Advanced in vitro exposure systems

VITROCELL VC 10® S-TYPE SMOKING ROBOT
VITROCELL SMOKING ROBOT VC 10® S-TYPE
Features all special requirements for high-class research

Objective

Cutting edge technologies make the VITROCELL® smoking machine VC 10® S-TYPE a perfect tool for evaluation of conventional and e-cigarettes. This smoking machine features all special requirements for high-class research: compliance with ISO, Health Canada and square puff profile protocols as well as ease of handling, fast cleaning and high-speed product change capabilities.

It is suitable for working with side- and mainstream smoke, and offers significant advantages over other smoking machines.

**Generation of smoke with the shortest distance to cell cultures**

For the success of an experiment with mainstream tobacco smoke it is important that the distance between the smoke generation (cigarette holders) and the VITROCELL® cell exposure system is as short as possible in order to avoid aging and to guarantee a smoke composition matching the real-life situation.

**Open and flexible system / incorporation of other analytical tools**

The robot is designed to allow easy access to all tubes, filters and the syringe system. Additional analytical equipment relevant to the experiment can be installed without difficulty by the operator.

**Freely programmable parameters**

The computer system allows highly flexible programming of the smoking process. Changing from single cigarette smoke to serial smoke mode for a defined number of cigarettes is possible.

VC 10® S-TYPE equipped for operation with e-cigarettes
All parameters of the smoking process like puff duration, puff volume, puff frequency and exhaust duration can be defined according to the needs of the experiment.

**Statistics**
The data of the smoking process are logged into an Excel® sheet for further processing.

**All components are easy to clean**
In particular the work with unfiltered mainstream smoke demands frequent cleaning of all parts of the robot which are in contact with the smoke.

Cleaning must take place after each experiment in order to avoid any influence of residual products on the following experiment. Due to the easy access to all parts the cleaning can be done quickly and efficiently.

**Compatibility with other systems in the lab**
The robot can be integrated with and connected to other lab systems, e.g. analytical or automation systems.

**Compliance with ISO 3308:2012**
The robot meets the requirements of ISO 3308:2012 which assures a compatibility with data generated for quality assurance purposes on other smoking machines.

**Compliance with Health Canada / CRM 81 Conditions**
The robot meets the requirements of 55 ml/30 sec puff frequency for smoking combustion as well as electronic cigarettes.

**Bell shaped as well as square puff profile capabilities**

**Human puff profiles**
This optional feature offers the possibility to feed data of human puff profiles registered by Smoking Puff Analyzers to the robot controls.

**Quality**
The robot is built to the highest standards using reliable and durable components. Precision of the process is ensured by a stepper motor for smoking port rotation and linear drive motor for the pump as well as sensor-controlled and pneumatically-driven components. Compliance with CE standards.

**Service**
All VC 10® robots are designed to be very service-friendly and have a secure internet-based remote servicing module.

**Special Features**

- Platform concept with docking stations
- Large magazine for 300 cigarettes enabling long test runs
- New smoking head with small dead volume and integrated butt ejector
- Quick-lock holder system for all types of conventional and e-cigarettes
- Machine-controlled button actuator for e-cigarettes
- Heated smoke path system
- New multiple 5-port exhaust system
- Scalable to up to 3 syringe drives
- Entire product change cleaning in < 10 min (with a few prepared exchange parts)

VC 10® S-TYPE equipped for operation with conventional cigarettes. Due to the unique platform concept with docking stations an entire product change including cleaning can be performed in < 10 min (with a few prepared exchange parts).
Operation for e-cigarettes

**Quick-lock holder system with e-cigarette support crown**

The holders can be quickly exchanged for cleaning and the support crown holds heavier e-cigarettes safely.

**Optional holder for e-cigarettes**

Secure and tight connection of any puff-actuated device to Smoking Machine.

**Programmable button actuator**

The button actuator has a trigger function which is controlled by the VC 10® S-TYPE software.

**Heated smoke path**

The smoke path can be heated and temperature controlled to avoid eventual condensation.
VITROCELL® Vapestarter

Innovative solution for smoking machines: automatic button activation of e-cigarettes

Button activated e-cigarettes put the user of smoking machines into a problem: should one press the button every 30 or 60 seconds manually? The automated solution to press the button in a precise manner is the VITROCELL® Vapestarter. The device can be connected to any VITROCELL® smoking machine. The trigger function is controlled by the software of the smoke generator.

The Vapestarter device is also available with a timer function so that it can be used for other types of smoke generators.

The system consists of Vapestart Controller, e-cigarette holder and different Vapestarter units. The Vapestarter units are tailor-made to fit tank products having different diameters as well as square shapes.

Features
- Integration into software of VC 1, VC 1 S-TYPE, VC 1/7, VC 10® and VC 10® S-TYPE Smoking Machines
- Vapestarters available for all sizes of tank products
- Inclination angle from 0-90°
- Quick-change mechanism for easy exchange of test products
- Also available as standalone version
- Operation by compressed air

The Vapestarter unit is available for different dimensions of tank products
Operation for conventional cigarettes

**Magazine**

The magazine stores up to 300 cigarettes and has a machine-controlled feeding and aligning system.

**Automatic leak detector**

There is the option to activate the leak detector prior to each experiment. The detector confirms the tightness of the system including cigarette holders and pump. The results are logged in the study files.

**Loading unit**

Damage-free loading of the cigarettes into the cigarette holders takes place fully automatically. The cigarette holders are equipped with labyrinth seals as required by ISO 3308:2012.
Ignition and smoking

Lighter
The electric lighter ensures the automatic ignition and a safe procedure without cigarette damage.

Syringe drive
The syringe pump is controlled with high precision by a strong linear motor. Due to the special design, the syringe can be dismantled for cleaning and refitted again in a very short time. The machine can be scaled up to 3 syringe drives to increase the puff frequency.

Stepper motor for rotation of port holder
The rotation of the port holder is controlled by a stepper motor with highest precision.

Cambridge filter
The Cambridge filter can be mounted easily into the system for analytical purposes.
Smoking and butt extraction

**Hood with sidestream smoke ducts**

The integrated fan evacuates the sidestream smoke. The air flow at the cigarette holders is adjusted by the fan speed.

**Butt length sensor**

The IR-sensor can be adjusted to a fraction of a millimeter and transmits reliable signals to the pump and butt extractor. If the critical butt length is reached, the pump stops immediately. Alternatively, it is also possible to work with a defined number of puffs.

**Butt ejector**

The cigarette butts are removed from the holder by ejection. The ashtray is kept permanently clean with a brush.

**Large butt reservoir**

The butts are forwarded into a large reservoir.
Example of 2-piston pump operation with 3 cigarettes

Example of 3-piston pump operation with 6 cigarettes
Unique 5-port exhaust system

5 individual machine-controlled exhaust lines direct the smoke to 5 dilution systems.

Software & Controls

Electrical control box

The control box houses the controls for the stepper motors, sensors and pneumatic valves. The whole process is controlled by Beckhoff software in conjunction with Microsoft Windows 10®. This setup offers extensive possibilities for integration with common Microsoft Office® applications and the exchange of data with Excel®-sheets.
**Smoking parameters**

Advanced, user-friendly software with recipe edit functions for favourite smoking / vaping regimes:

- Puff volume: up to 200 ml
- Puff frequency: 4 – 250 s
- Puff duration: 0.1 – 15 s
- Puff exhaust duration: 0.5 – 15 s
- Number of cigarettes per run: 300
- Number of puffs: 1 – 250
- Smoking modes: single, cycle, serial
- Profiles: bell, square, human

**Smoking modes**

- Single, cycle and serial mode
- Pre-loading mode
- Cycle mode with system purging after each cycle

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**Technical Data**

<table>
<thead>
<tr>
<th>Dimension</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dimensions electrical control box</td>
<td>790 x 300 x 600 mm (L x W x H); 31 x 12 x 24 inches</td>
</tr>
<tr>
<td>Dimensions smoking platform</td>
<td>940 x 690 x 670/694* mm (L x W x H) / (height without hood); 37 x 28 x 27/28 inches</td>
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<tr>
<td>Power supply</td>
<td>1 x 208-240 V, 50/60 Hz, 16 A</td>
</tr>
<tr>
<td>Compressed air</td>
<td>Operating pressure 6 bar (87 psi); system pressure 10 bar (145 psi)</td>
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<tr>
<td>Remote service module</td>
<td>Included / Internet access mandatory</td>
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</tbody>
</table>

*platform opened
CHEMCONTROL Feature
Whole smoke and gas phase analysis of single puffs for Smoking Robots VC 10® / VC® 10 S-TYPE

Special configuration for VC 10® CHEMCONTROL
Individual sampling points allow separate analysis of 8 puffs per cigarette. The puffs 1 to 8 are guided to a total of 8 individual sampling points, where e.g. impingers or other analysis tools may be placed. The base robot is as above.

4 Cigarettes are loaded and lightened automatically. The unique valve and purging system allows for the following regime:
- Each first puff of cigarettes #1 - #4 is directed to sampling point #1. After that there is the choice to purge the system. For this purpose the valve towards the cigarette holders is closed and the valve towards the purging gas (e.g. Synthetic Air) is opened. The pump is performing 1...5 purging puffs. Thereafter the valve for the purging gas is closed and the valve towards the smoke ports opened.
- Each 2nd puff of cigarettes #1 - #4 is directed to sampling point 2. Then purging takes place in the same way than above.
- Each 3rd puff of cigarettes #1 - #4 is directed to sampling point 3. Then purging takes place in the same way than above.
- Same procedure for 4th until final puff 8 (or a fraction of final puff) which is directed to sampling point 8. Then purging takes place in the same way than above.

The VITROCELL® VC 10® CHEMCONTROL Smoking Robot is specifically developed for the chemical and biological analysis of single puffs. The effects of whole smoke as well as the gas phase of each individual puff can be analysed by a special smoking regime and sampling unit.

Highly flexible smoking parameters combined with the compliance to ISO as well as Health Canada smoking regime requirements make the VC 10® CHEMCONTROL an efficient and extremely powerful analysis tool.
Human Puff Profiles
For Smoking Machine VC 1 / VC 1 S-TYPE and Smoking Robots VC 10® / VC 10® S-TYPE

Direct Reading from Puff Analyzer Data Files

Human puff profile capability
This optional feature for the VC 1 and VC 1 S-TYPE smoking machine, VC 10® and VC 10® S-TYPE smoking robots offers the possibility to feed data of human puff profiles registered by Smoking Puff Analyzers to the machine controls.

Puff time – precision of replication *

Inter puff time – precision of replication *

Puff volume – precision of replication *

Flow versus time – precision of replication *

*) Data from smoker compared with 2 channels of VC 10® smoking robot (VC 1 is using same technology).
## Comparison Vitrocell® Smoking Machines

<table>
<thead>
<tr>
<th>#</th>
<th>Criteria</th>
<th>Smoking Machine VC 1</th>
<th>Smoking Machine VC 1 S-TYPE</th>
<th>Smoking Machine VC 1/7 and VC 1/8</th>
<th>Smoking Robot VC 10</th>
<th>Smoking Robot VC 10 S-TYPE</th>
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<tbody>
<tr>
<td>1</td>
<td>Smoking Ports</td>
<td>1</td>
<td>Up to 5</td>
<td>Up to 8</td>
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<td>10</td>
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<td>5</td>
<td>Butt Length Sensor</td>
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<td>Cylinder Volume</td>
<td>200 ml</td>
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</table>
About VITROCELL®

VITROCELL® exclusively concentrates on the developing, producing, installing, training and servicing of advanced \textit{in vitro} exposure systems.

The VITROCELL® Systems’ team is driven by their vision for new \textit{in-vitro} standards through state-of-the-art technology, highly qualified workmanship and absolute client dedication. VITROCELL® has successfully collaborated with clients from leading research institutes, contract research organizations, regulatory authorities or industrial laboratories across the world. Working with our team experts, all modules have been tailored to create durable and complete turnkey-systems for \textit{in vitro} inhalation toxicology. Gases, environmental atmospheres, nano particles and complex mixtures are analyzed on lung cells at the air/liquid interface using these systems. VITROCELL® technologies are also applicable to solutions for skin research.

Over a decade of devotion to research in this specific field has given our team of design & precision manufacturing specialists the opportunity to mentor highly diversified and complex projects from \textit{conception to completion}. We strive to become a constructive member of each research team, providing support when it is needed, advice when it is required and modules of the highest quality, which are even polished by hand before leaving here to be integrated into your workspace. Every piece of our German engineered equipment is manufactured to the highest of standards – yours.

For more information please scan the QR-Code: