

2005 CORESTA study group meeting Stratford upon Avon

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RM20S

**Smoke generator for in vitro
research**

Nils Rose

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Since KC-Automation is fully integrated into the Borgwaldt group, Borgwaldt-KC is supplier of:

- 3 rotary smoking machines**
- 4 linear smoking machines**

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Rotary Machines:

- RM200
- RM20H
- RM20S

Linear Machines:

- LM20x
- LM5
- LM1
- LMC2, LMC4, LMC8

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Routine analytical smoking

RM200



Fully automatic 20-port smoker
for 200 cigarettes

LM20x



20-channel smoker

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Special analyses

RM20H



LM5



Semi automatic 20-port smoker for Hoffmann analyses and routine smoking

5-port smoker for side-stream analyses

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R&D machines

LM1



Single port smoker for R&D tasks, routine and side-stream analyses

LMC



2-,4- or 8-channel smoker for high versatile R+D tasks

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RM20S

4-channel smoke generator for in vitro
research

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To satisfy the need of the tobacco industry for a fully automatic smoke generator for diluted smoke, the **RM20S** was developed in close cooperation with BAT Southampton.

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RM20S 4-channel smoke generator

RM20S



The **RM20S** is designed as a fully automatic 4-channel rotary smoker.

The machine is based on the proven technology of the smoking machine **RM200** and **RM20H**.

Hood and airflow allows to smoke under ISO conditions.

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RM20S 4-channel smoke generator

RM20S



The 4 channels are operating independently. It is possible to smoke 4 different brands of cigarettes concurrently with different puff parameter.

Smoke of each puff can be diluted up to 1:1,5 Mio.

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RM20S



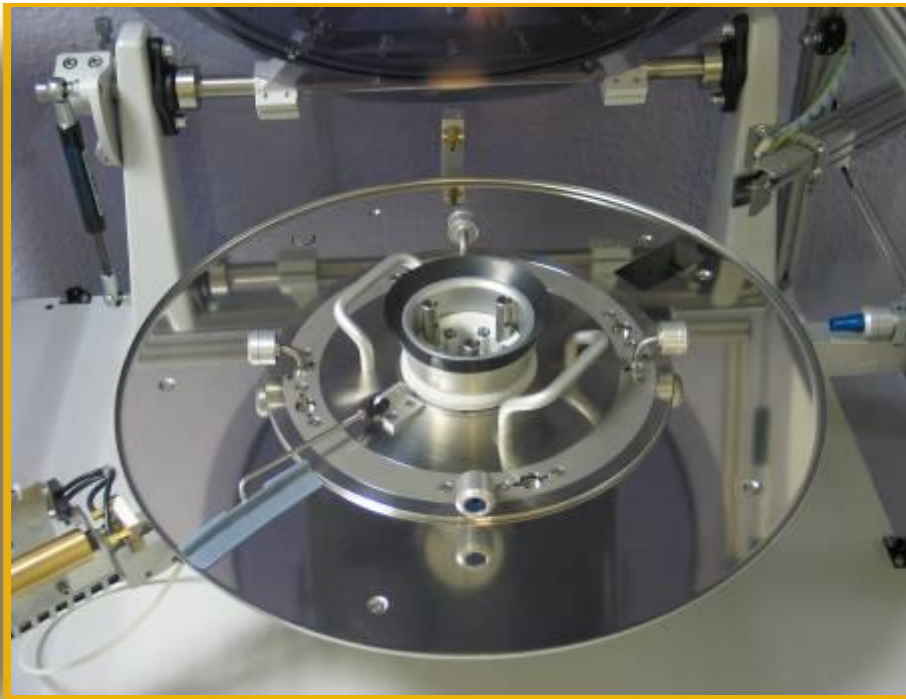
Changeable puff parameter:
Puff profile
Puff volume (5 – 140 ml)
Puff duration (up to 2 sec.)
Cigarette length (65-100 mm)
Lighting power (50-90W)

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Smoking ring



Cigarette holder for each of the 4 channels

Ventilation position for each channel

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Air flow guidance



Proven technology based
on the RM200/20H family
Unmodified air flow

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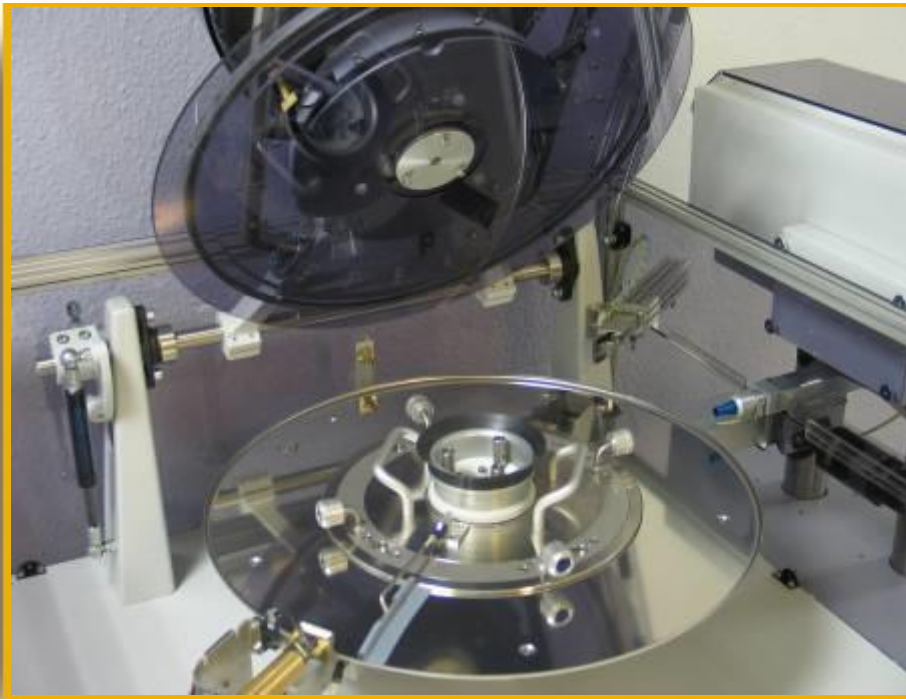
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Air flow guidance

Hinged unit to gain optimal access



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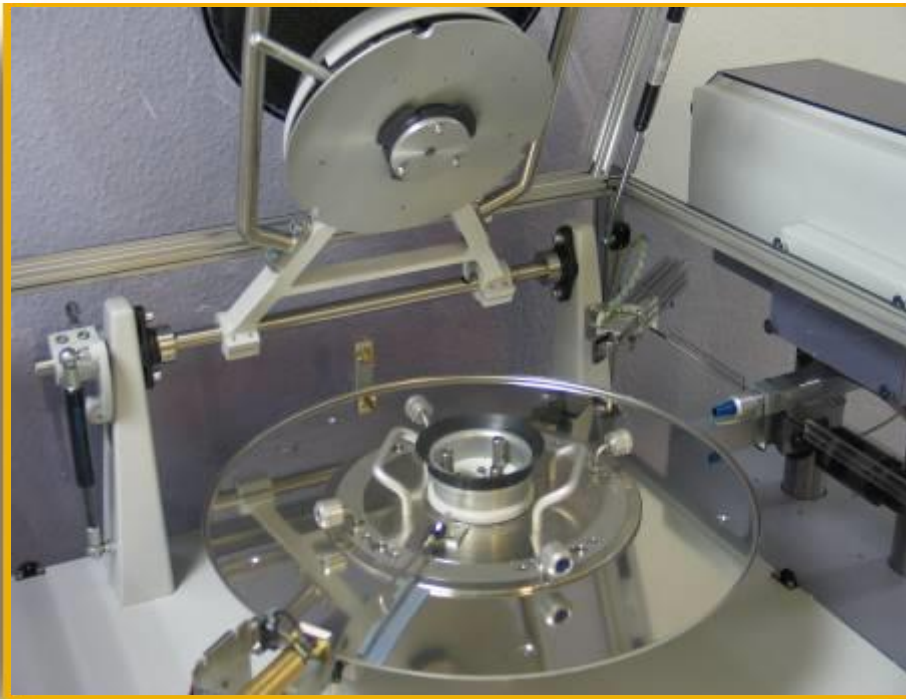
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Air flow guidance

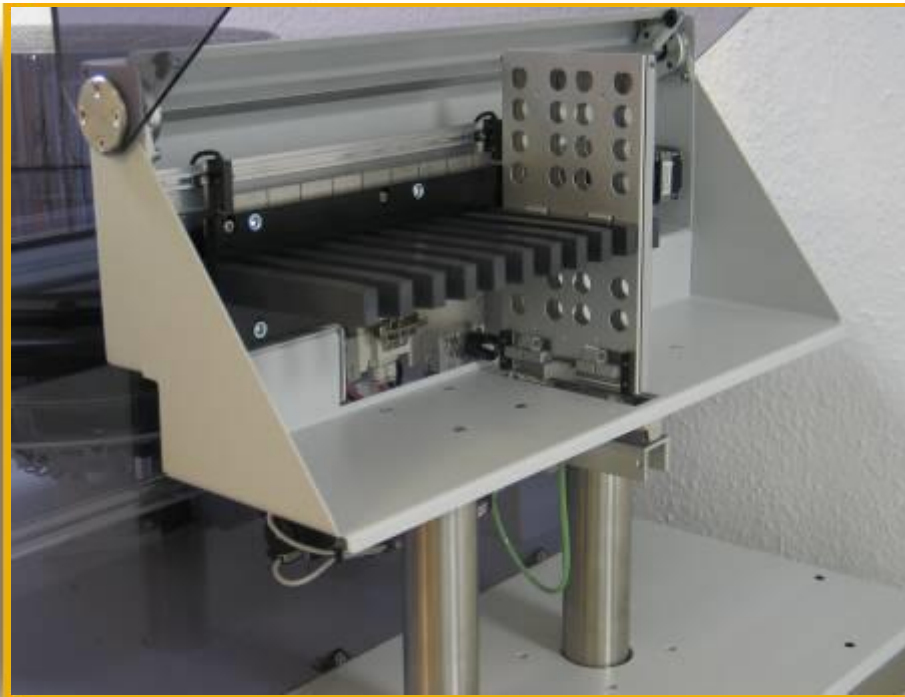
Quick out air flow guide for easy maintenance and cleaning



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Cassette Magazin



Capacity for 8 cassettes with 20 cigarettes each.

Empty cassettes can be replaced during the smoke run

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Cassette Magazin

Cigarette separation
integrated into each cassette



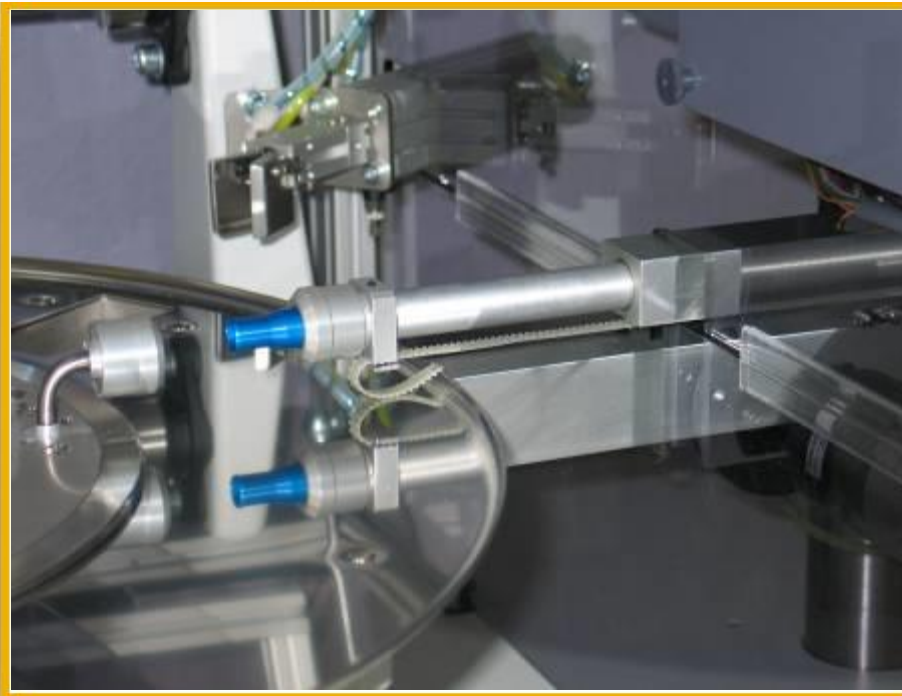
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Loading unit



Directly mounted to the central unit

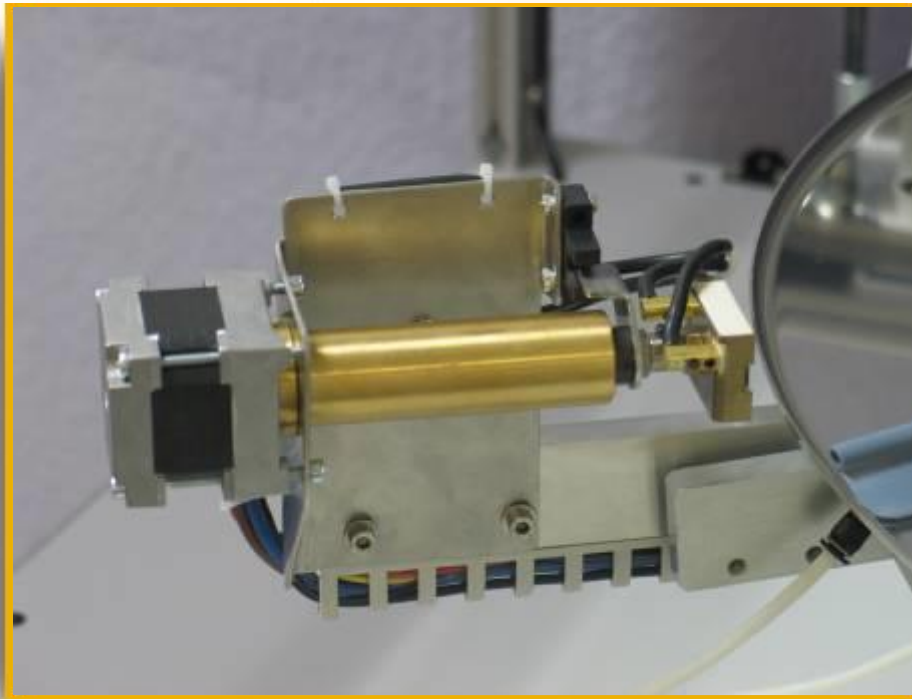
Contactless loading using air and vacuum to treat the cigarette with maximum care

The seals are opened with the tip of the nozzle

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Lighter



The Borgwaldt standard lighter element is used.

Stepper motor driven actuator.

The lighter element radiates power between 50W and 90W.

The power is determined by measuring voltage and current.

Lighting power is software controlled and can be altered in steps of 1W.

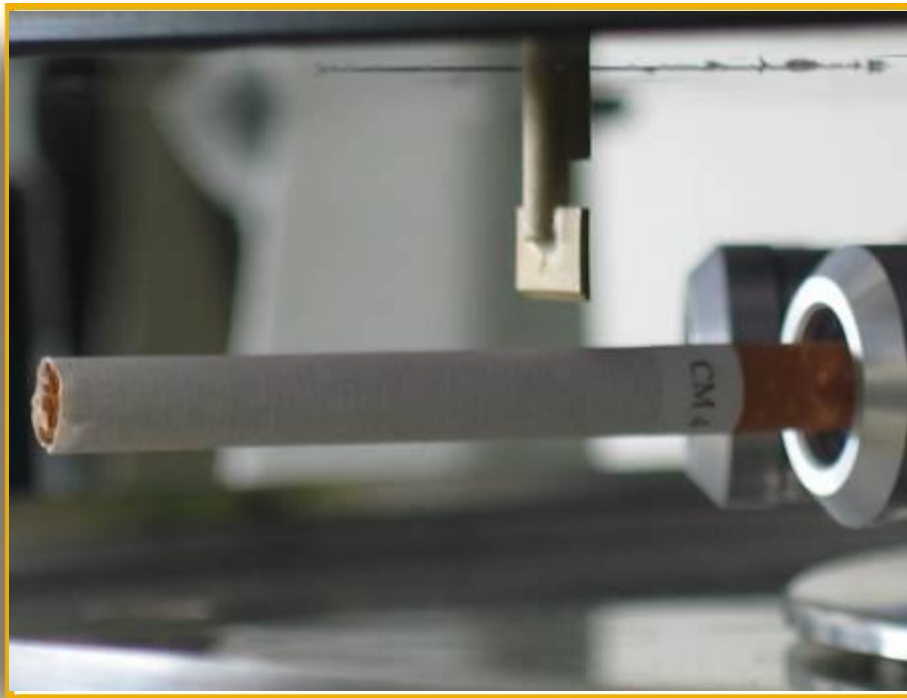
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Butt length detector



For higher accuracy, smoking is terminated by an infrared butt length control (BLC).

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Butt length detector



The BLC is a further development of the Borgwaldt standard BLC.

It is mounted onto the pivoting frame of the air flow guidance.

The unit is driven by a powerful stepper motor for exact positioning.

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Syringe assembly

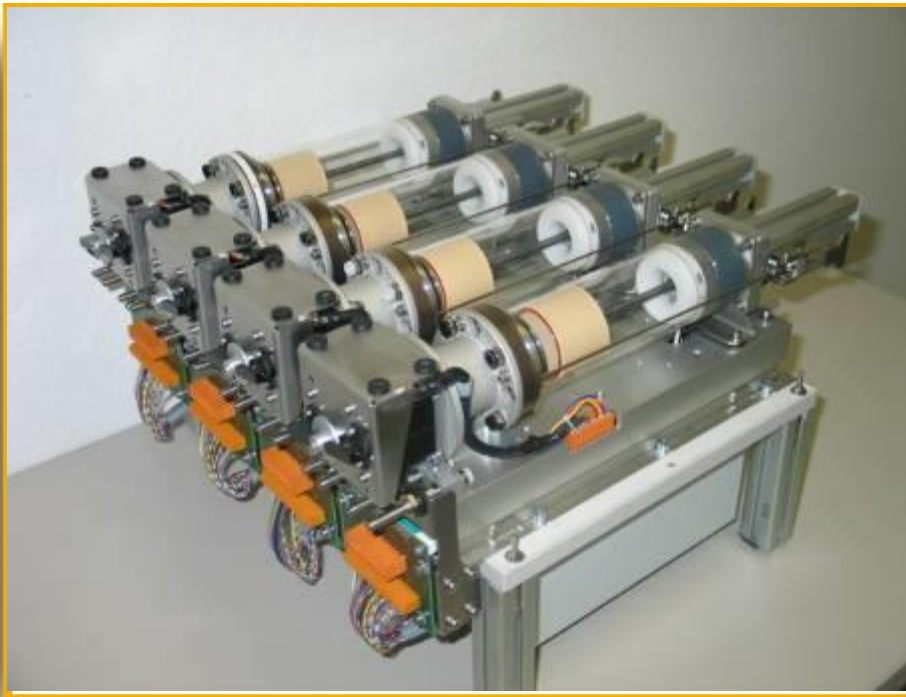


The 4 channels are operating independently
Mounted on a swivelling frame to gain optimal access

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Syringe assembly

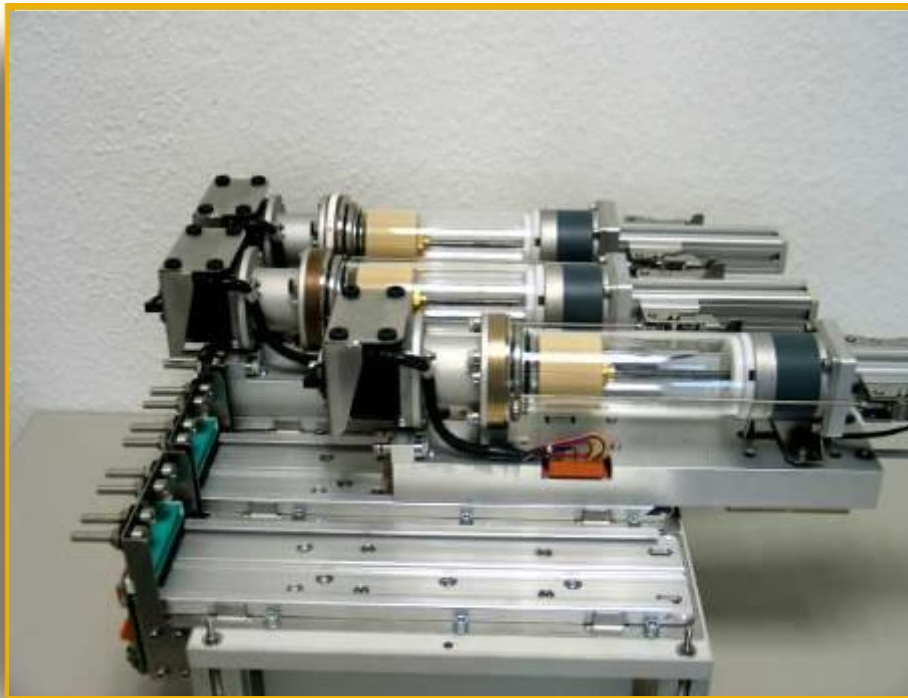


The syringe system is designed as a cassette installation.

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Syringe assembly



The complete operational unit is mounted on a sliding keyway.

It can be disconnected and withdrawn as a single module in an instant.

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Syringe assembly

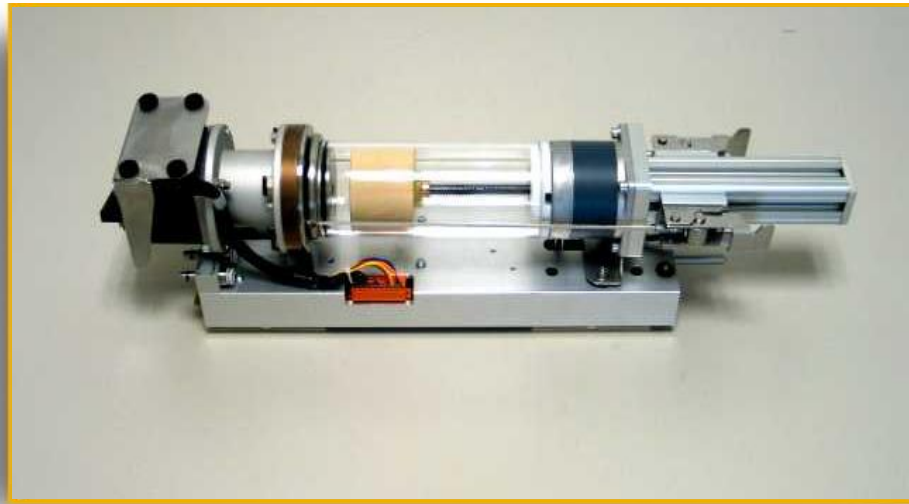


Service and maintenance of the syringe can then be carried out on the bench top.

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Syringe assembly

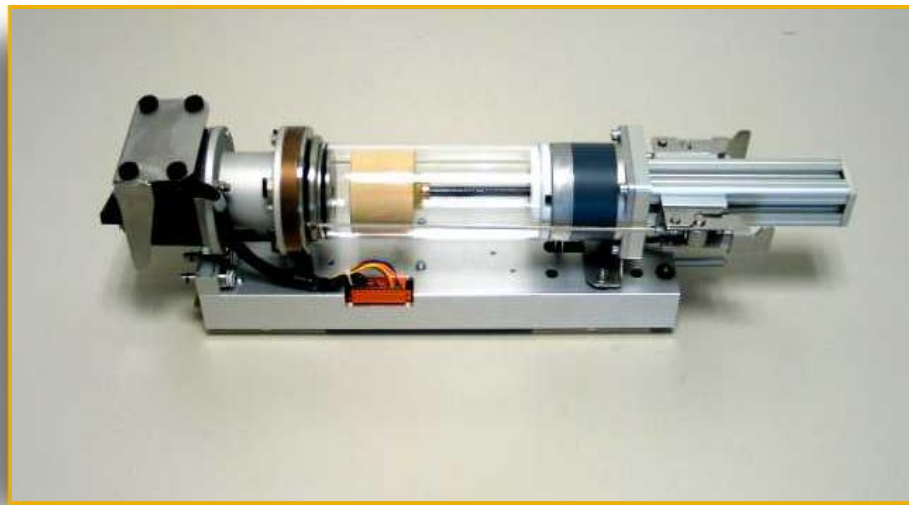


The syringe is stepper motor driven.
It can replicate different puff profiles.
10 Puff profiles are pre designed.
9 of these profiles can be modified.

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Syringe assembly



Data of the syringe:

Piston speed: 0,1 - 80 mm/s = 6 - 4800 mm/min

Flow rate: 0,2 - 157 ml/s = 12 - 9420 ml/min

Puff volume : <5 - 140ml at 2 sec puff duration

Valve assembly

To direct the gas phase within a smoking machine, standard valves, designed for pneumatic applications are commonly used.

Not being designed for this purpose, these valves need a lot of attention and are a constant source for failure and service.

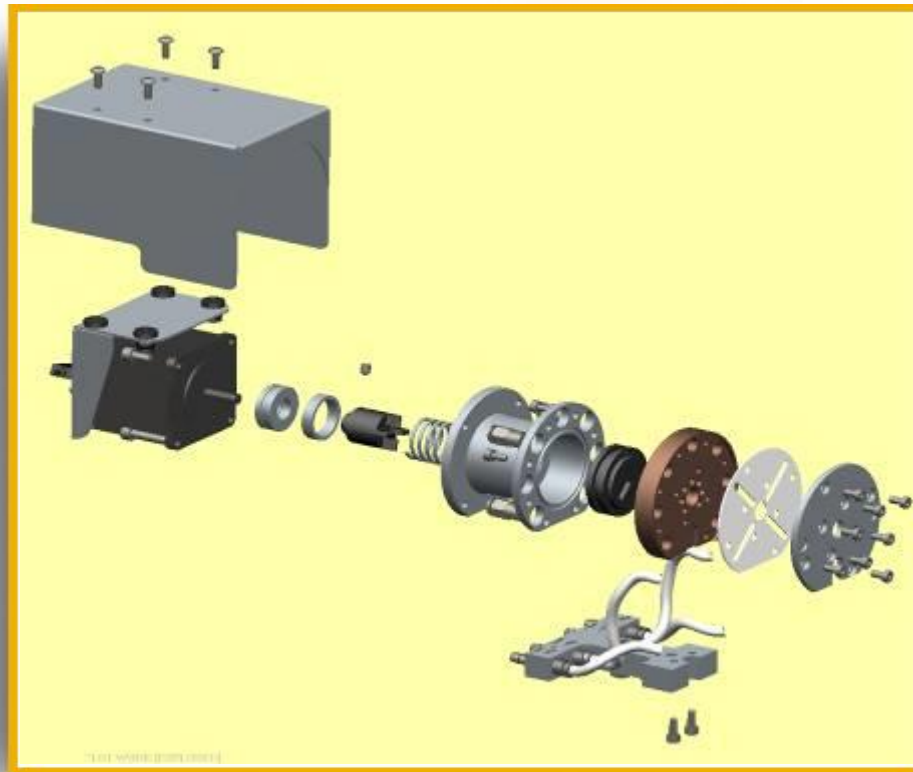
If whole smoke needs to be directed, commercially available valves cannot provide the security and reliability of operation that is required.

The valve needs to be of a chemically inert material.

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Valve assembly

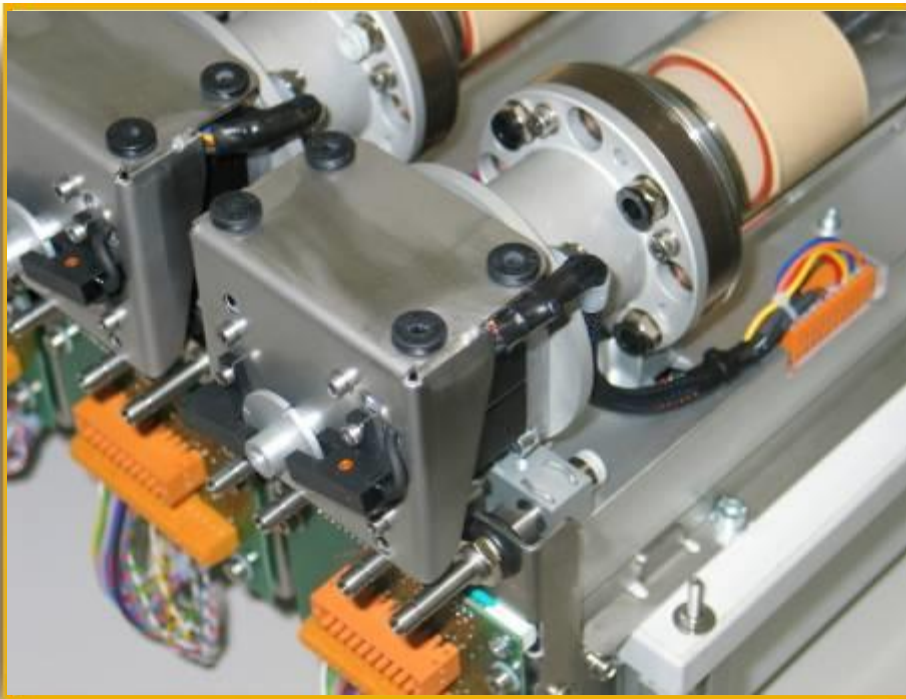


New developed rotary 5/4 way valve for this special application.
Stepper motor driven valve disc.

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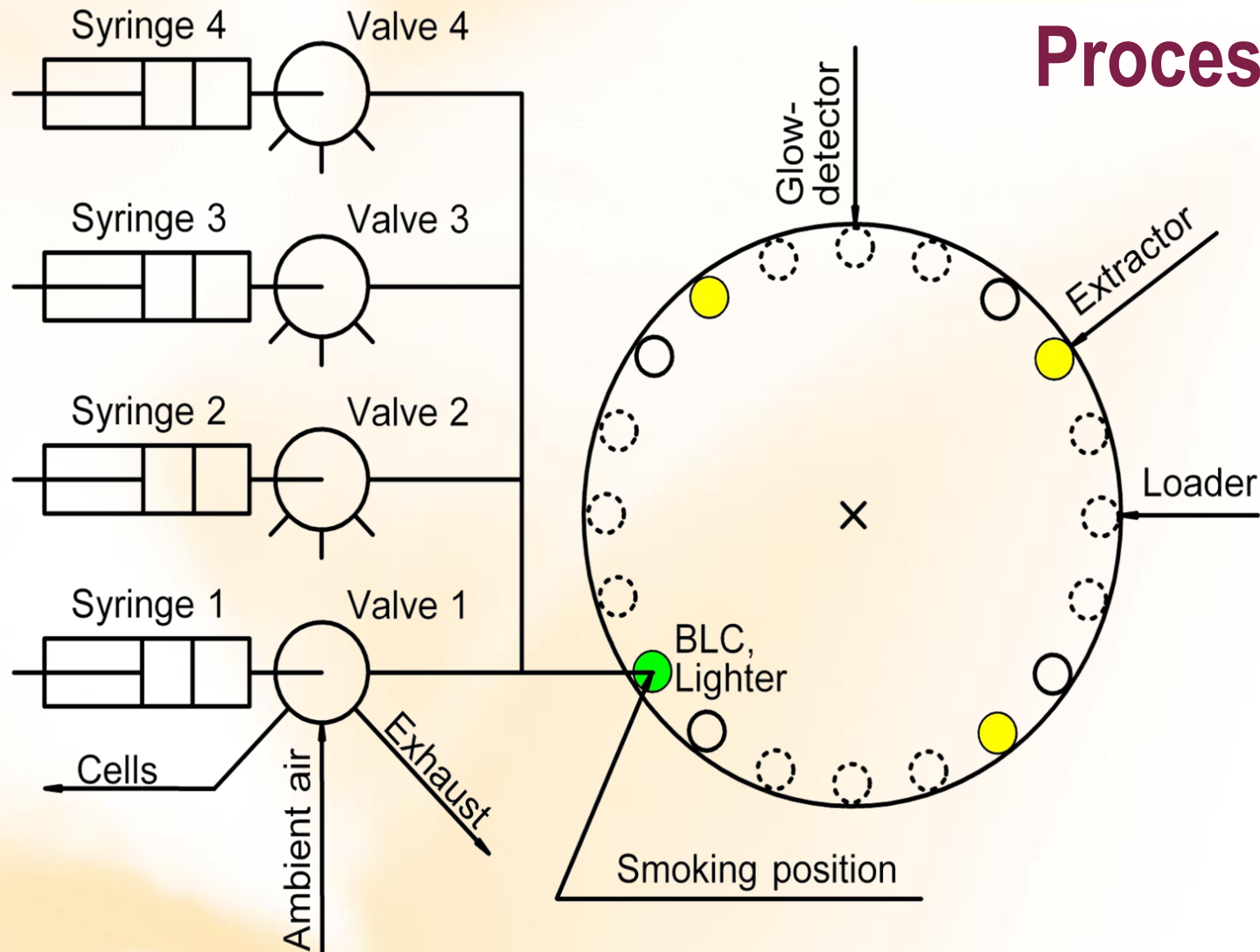
Valve assembly



Operating directly at the head of the syringe assembly.
Low impedance.
Minimal dead volume.

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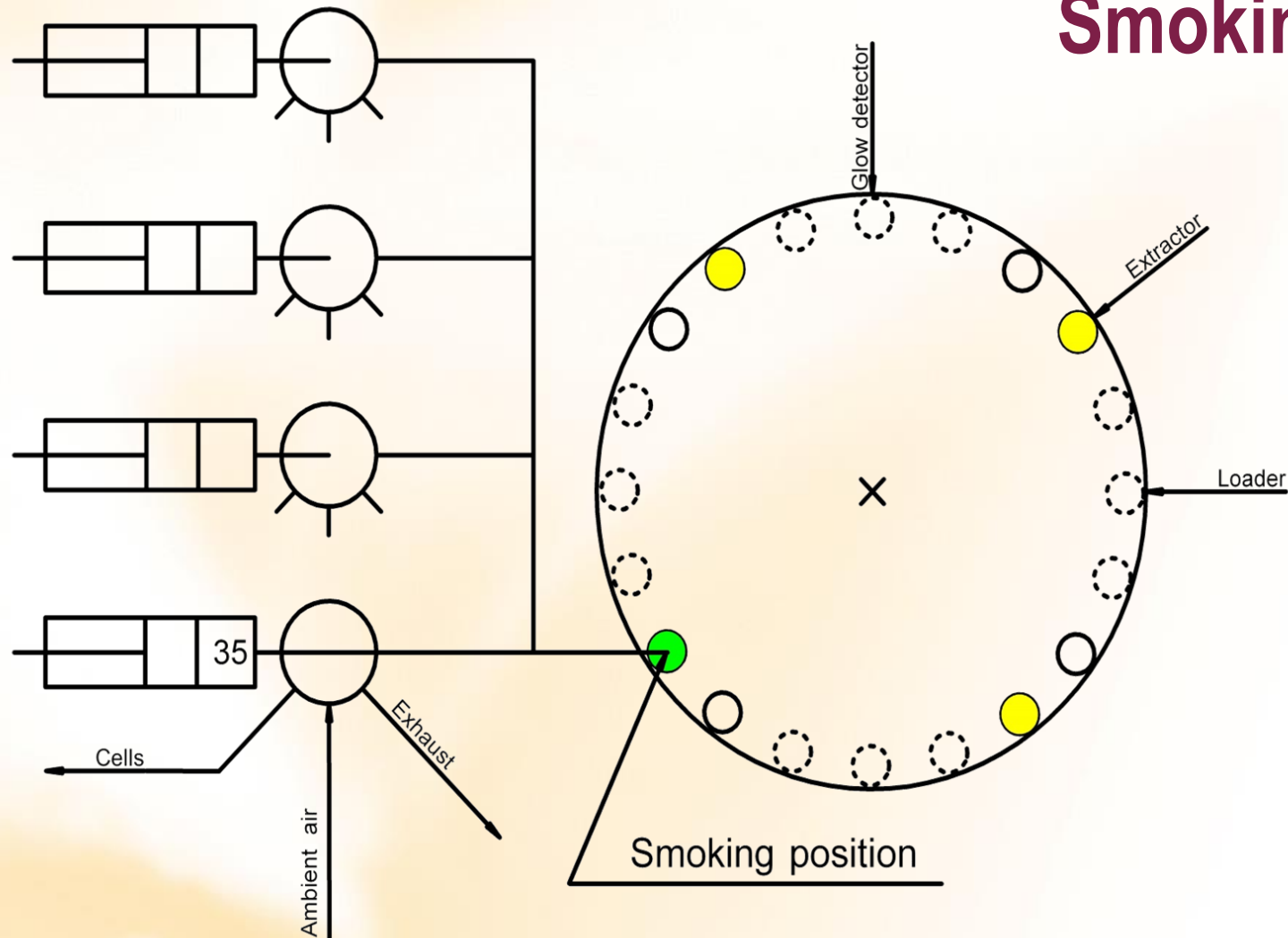


Process flow

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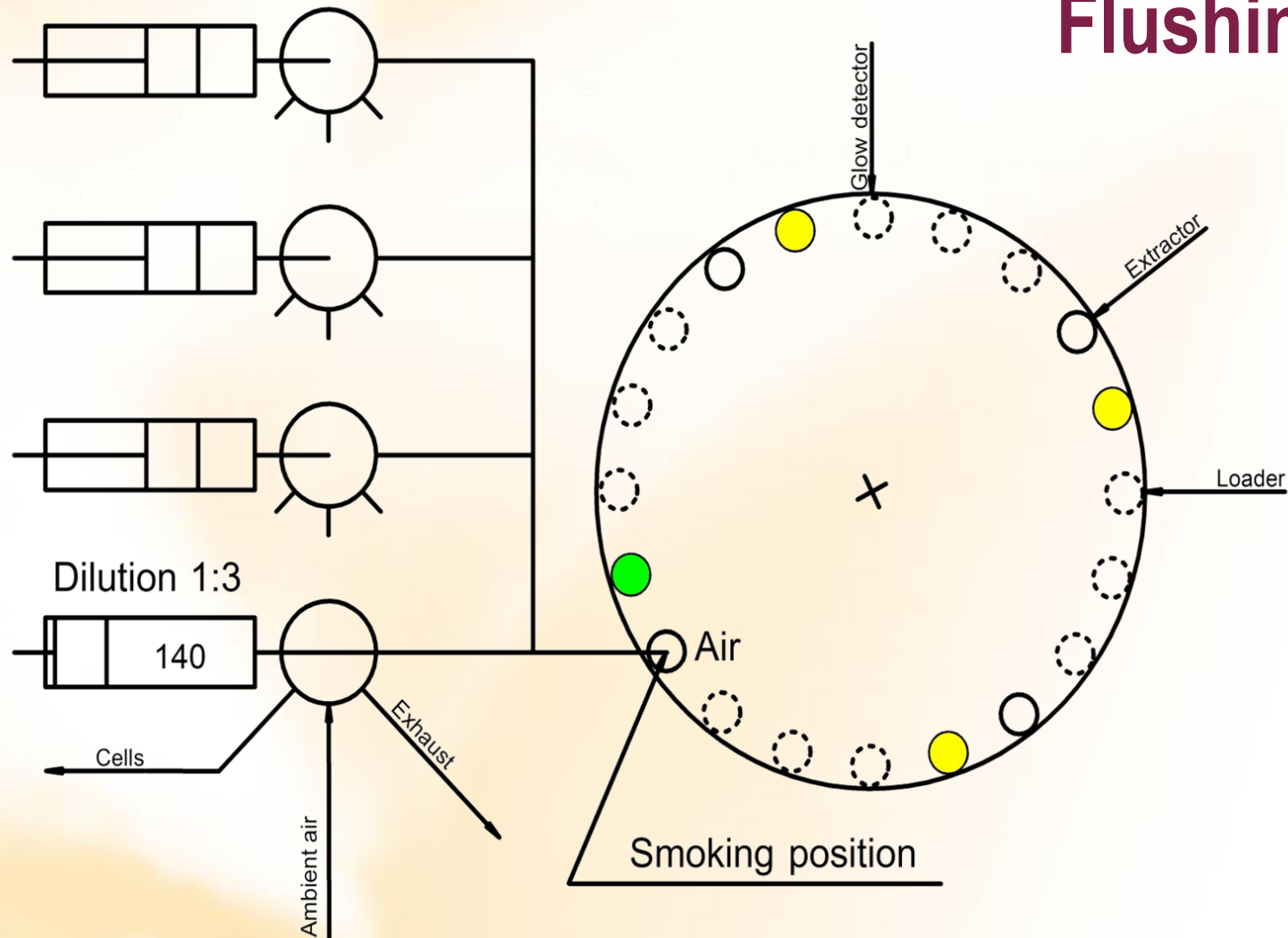
Smoking



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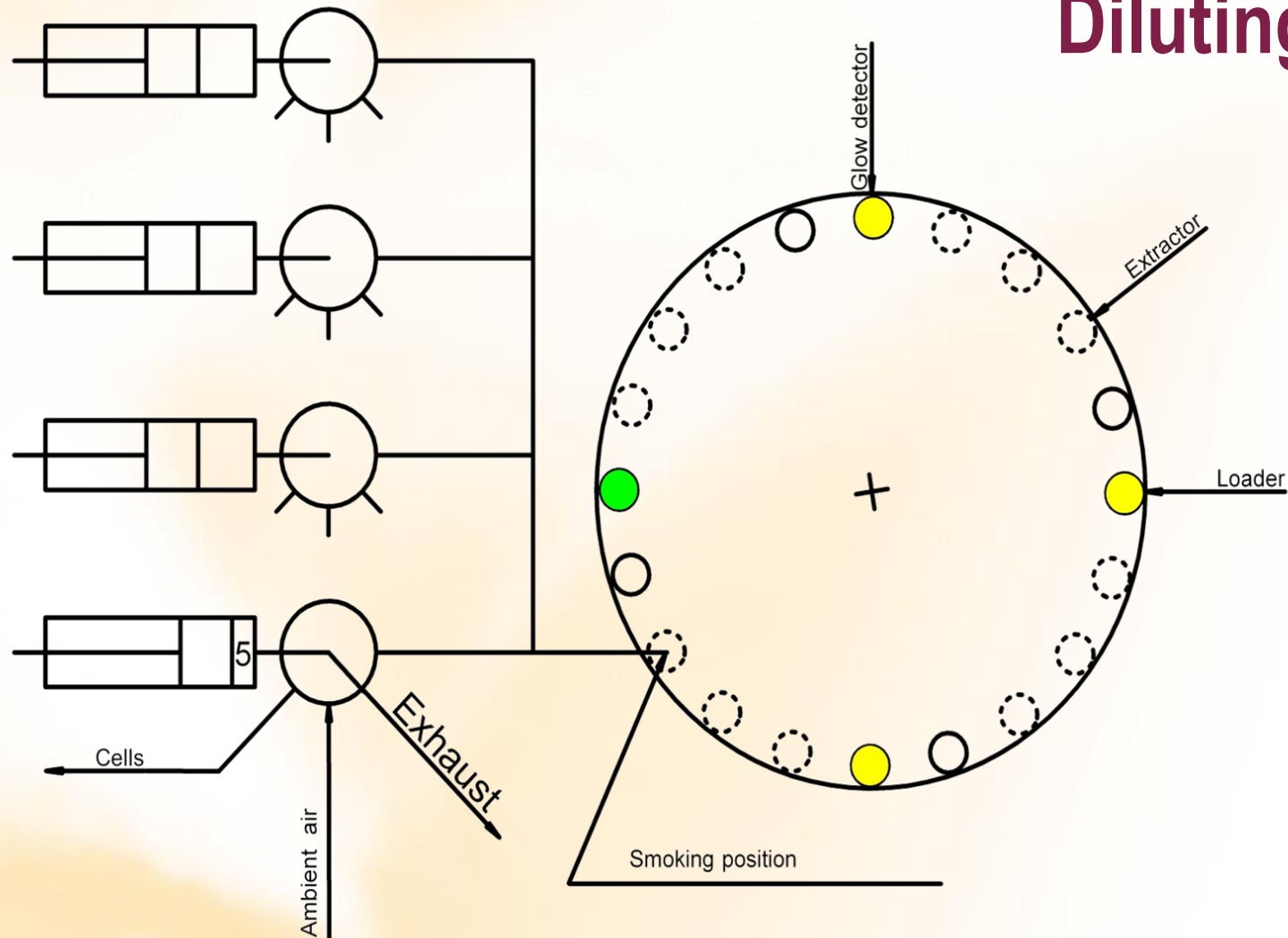
Flushing



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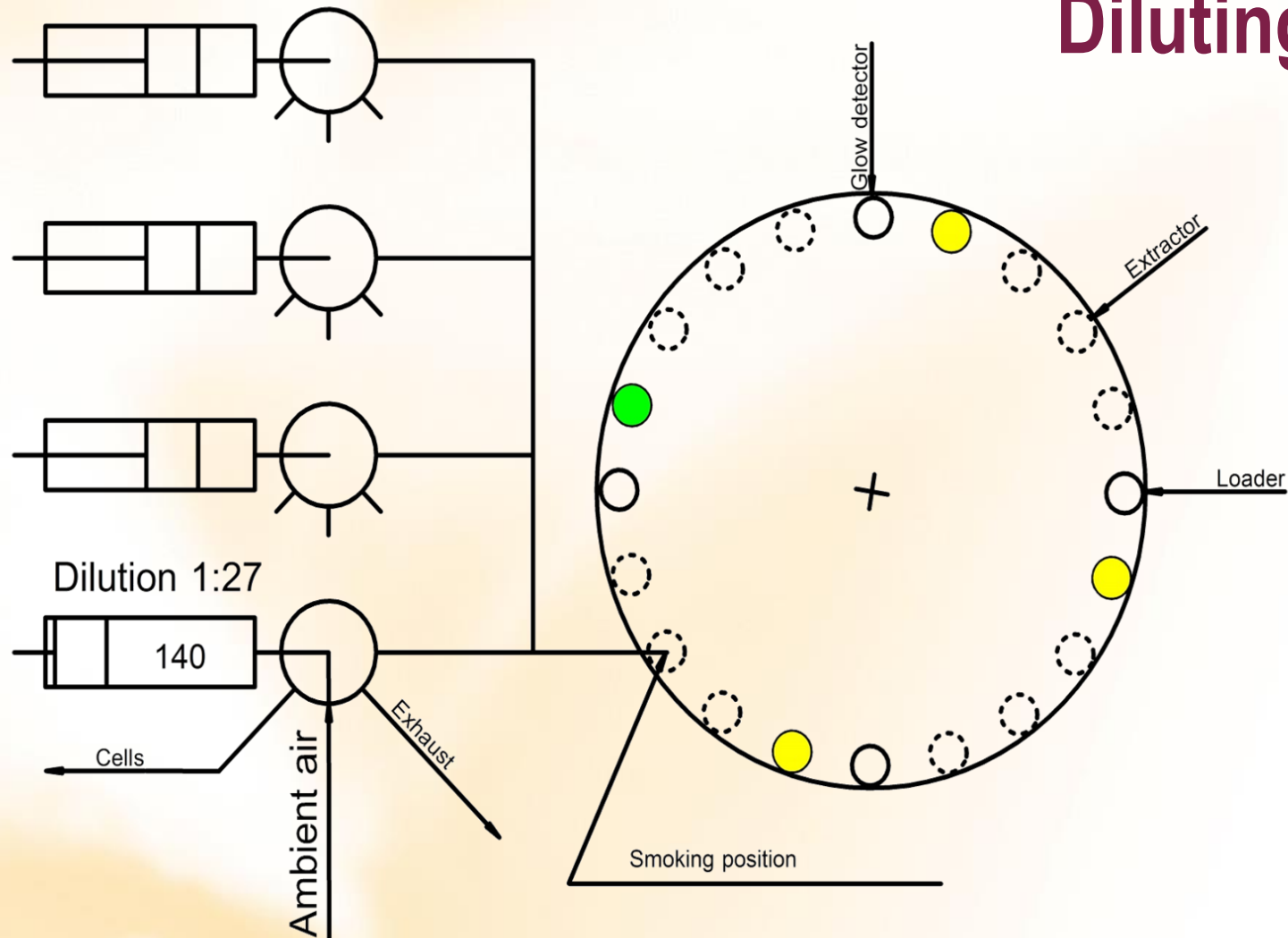
Diluting



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Diluting

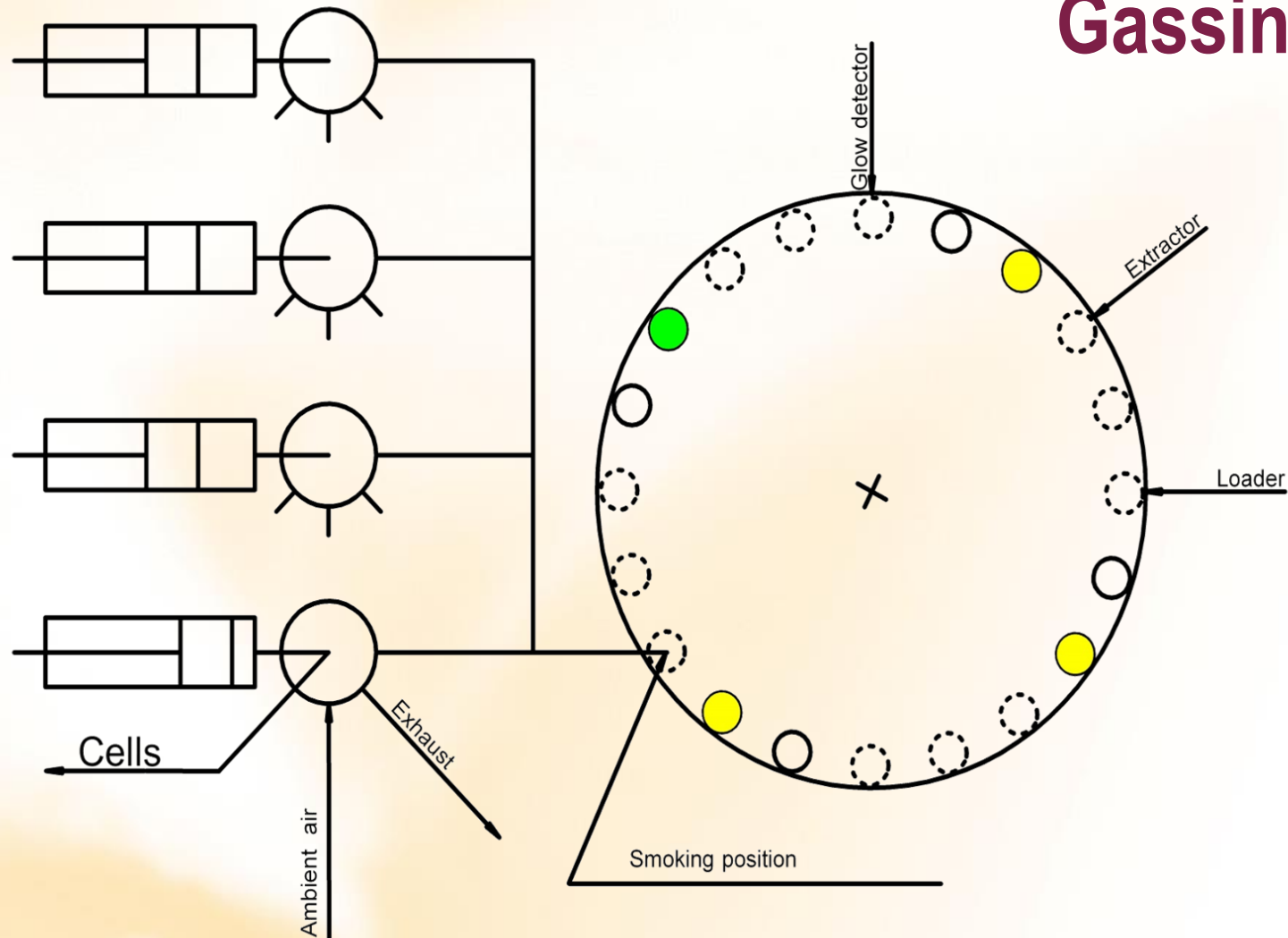


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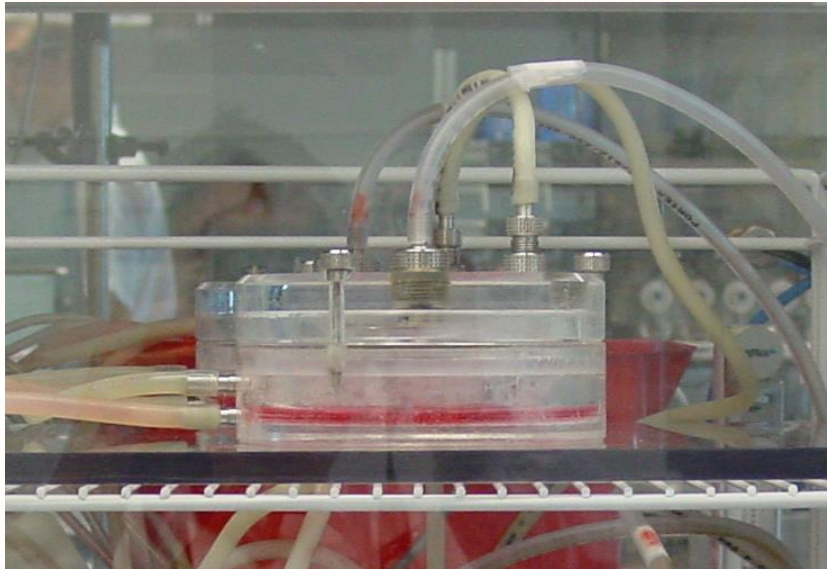
Gassing



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Cell chamber



Incubator

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Conclusion:

- The RM20S is a highly versatile smoke generator for the in vitro research work.
- Due to the fact, that the machine is based on the technology of the RM200/20H the machine can smoke under ISO conditions.
- All 4 channels operate independently.
- Different brands can be smoked concurrently with different puff parameters.
- A smoke dilution up to 1:1,5 mio is possible.

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Many thanks for your attention

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