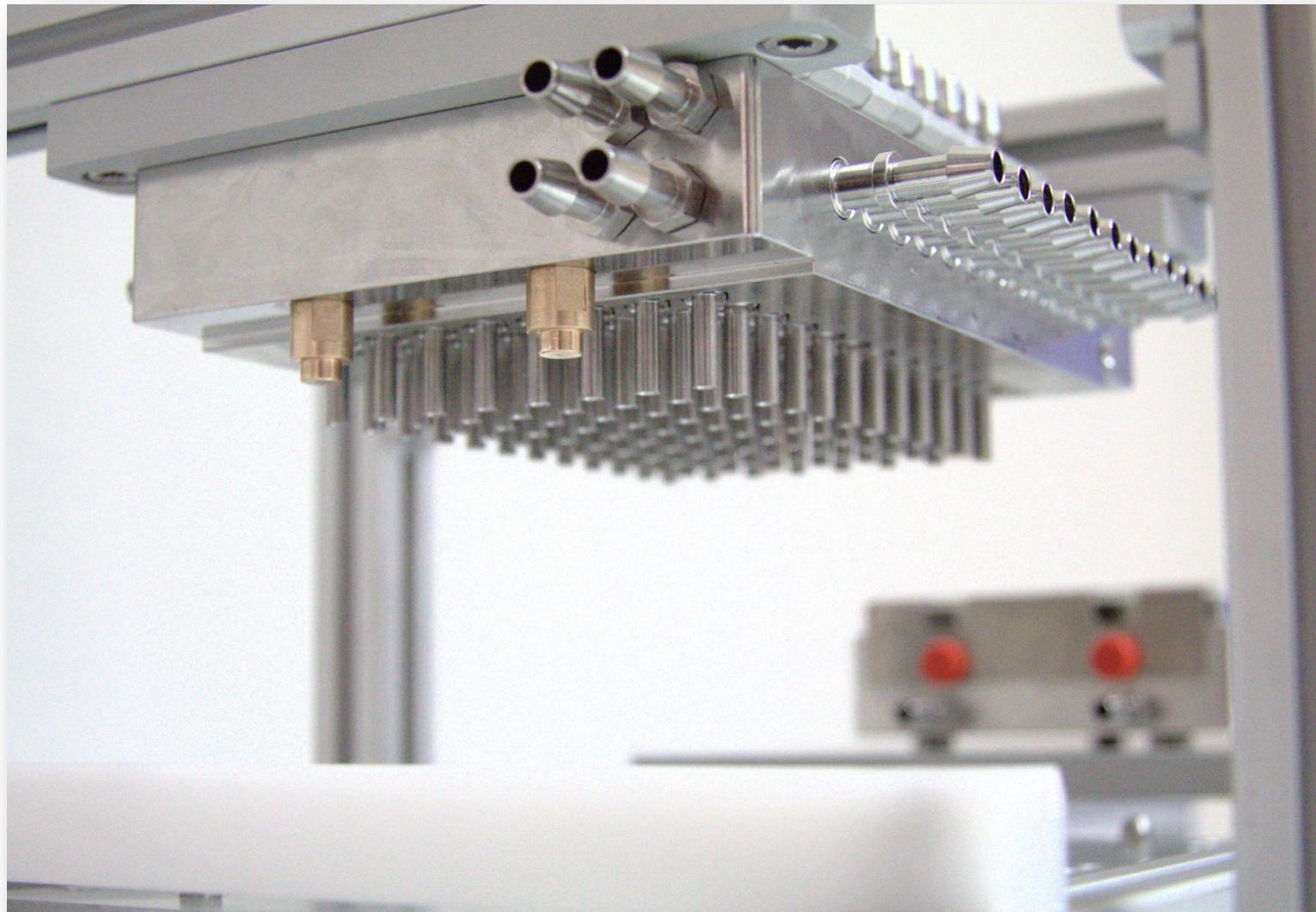
Base Module

VITROCELL®
S Y S T E M S



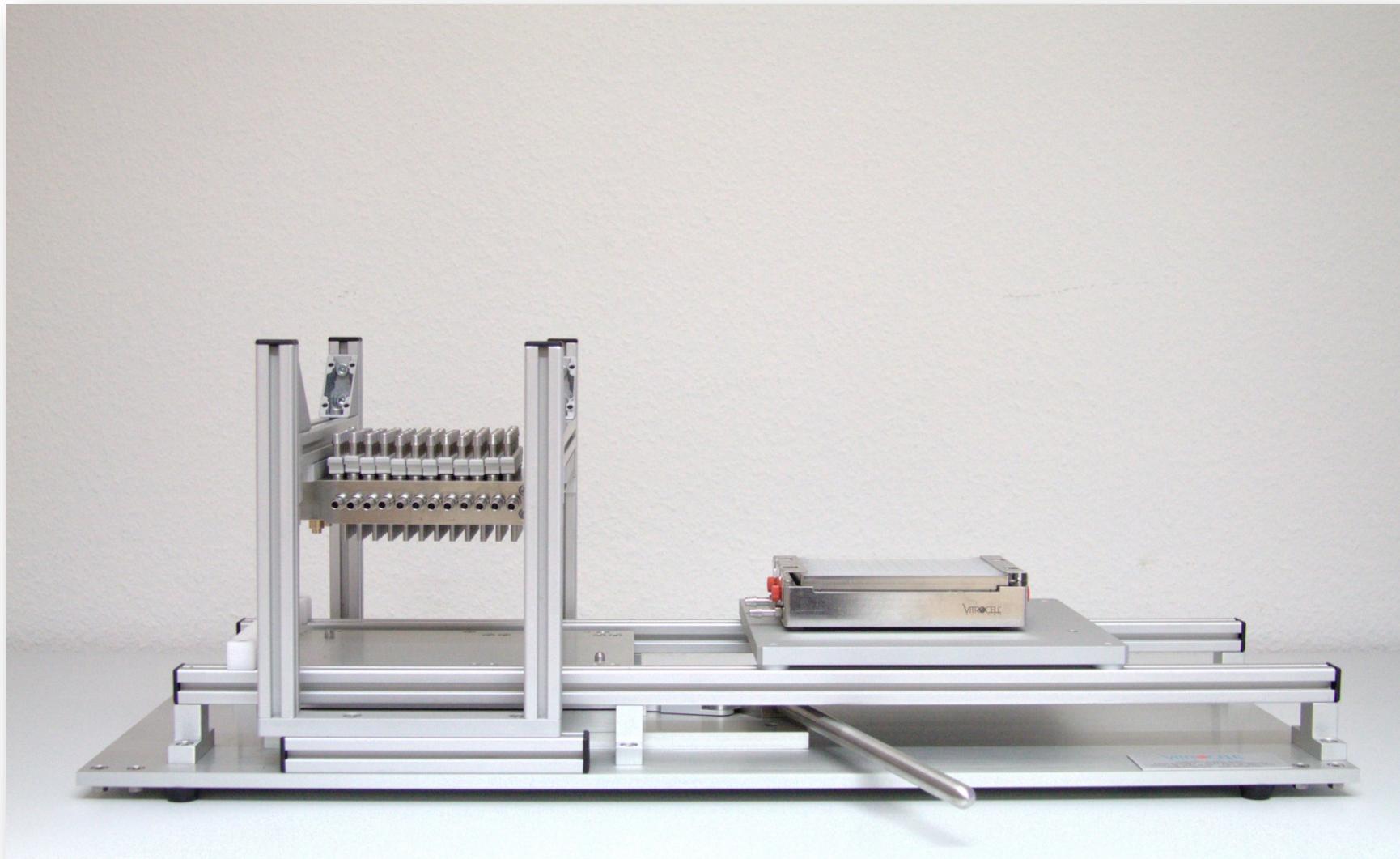
VITROCELL® 96 Exposure Top

VITROCELL®
S Y S T E M S



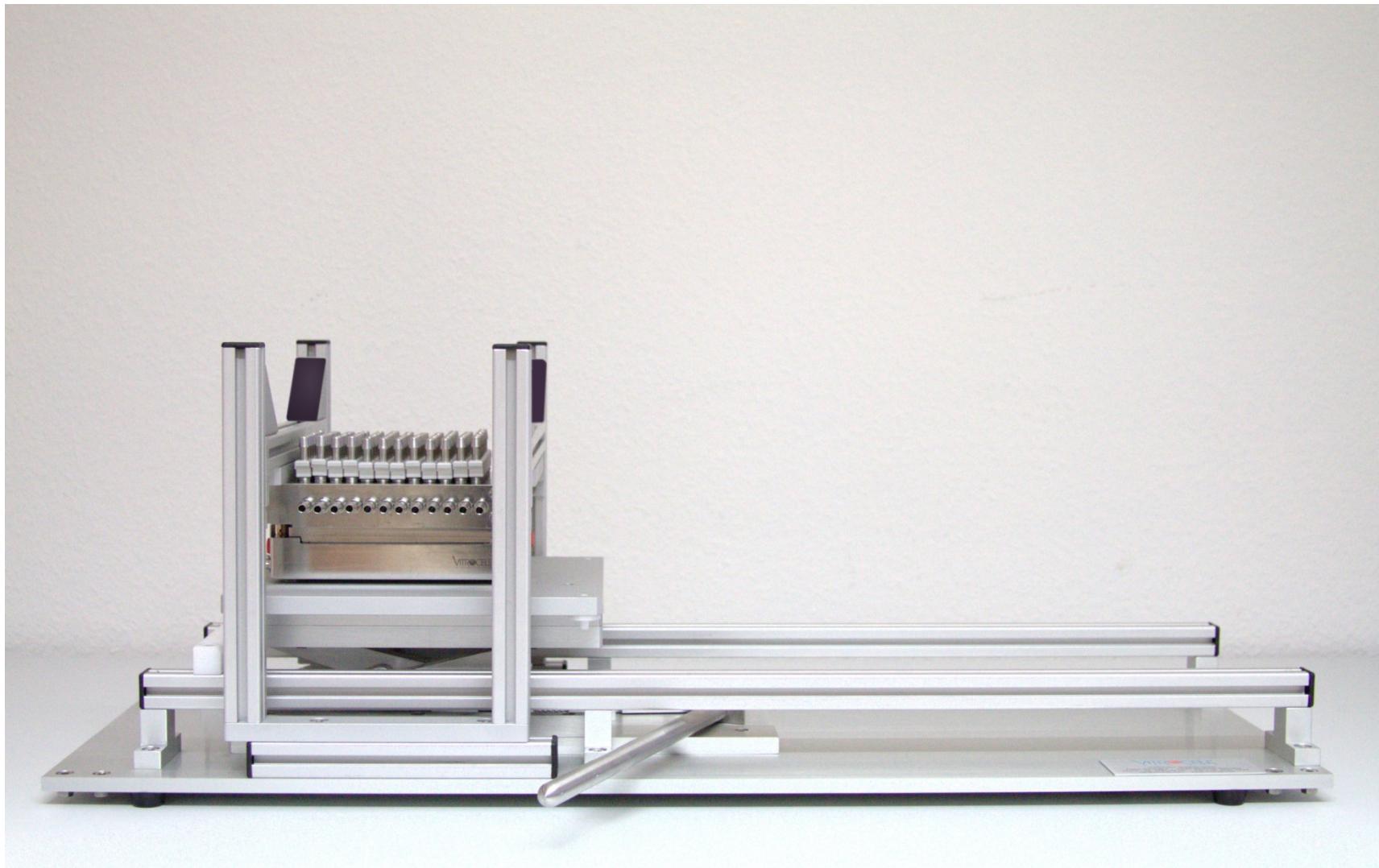
VITROCELL® 96 Locking Device

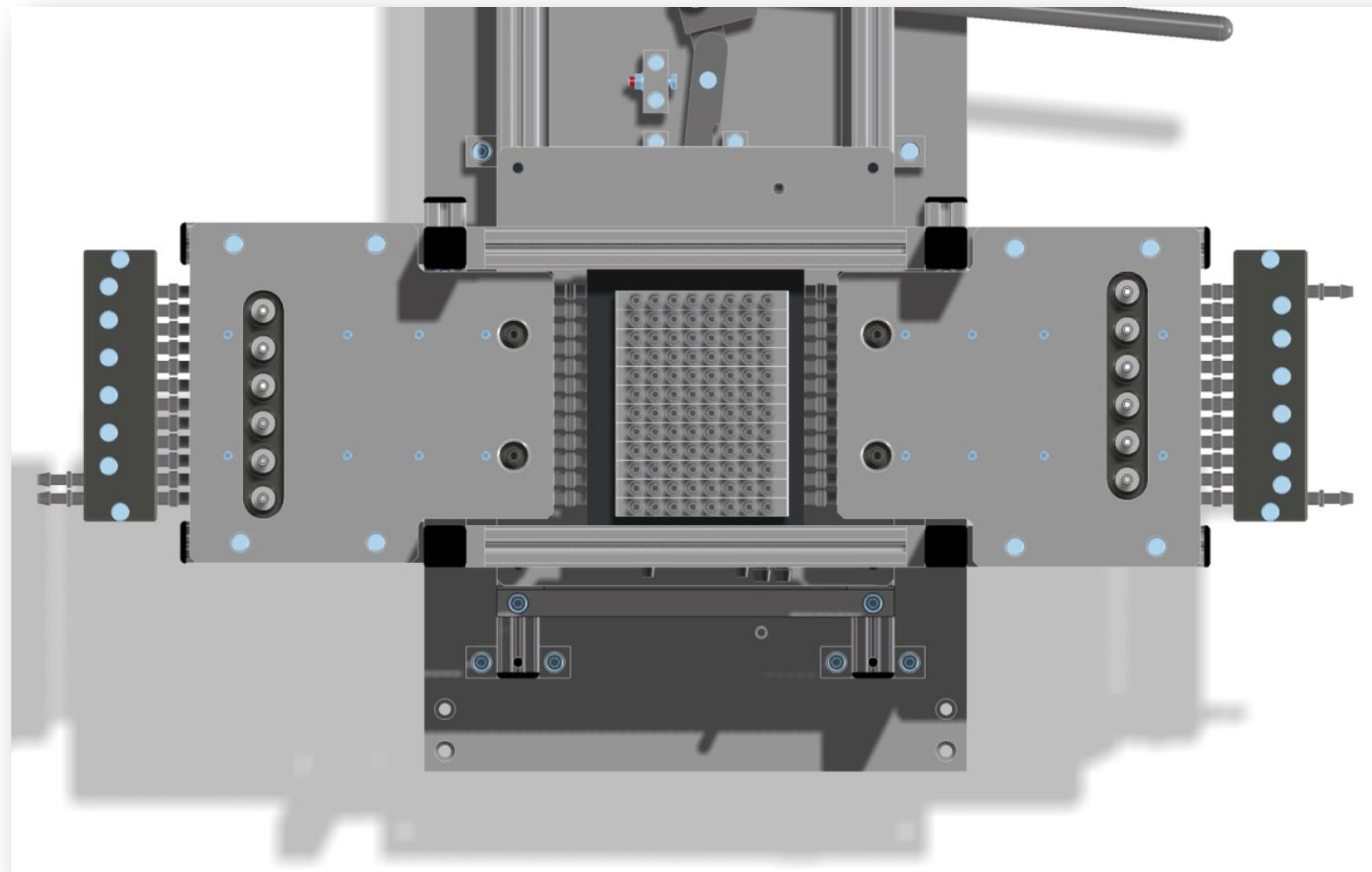
VITROCELL®
S Y S T E M S



VITROCELL® 96 Locking Device

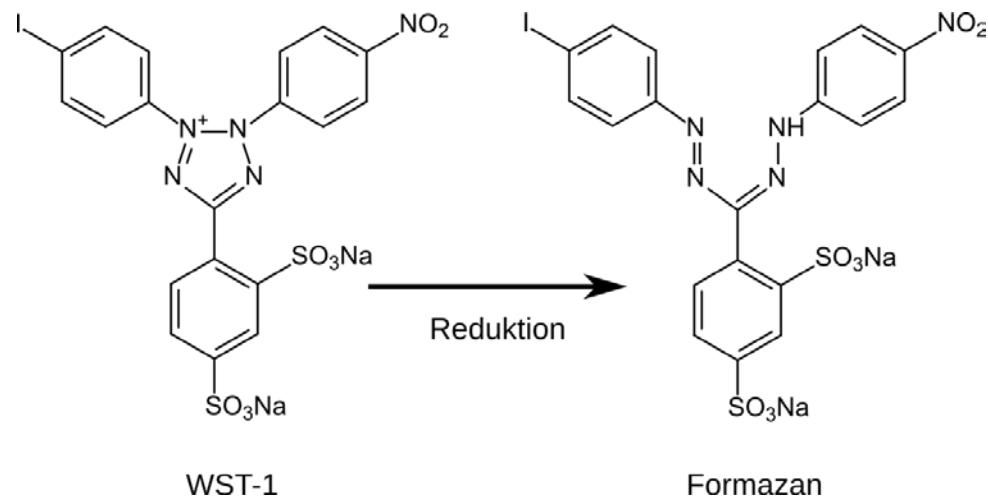
VITROCELL®
S Y S T E M S



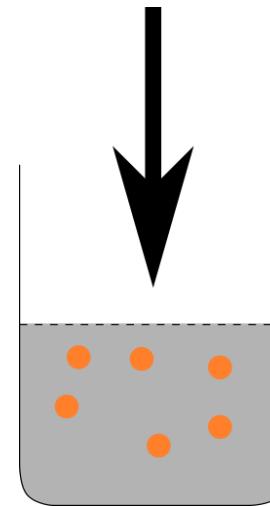


Test of equal distribution using tobacco smoke

WST-1

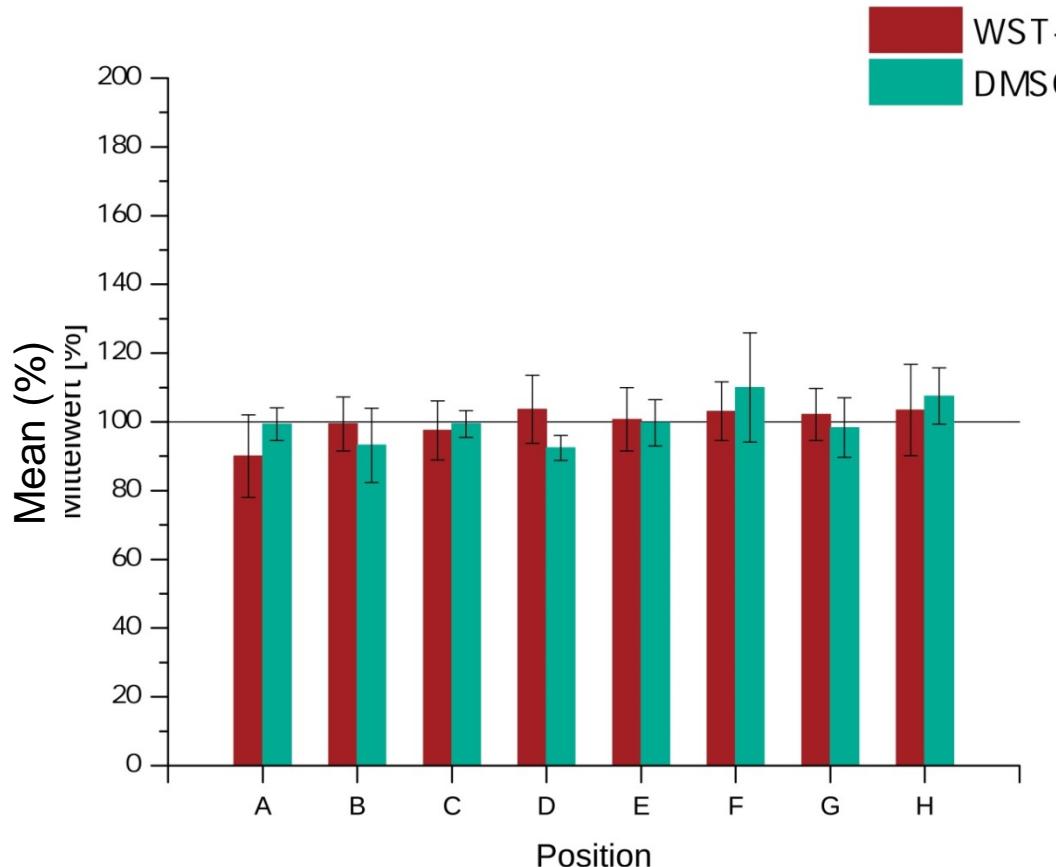


DMSO



- Reduction by cigarette smoke
- Colour change
- Absorption measurement at 450 nm
- Deposition and dissolution of particles

Test of equal distribution using tobacco smoke



WST-1

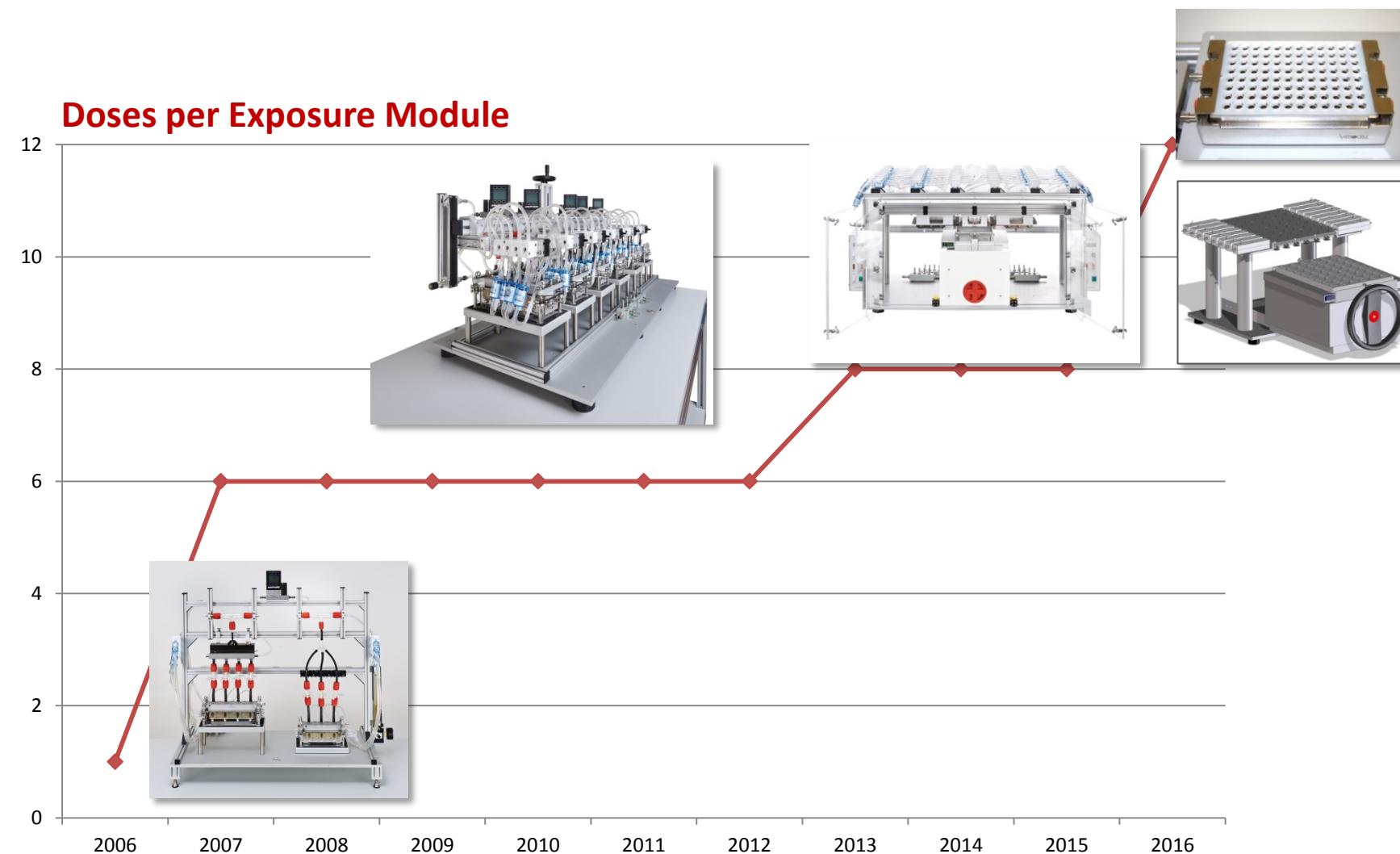
Dilution rate 1l/min
 Vacuum flow 1.2 ml/min
 N=5
 5 Cigarettes, 8 puffs, ISO

DMSO

Dilution rate 1l/min
 Vacuum flow 0.5-1.0-2.0 ml/min
 N=3
 5 Cigarettes, 8 puffs, ISO

VITROCELL® Installations

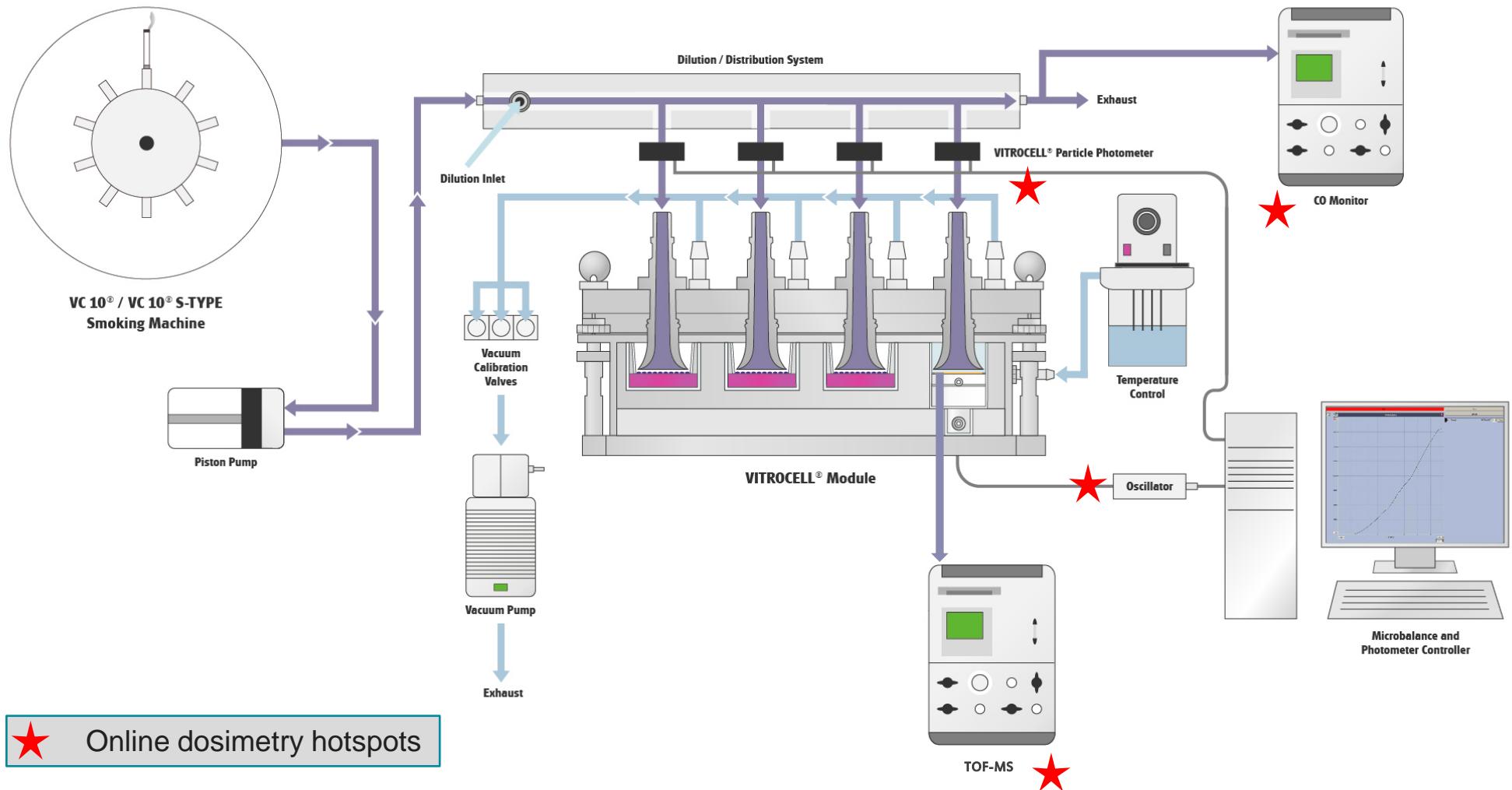
Trend for higher throughput at multiple doses



Typical Installation for Suspension Cells



System Element: Online Dosimetry Tools



Online dosimetry hotspots

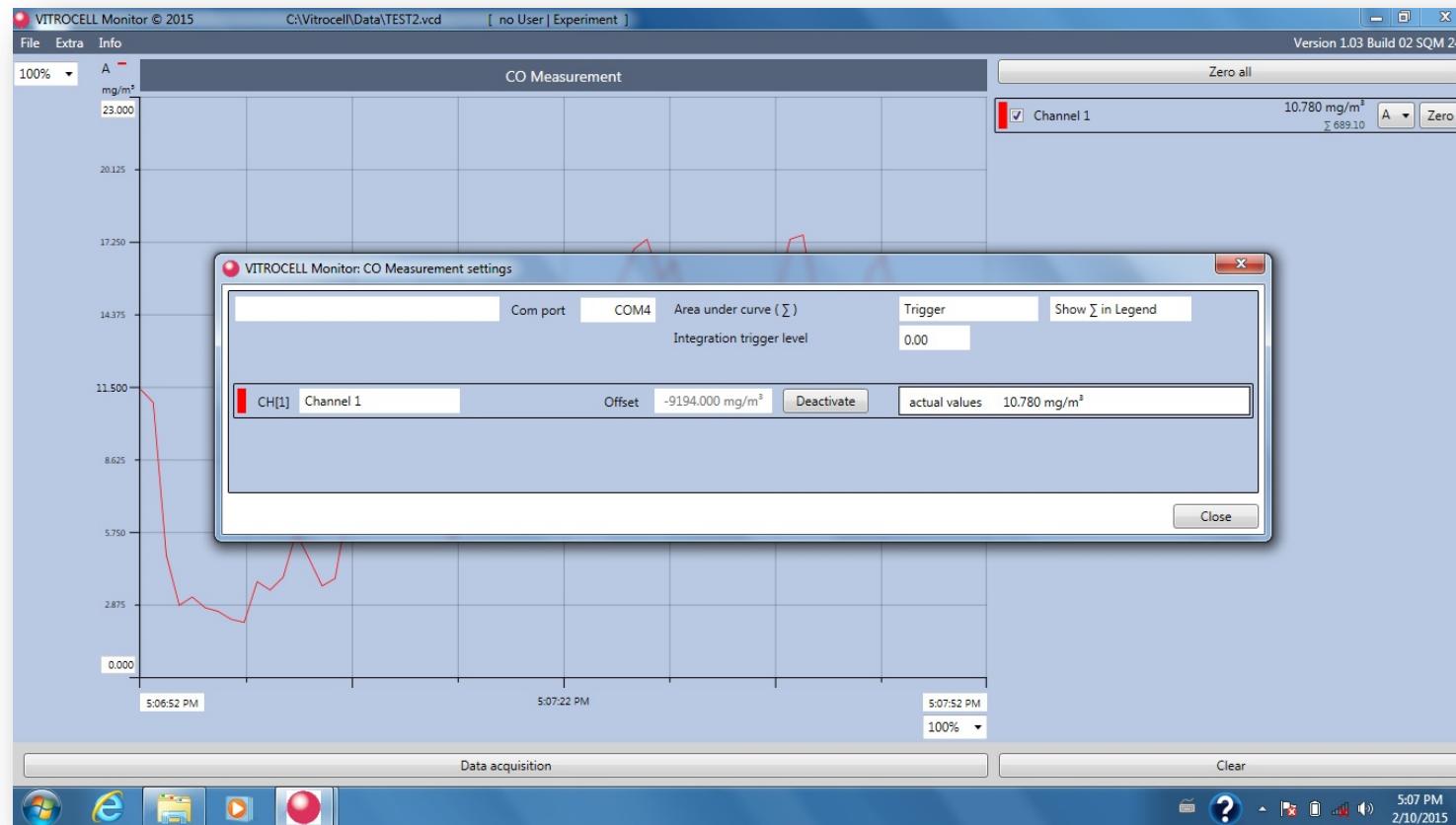
VITROCELL® CO Online Monitoring Software



Online monitoring of each puff



VITROCELL® CO Online Monitoring Software

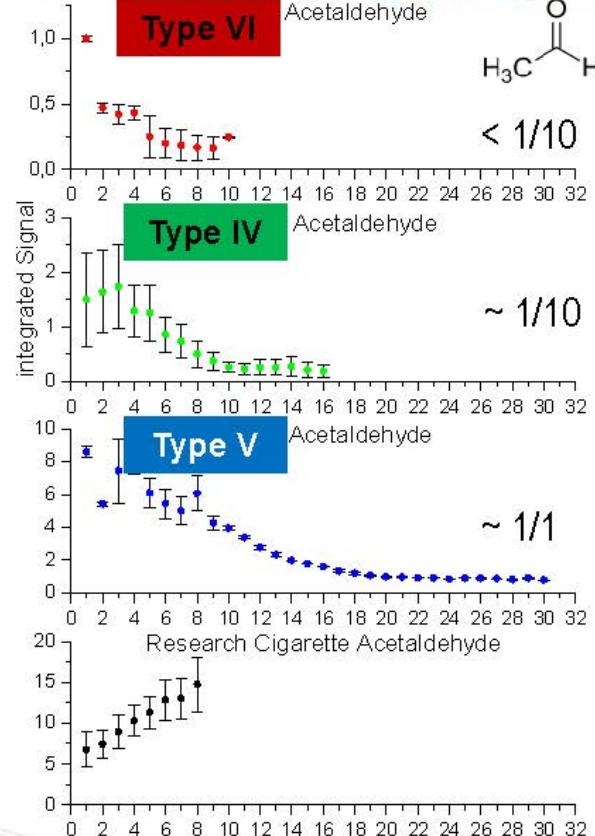


Area under curve function (same as photometer software)

Online TOF-MS

Applications

SPI-TOFMS for on-line analysis of Heat-not-Burn tobacco product smoke: **Acetaldehyde**

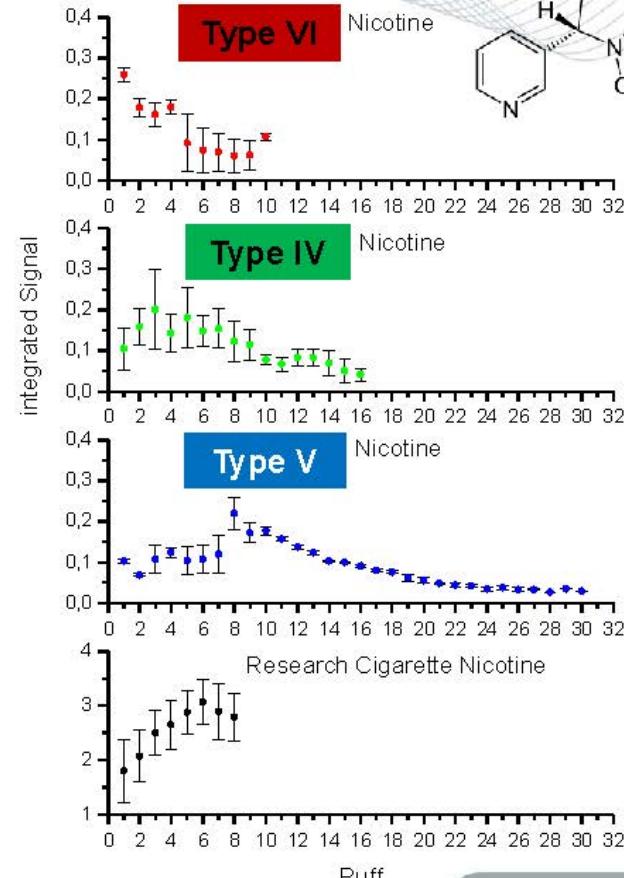


26.05.2015

Puff

VITROCELL User Meeting May 2015

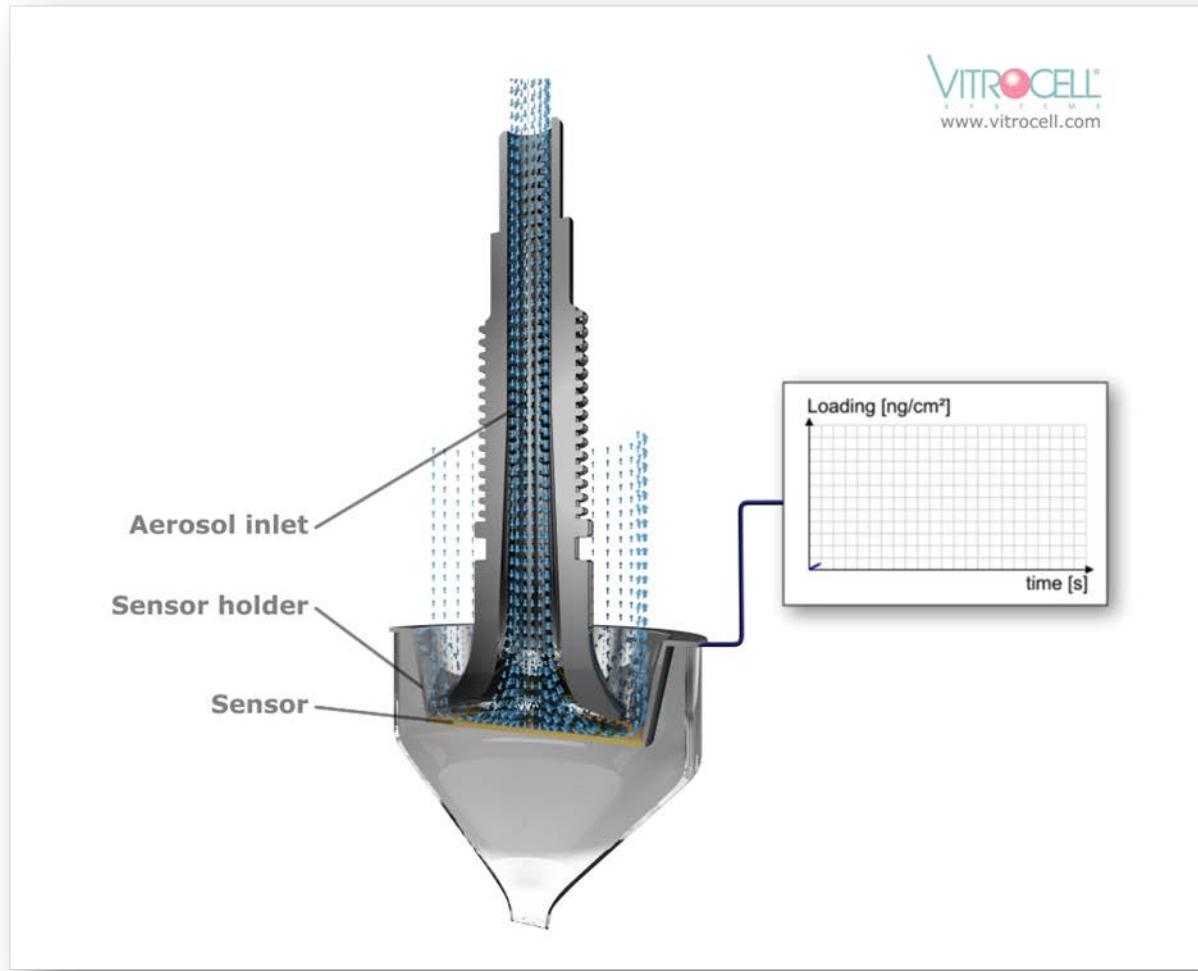
photonion



Puff
33

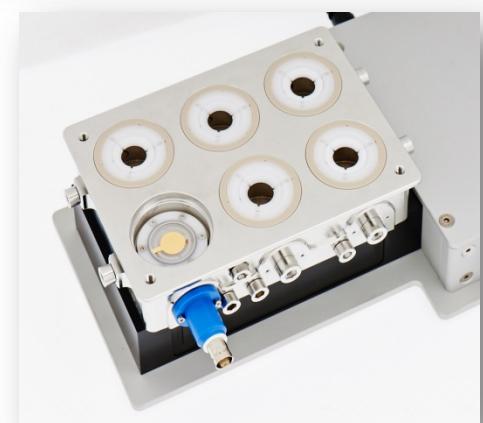
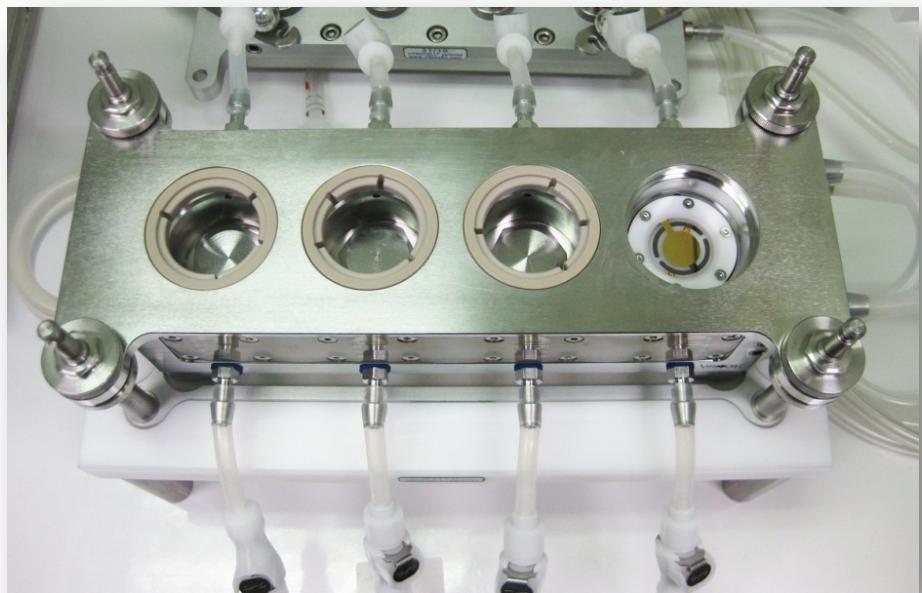
www.photonion.de

Dose Monitoring with Microbalance Technology



VITROCELL® 12 and 6 Microbalance Technology

VITROCELL®
S Y S T E M S



VITROCELL® VC Monitor Software Microbalance Application



VC Monitor Software Features:

- Up to eight Balances can be displayed
- Online reading in ng/cm^2
- Data Reporting in a MS excel executable format (*.csv)
- Checksum protected evaluation file
- GLP compliance

VITROCELL® VC Monitor Software

Photometer and Microbalance Combined



Combined
view



VITROCELL® Publications

Please visit our website vitrocell.com and the „Publications“ chapter

The screenshot shows the VITROCELL Systems website with a teal header bar containing links for About Us, News, Contact, and a search bar. Below the header is a "GET IN TOUCH" section with a phone number and email address. The main navigation menu includes INHALATION TOXICOLOGY, SKIN EXPOSURE, AUXILIARY EQUIPMENT, and INFORMATION CENTER. The INFORMATION CENTER page features a red sidebar with text about working together and a partnership for success, mentioning valuable documentation and publications. Below the sidebar is a large image of several cylindrical metal components. The footer contains a news article about toxicity testing of combustion aerosols, author information, and a list of categories and tags.

CATEGORIES

- Publications (113)
- Product News (34)
- Publications (113) (circled in red)
- User Group Meeting (1)

TAGS

- aerosol generator aerosolist
- airborne particles air-liquid interface
- AMES autosampler congress diesel
- e-cigarettes exposure station
- gas exposure humidification
- inhalation exposure liquid aerosol
- microbalance nanoparticles
- photometer precision pump system
- skin spiking system tobacco smoke

Critical System Elements for *in vitro* Exposure to Conventional and E-cigarettes



- Smoke / Vapor generation
- Dilution for dose / response
- Exposure system
- Auxiliary equipment
- Dosimetry tools

Thank you for your attention !

