



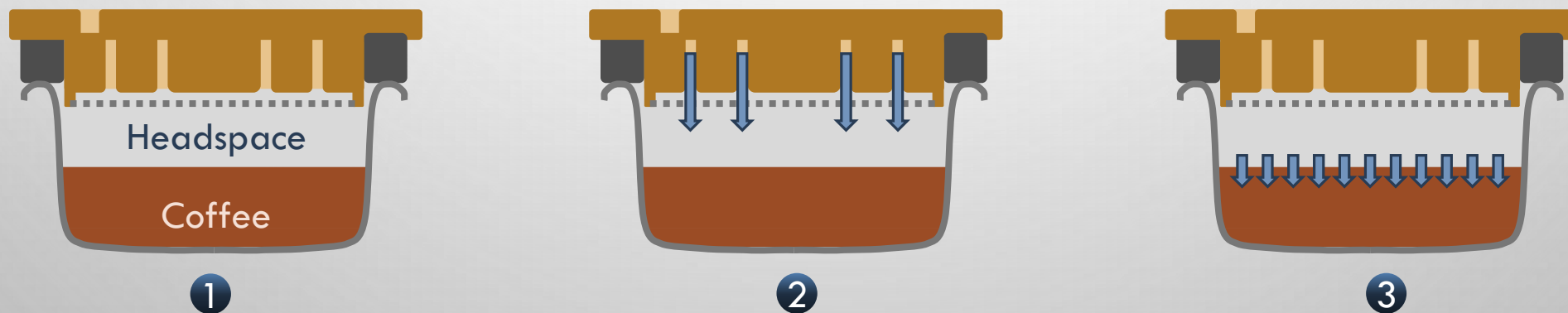
IT'S ALMOST A BLIND BASKET

A FIRST STEP TO BETTER UNDERSTAND A PRESSURE CURVE DURING
ESPRESSO

STÉPHANE RIBES – JUNE 2019

IT'S ALMOST A BLIND BASKET SUMMARY (1 / 3)

- Compression of the air pocket trapped above the coffee puck drives the pressure evolution during an espresso shot
- Air compression is driven by 3 main parameters:
 - 1 Initial available air volume above the puck (headspace)
 - 2 Flow rate of input water (from the pump)
 - 3 Exit water flow rate penetrating the coffee puck

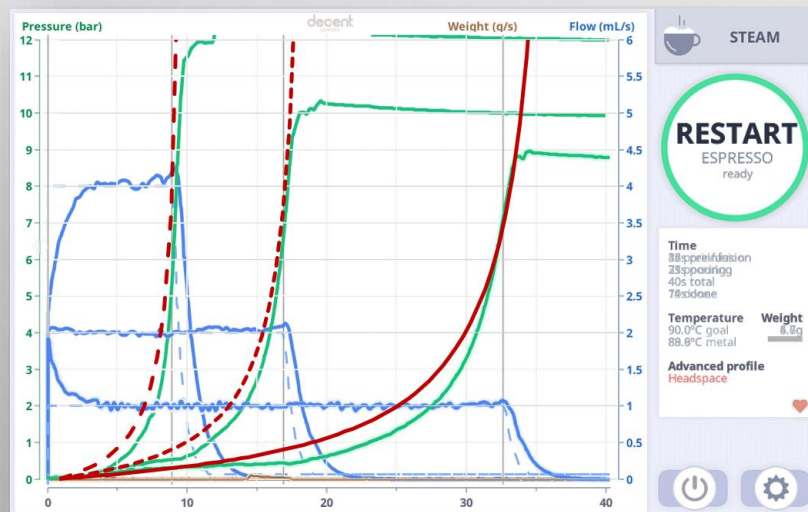


IT'S ALMOST A BLIND BASKET SUMMARY (2/3)

- Considering a perfect gas model, the following formula can be established:

$$P(t) = \frac{HS}{HS - [V_{input}(t) - V_{exit}(t)]} * P_0$$

- P : absolute pressure (in bar) – P_0 : 1 bar = atmospheric pressure
 - t : time (in seconds) – t_0 : the system becomes air tight due to the presence of a continuous water bed above the puck
 - HS ¹: initial headspace (in cm³)
- V_{input} ²: total volume of water dispensed by the pumps after t_0 (in cm³/s)
 - V_{exit} : total volume of water that has flown through the top surface of the puck
- Experiments with a **blind basket** and the DE1PRO machine show acceptable validity of this formula³



Input water flow rate:

— 1 mL/s
 - - - 2 mL/s
 - - - 4 mL/s

¹ Headspace is often described as the distance from the top of the puck to the shower screen – in this document it represents the total air volume trapped above the coffee puck, including between the screen and the brass diffuser

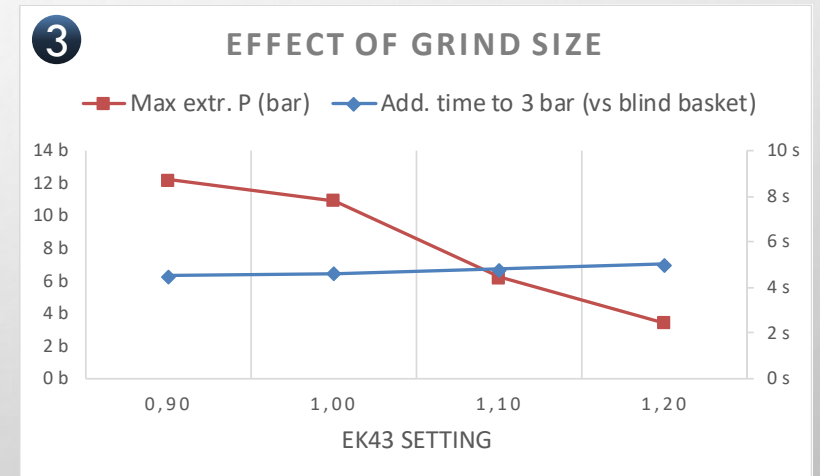
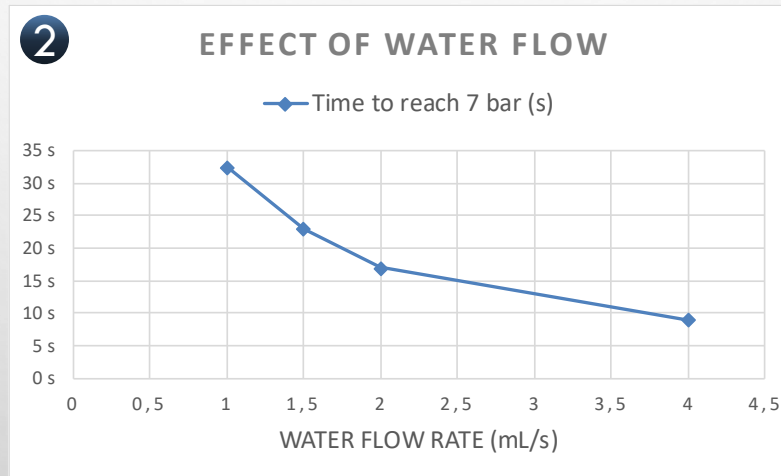
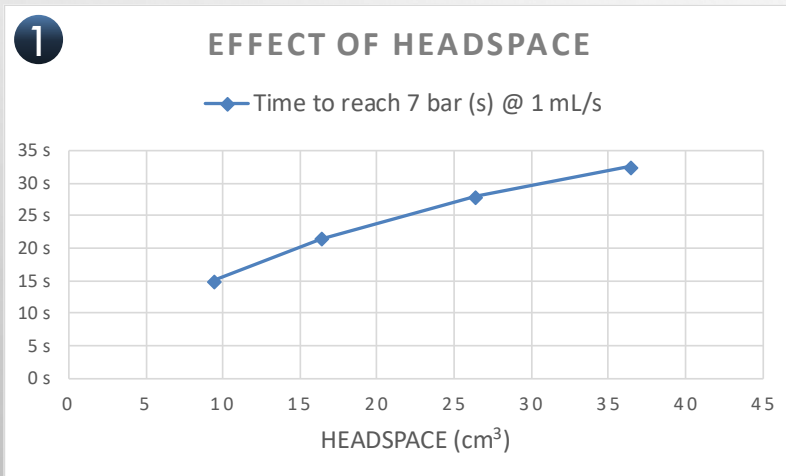
² For liquid water we assume 1 cm³ = 1 mL
With a constant water flow, $V_{input} = \text{Flow rate} * (t - t_0)$

³ For this experiment, the trigger to switch from the initial flow rate to 0 mL/s was set to 7 bar

IT'S ALMOST A BLIND BASKET SUMMARY (3/3)

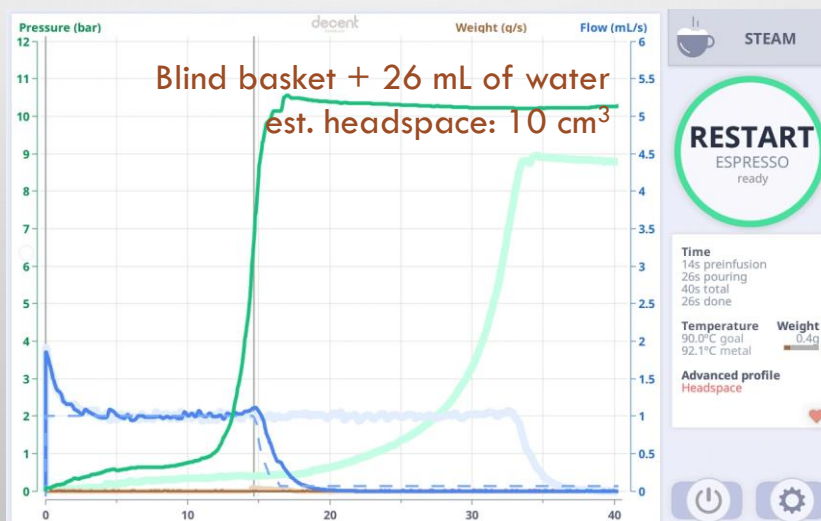
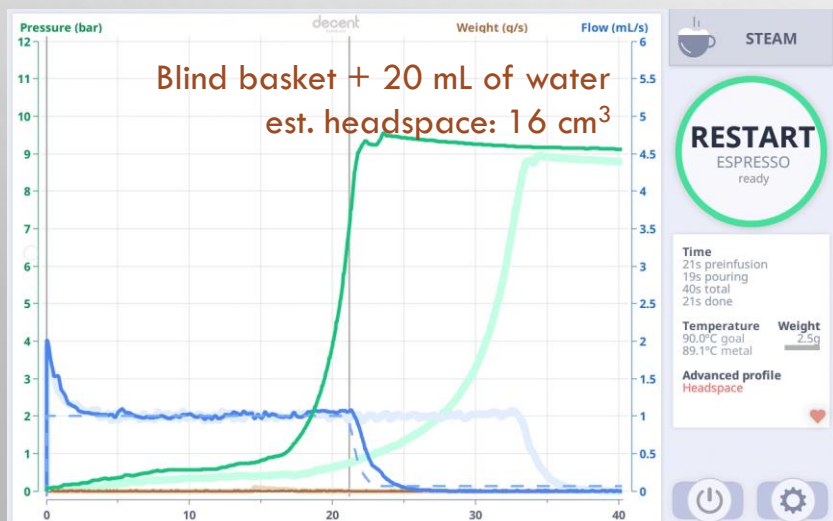
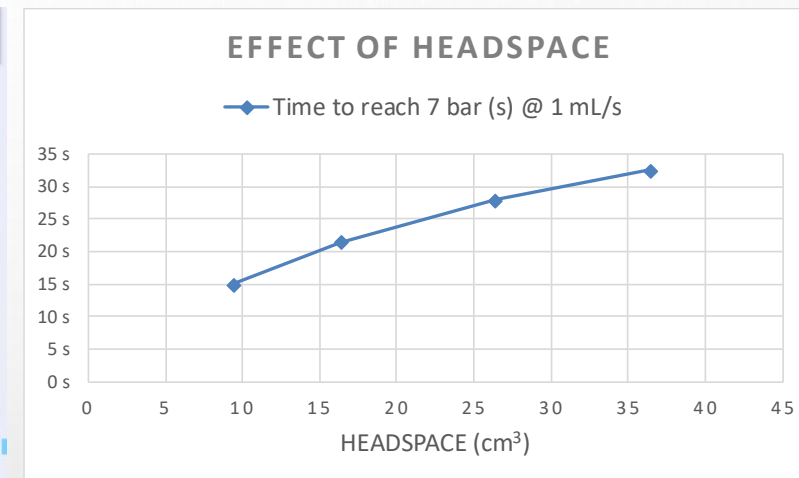
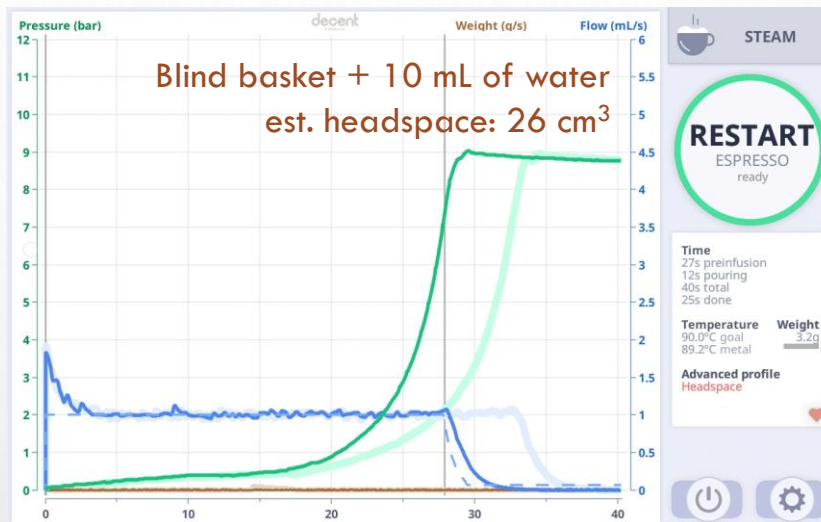
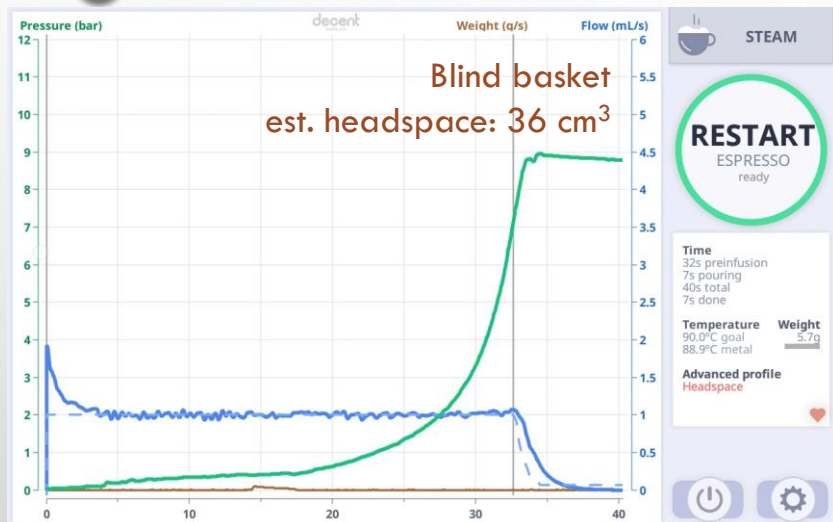
- Main observation results:

- 1 The lower the initial headspace the sooner and quicker the pressure increases
- 2 The higher the input water flow rate the sooner and quicker the pressure increases
- 3 Penetration of water into the coffee puck delays the pressure rise; with slow preinfusions (e.g. 2.5 mL/s) this effect is barely influenced by the grind size



1

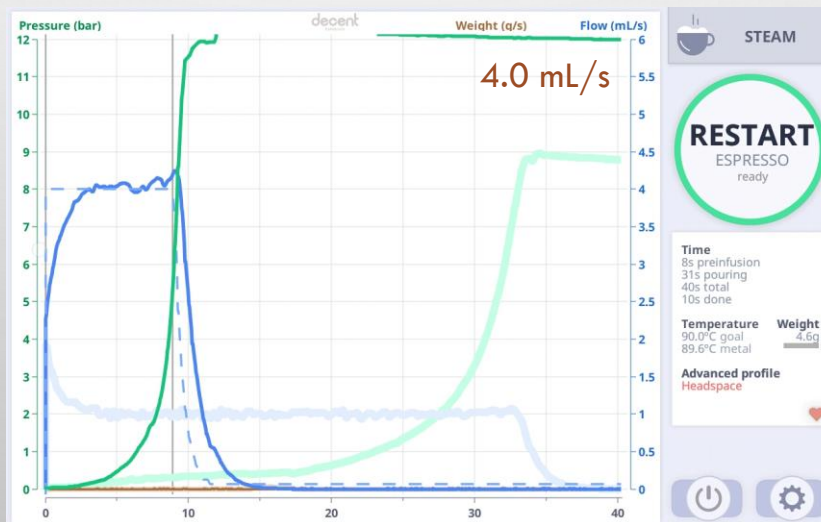
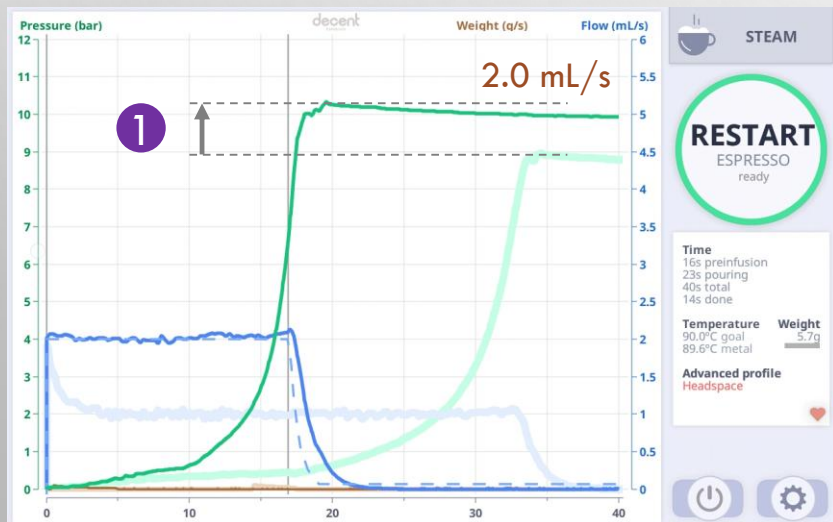
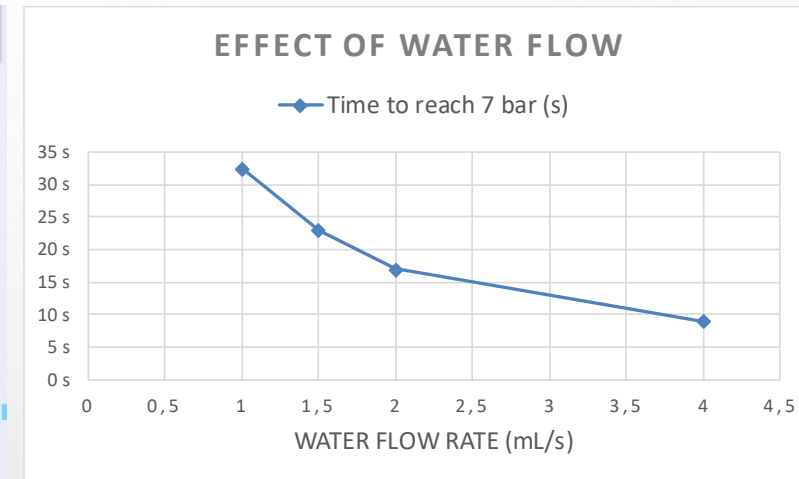
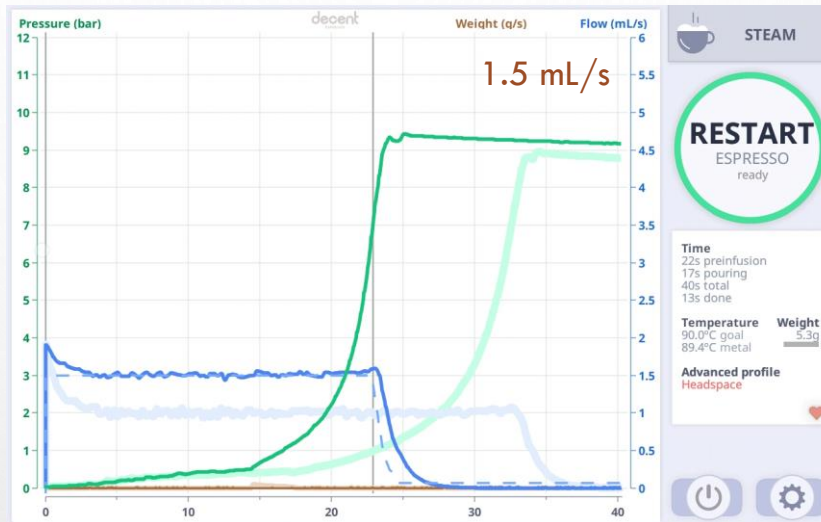
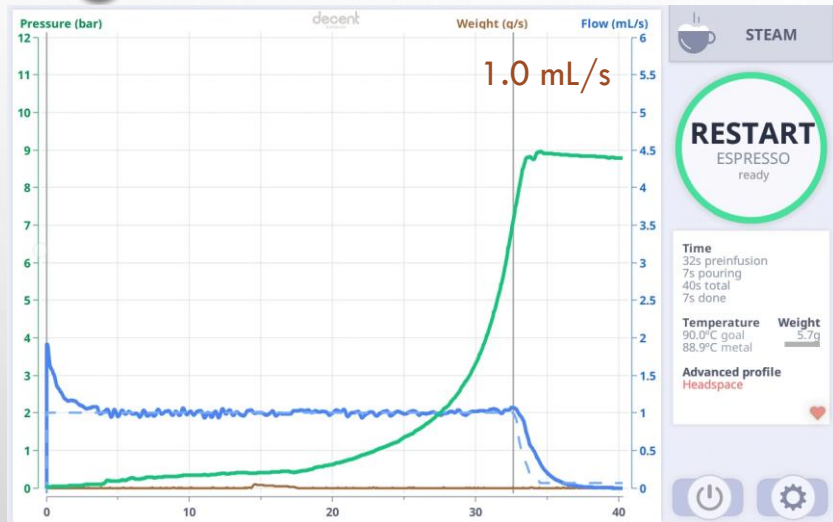
IT'S ALMOST A BLIND BASKET EFFECT OF HEADSPACE



DE1PRO v1.1 – Blind basket
Lower headspace values obtained with
additions of water into the blind basket

IT'S ALMOST A BLIND BASKET

2 EFFECT OF WATER FLOW RATE



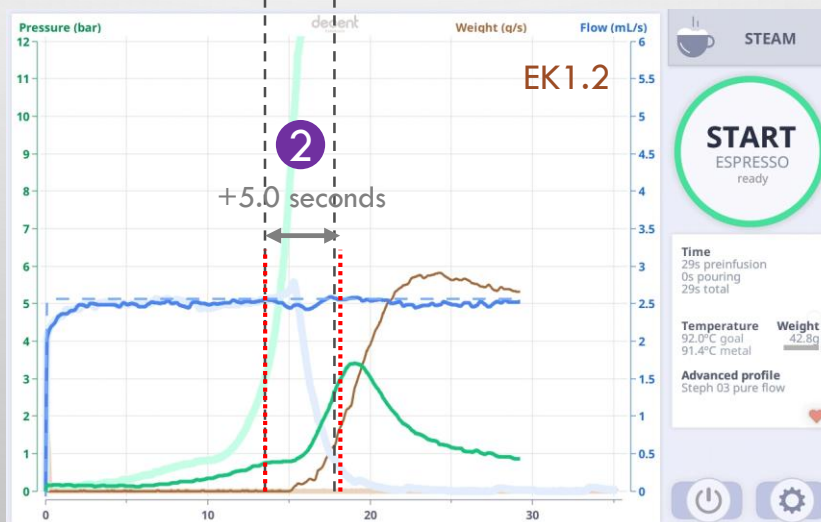
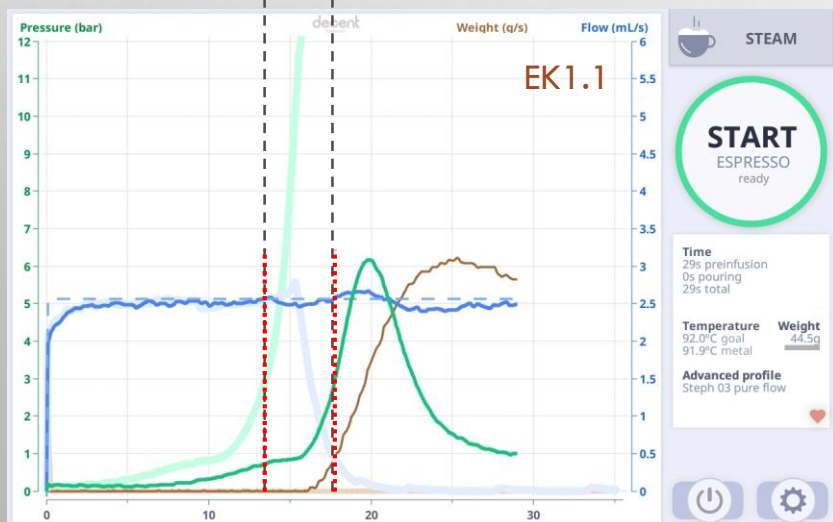
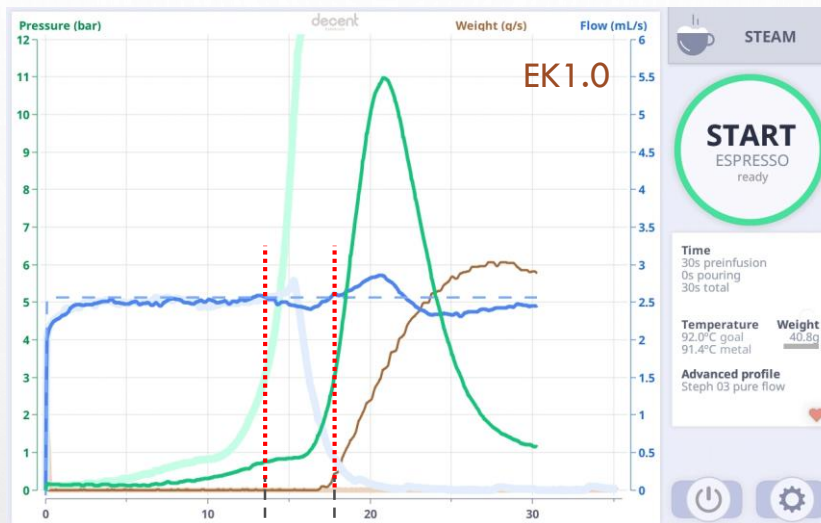
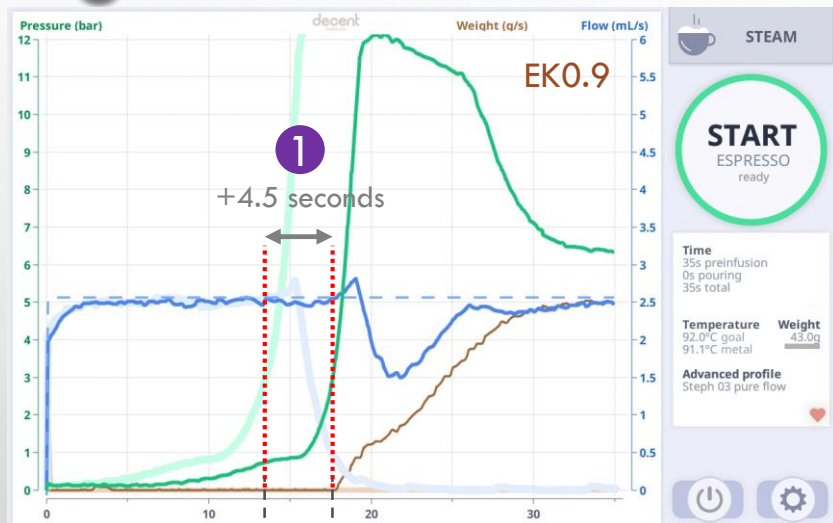
1 More pressure overshoot as the input water flow rate increases

DE1PRO v1.1 – Blind basket

For this experiment, the trigger to switch from the initial flow rate to 0 mL/s was set to 7 bar

3

IT'S ALMOST A BLIND BASKET EFFECT OF GRIND SIZE



1 With an overly fine grind the pressure curve looks similar to the blind basket curve (light green) with the same headspace – the delay before the pressure rise (in this example 4.5 s to reach 3 bar) is caused by the “exit” water flow that penetrates the coffee puck

2 Changing the grind setting to cover a wide range of extraction pressures does not significantly modify the delay before the pressure rise

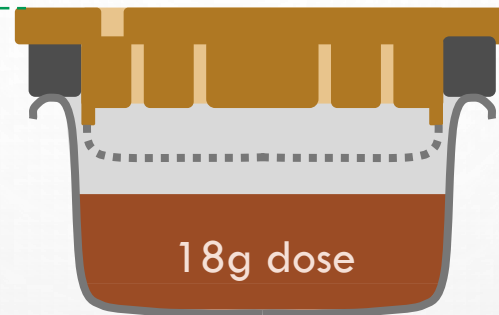
DE1PRO v1.1 – IMS SI 200 IM shower screen
12 grams dose in a 15g VST basket
No paper filter, no hog tool

IT'S ALMOST A BLIND BASKET

EXAMPLE 1: BASKET SIZE

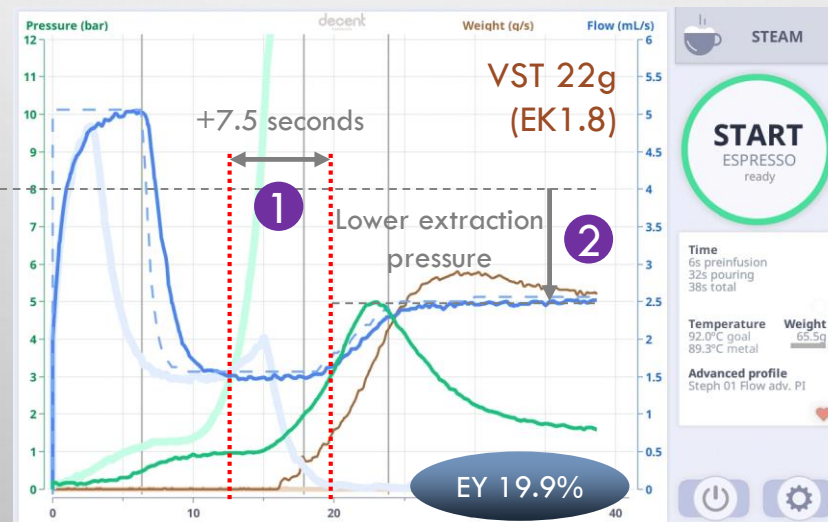
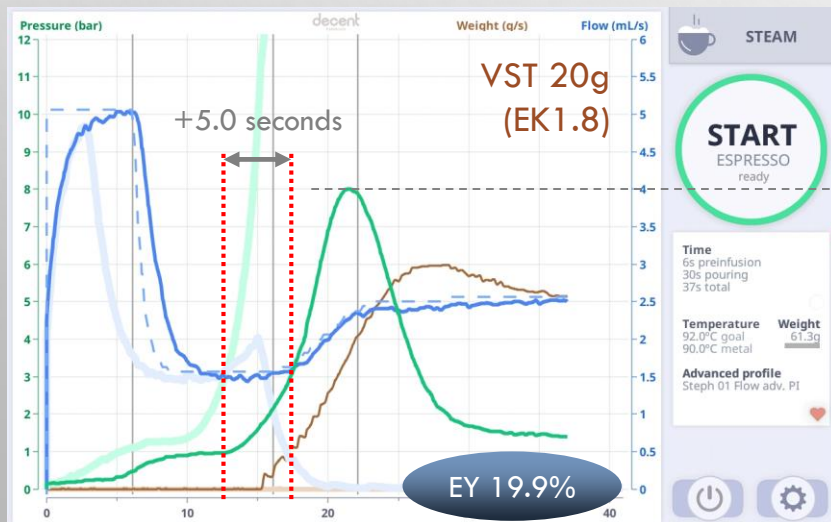


VST 20g



VST 22g

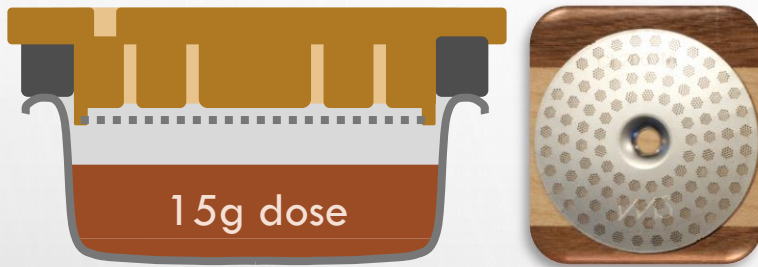
- 1 With the same coffee dose and grind setting, an increase in the basket size (20g to 22g = +2 mm height) creates more headspace that induces additional delay to start building up pressure
- 2 The later pressure rise induces a lower maximum extraction pressure



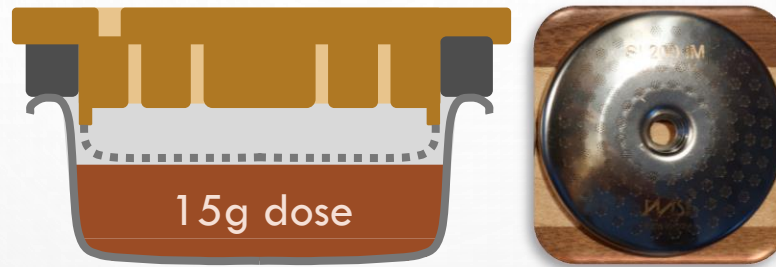
DE1PRO v1.1 – IMS SI 200 IM shower screen
No paper filter, no hog tool

IT'S ALMOST A BLIND BASKET

EXAMPLE 2: SHOWER SCREEN (1 / 2)



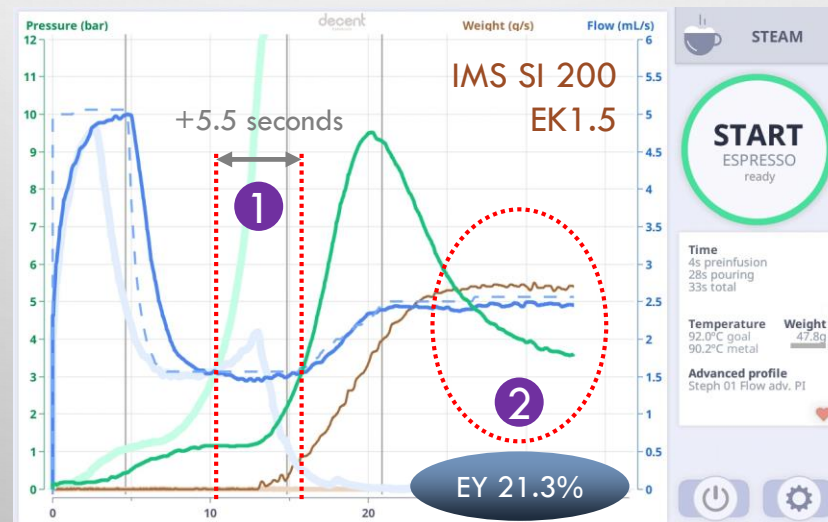
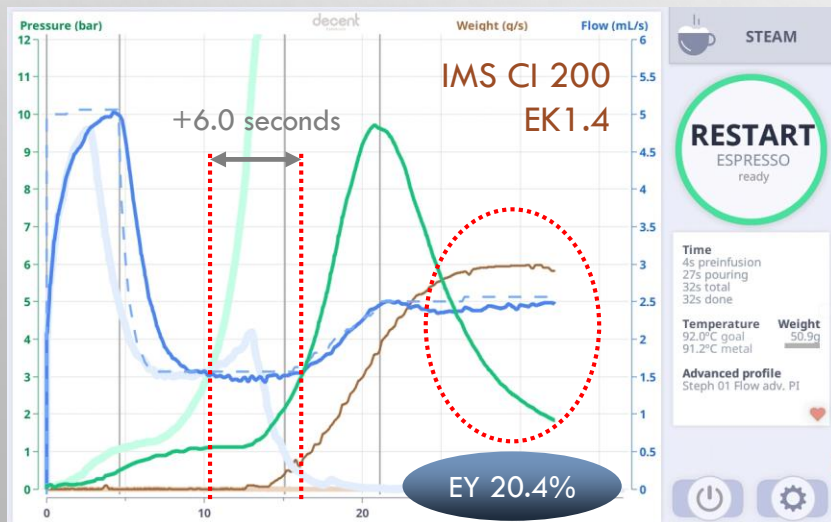
IMS CI 200 IM



IMS SI 200 IM

1 The change of shower screen has almost no impact on headspace, thus with the same dose the additional delay to build pressure is roughly unchanged

2 The gentler pressure decrease with the SI 200 screen may be related to the shorter distance of the shower screen to the top surface of the puck (additional tests required to confirm this hypothesis)



DE1PRO v1.1

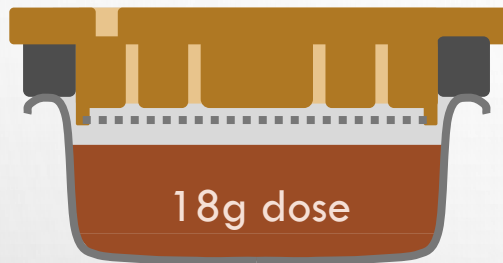
15 grams dose in a 15g VST basket

Grind setting adapted to reach the same extraction pressure

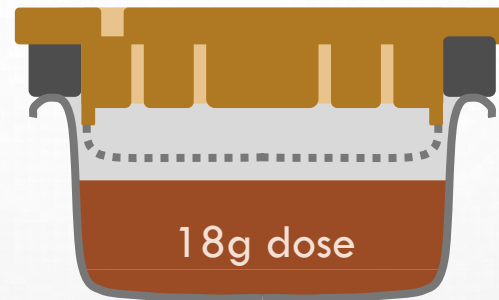
No paper filter, no hog tool

IT'S ALMOST A BLIND BASKET

EXAMPLE 3: SHOWER SCREEN (2/2)

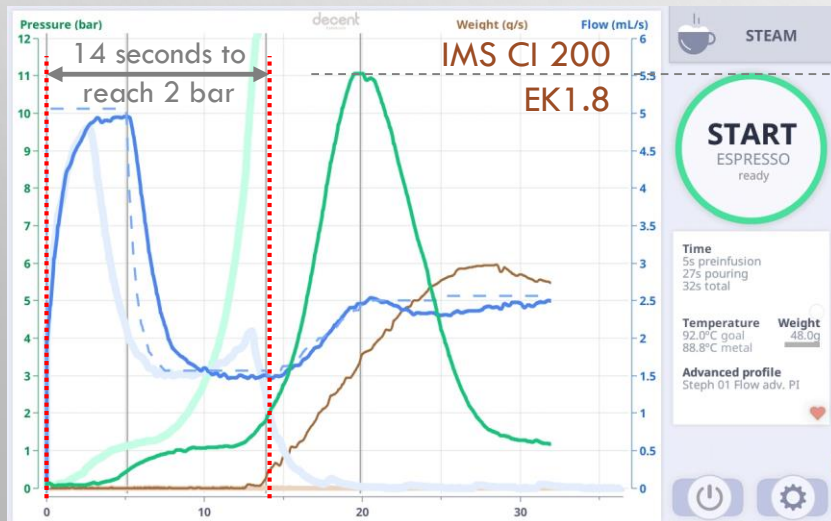


IMS CI 200 IM – VST 15g



IMS SI 200 IM – VST 20g

- 1 Switch to the SI 200 screen and increase the basket size to maintain an almost constant distance from the screen to the puck surface induces a headspace increase that adds more delay to the pressure rise
- 2 The drop in the maximum pressure reached during extraction (with same dose and grind size) is the result of both higher headspace and larger hole size of the VST 20g basket



DE1PRO v1.1

No paper filter, no hog tool