Chapter 9

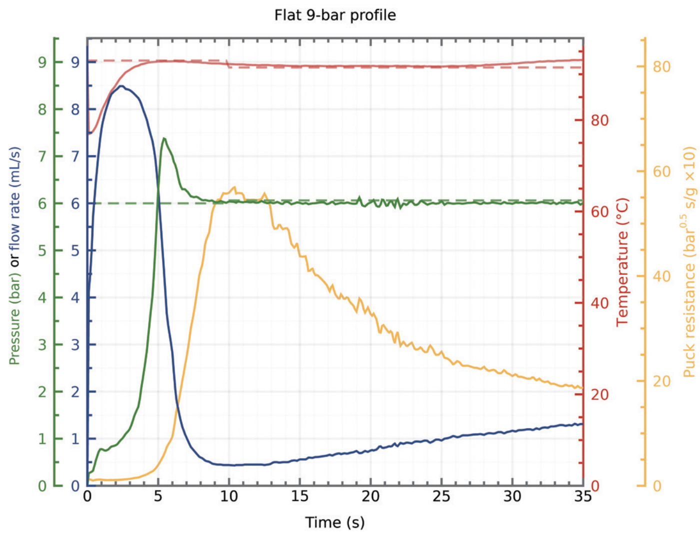
Beverage Types and Recipes

Recent developments in espresso machines offer baristas increasing control over extraction parameters. This has caused what we may still loosely call espresso to branch out into a variety of beverage types with a wide range of subjective properties. This chapter reviews some of the beverage types most widely prepared today, including traditional espresso and more modern approaches, and describes how they can be prepared and optimized.

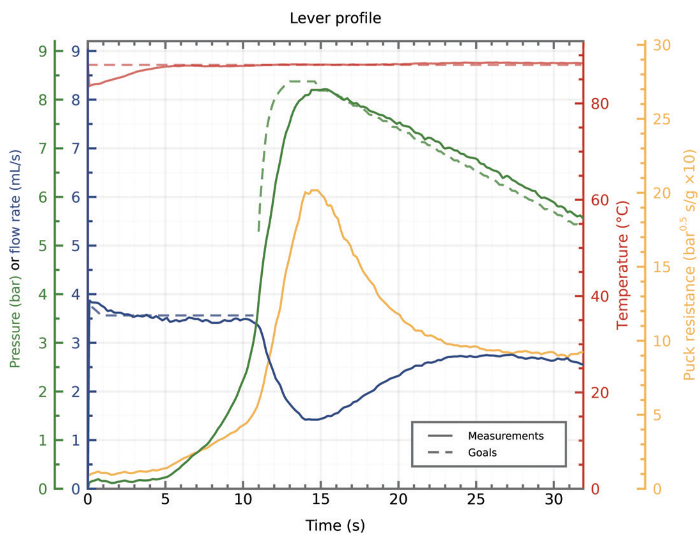
The Traditional Espresso Profile

Historically, espresso has been prepared using relatively slow drip rates, in the range of 0.5–1.5 mL/s with a ratio of approximately 1:2, but they can vary from the shorter ristrettos at 1:1 to the lungos that reach ratios up to approximately 1:3. Because drip rates are usually not adjusted in this context, ristrettos will have the lowest extraction yields and produce the largest fraction of crema. Flavors associated with lower extraction yields, such as saltiness, sourness, and more intense concentrations, are therefore more typical of ristrettos. Lungos, in contrast, can be associated with higher extraction yields, more flavor clarity, and weaker concentrations, and they can produce additional harsh and bitter flavors when taken to the extreme. Although the ideal ratio and overall recipe are a matter of personal taste preference, the balance in flavors and the mouthfeel of a regular espresso (sometimes referred to as a normale) tends to make it more popular than lungos and ristrettos.

Because the recipes for these three types of espresso are universally standard, almost any espresso machine can produce them—with a few caveats. As discussed earlier, the properties of shots produced with pressurized baskets will not be identical to the properties of shots produced with traditional baskets. The use of a lever or controllable pump can allow the barista to achieve a specific flavor profile, different from that obtained with a flat 9-bar pressure. Beverages produced with a declining flavor profile tend to have a reduced harshness and bitterness in the aftertaste of the



An example of a flat, 9-bar traditional espresso pulled on the Decent DE1 espresso machine. *Data are original to this work*



An example of a traditional lever-profile espresso shot, where the pressure peaks near 9 bar and then gradually declines. *Data are original to this work*

drink. Further, different machines operate with a range of flow rates and basket headspaces that affect the length and evenness of the preinfusion. Both factors can modulate the taste and mouthfeel of the resulting espresso, even when the barista is using a standard overall pressure profile.

It is common to dial in regular espresso shots such that they are pulled with a total shot time in the range of 26–30 seconds. Although this metric is affected by the headspace and the flow rate of the preinfusion, it has the advantage of correlating with the average flow rate. It is therefore a much more reliable indicator of the drink properties of regular espresso than it may be for other types of beverages. Shot times are conventionally measured beginning at the moment the pump is turned on.

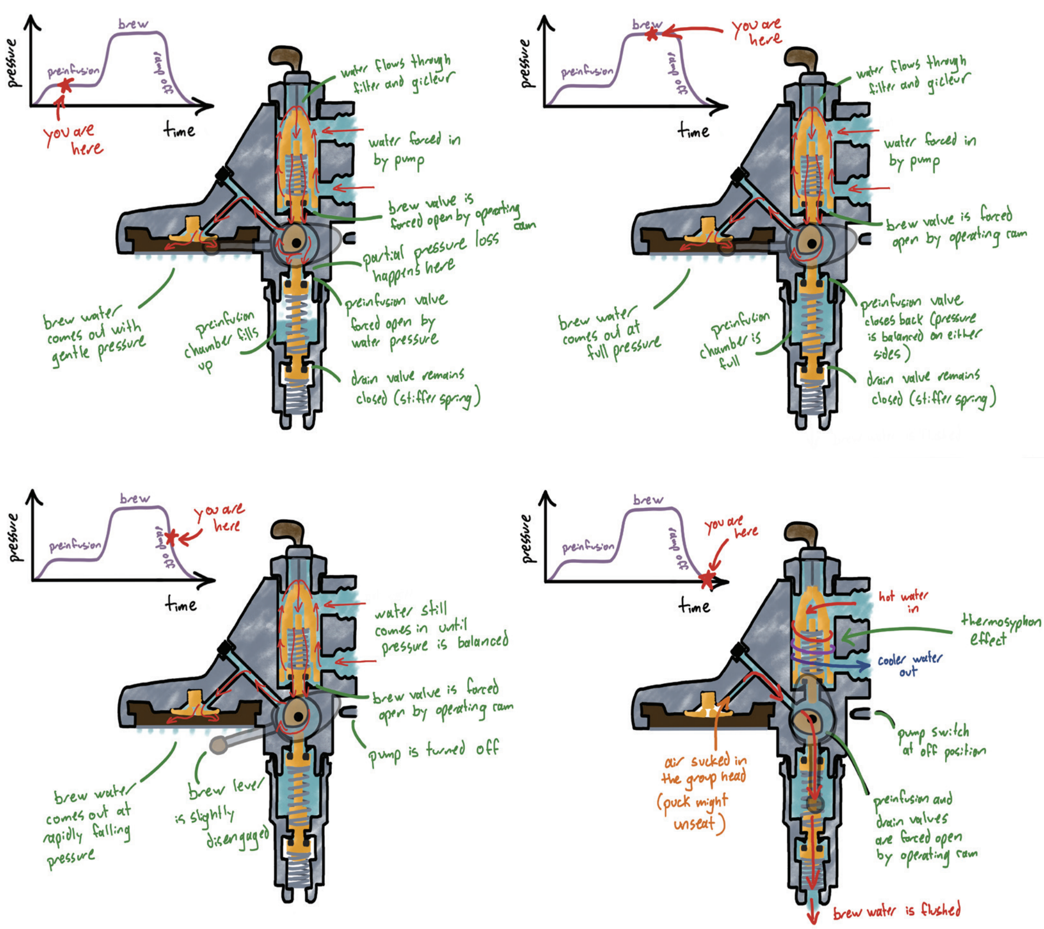
Preinfused Shots

Relatively short preinfusion stages, characterized by slower flow rates and lower pump pressures than the main percolation stage, were introduced with the use of steam pressure (1.5 bar) in early lever espresso machines. This method favors a relatively rapid wetting of the puck while keeping it compressed and allows the temperatures between the top and the bottom of the puck to begin to equalize prior to the main stage of the shot, affecting the resulting flavor profile.

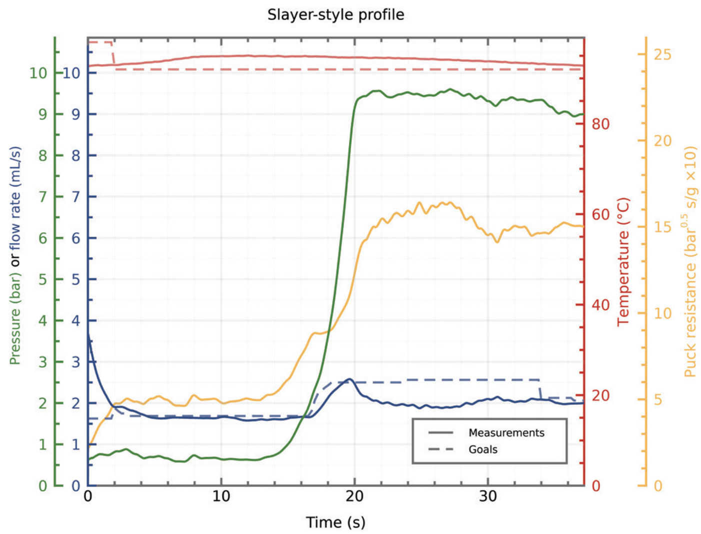
The invention of the E61 group introduced yet another analog method to achieve low-pressure preinfusions. It utilizes a preinfusion valve and chamber that maintain a low pressure drop across the puck until the preinfusion chamber fills up, triggering the main extraction phase. Some modern, plumbed-in lever machines also feature a preinfusion stage that relies on the plumbing line pressure (typically 3–5 bar) to achieve a preinfusion stage.

Later, the inclusion of a needle valve at the group head of Slayer espresso machines, as well as the inclusion of low-voltage

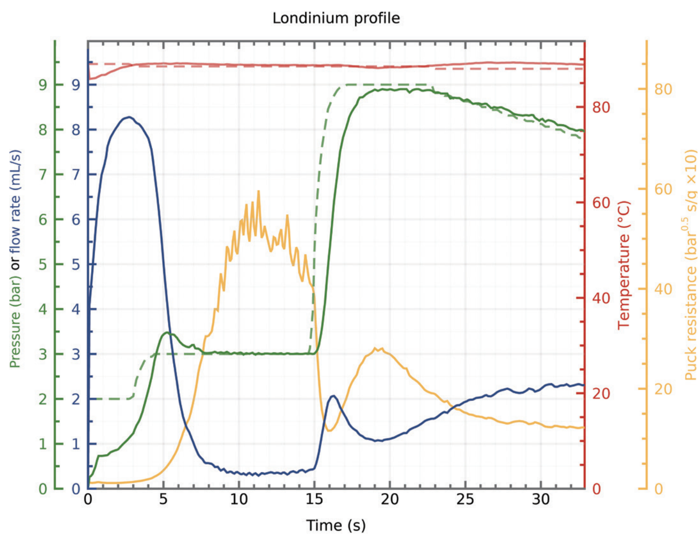
The propagation of water through the chambers and valves of the E61 group as a preinfused espresso shot progresses through its stages



In a Slayer-style shot, a slow preinfusion phase is followed by a slow rise in pressure. *Data courtesy of visualizer.coffee*



A Londinium-style preinfused shot featuring a rapid filling and a preinfusion phase where the pressure is kept at 3 bar for about 10 seconds, to allow a full saturation of the puck, before ramping up to 9 bar and subsequently declining similarly to the traditional lever style. *Data are original to this work*



modes in the pumps of Londinium espresso machines, followed these traditions of preinfusing the puck at low pressures prior to the main extraction phase. These two approaches have retained their original names based on the machines that popularized them. The case of Slayer-style shots is unique because it also involves a slower filling of the headspace, which requires paying particular attention to make the headspace as small as possible by dosing the basket appropriately to avoid uneven extraction. Further, it usually involves a slow (3–5 seconds) ramp-up to 9 bar, contrary to the typical pressure rise that often lasts less than 1–2 seconds in traditional espresso profiles.

On the other hand, Londinium-style shots will fill the headspace with faster-flowing water and then hold the pump at a relatively low pressure (e.g., 3 bar), more similar to traditional preinfused shots. The resulting flavor profiles are distinct and worth exploring, as they will better suit specific taste preferences or coffee beans.

In addition to favoring a faster saturation of the espresso puck, a longer preinfusion phase requires a finer grind size and leads to a decreased temperature differential between the top and the bottom of the puck during the main extraction phase. Preinfusions that rely on a fixed pump pressure will also prevent the puck from expanding during the preinfusion phase.

Flow-controlled Shots

The ability to control an espresso shot based on a measurement of the incoming water velocity at the group head was recently popularized with the commercialization of the DE1 espresso machine by Decent Espresso. These flow-controlled profiles adjust the pump's pressure in real time to achieve the desired flow rate at the group head. Although this makes it possible for the machine to adapt to slightly different puck resistances, the fact that the compression and thus the porosity of the coffee puck depend on the pressure drop means that the machine may have to make large pressure changes to make up for small changes in puck resistance. This can lead to further problems when the required pressures exceed the maximal pressure achievable by the espresso machine. In principle, such flow-controlled shots have the potential to be less affected by the formation of channels that would suddenly decrease the puck resistance. However, data are still lacking to fully explain how a stable flow rate affects the taste of espresso shots in contexts where the hydraulic resistance of the system increases or decreases, whether channels are involved or not.

Flow-controlled profiles, when paired with lighter-roasted coffees, tend to mimic lever-style shots: the pressure profile will naturally decrease following the viscosity drop of the shot, leading to an improved taste profile when compared with flat pressure profiles. Achieving a similar effect by manually decreasing the pressure can be difficult because the pressure decrease rate required to maintain a fixed flow rate depends on factors such as the unimodality of a grinder. Flow-controlled profiles are generally harder to dial in compared with pressure-declining profiles because the range of acceptable grind sizes to obtain a desirable shot pressure tends to be smaller.

The DE1 espresso machine introduced an additional innovation with "range of action" limiters. These options allow users to perform more-delicate adjustments when the desired pressure or flow rate is close to the desired range and make more-strident adjustments as the measurements drift further. This can allow a softer approach to flow control that does not require overly aggressive pressure changes.

Blooming Shots

In a "blooming" phase, the flow of the espresso machine is stopped for a fixed amount of time, without the opening of the release valve of the espresso machine's group head. This phase gives the water additional time to propagate through the coffee bed and inside the coffee particles and for the particles to degas. As the water propagates inside the puck, the pressure drop across the puck gradually decreases. The surface tension of water creeping inside the coffee particles pushes them upward, causing the puck to expand, provided there is sufficient headspace.

When the blooming phase is complete,[39] the puck has been fully saturated with water and has a much more even temperature across its vertical layers. The pump is then turned back on to compress the puck again and reestablish the flow of water through it.

The main impacts of using such a blooming stage on the properties of an espresso shot are fourfold:

- The required grind size is much finer.
- The resulting extraction yield is higher (especially when using lighter-roasted coffee).
- The flavor clarity is improved.
- The mouthfeel and crema are somewhat reduced.

A finer grind size is required to prepare blooming shots, mainly because the initial puck resistance is lower after air has been pushed out from the puck. The longer contact time allows for better penetration of water into the coarsest coffee particles and allows diffusion to extract soluble compounds more efficiently, leading to the increased extraction yield. The initial pushing out of air from the coffee puck at a lower pressure may be responsible for the decreased crema and mouthfeel, although this is somewhat speculative. The impact on flavor clarity is likely affected by both the increased extraction yield and the decreased mouthfeel.

Blooming shots cannot be easily achieved on all espresso machines. As noted above, they require the ability to stop the flow of water for an extended time without opening the release valve.

Although the original blooming shot profile was introduced with a flow-controlled, pressure-declining phase after the bloom, the name "blooming shots" is commonly used to refer to any types of espresso shots that include a significant blooming phase.

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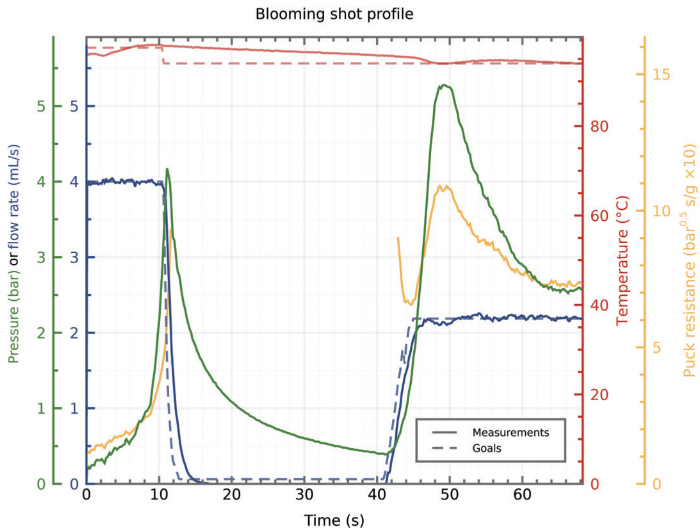
[39] The blooming phase originally lasted for 30 seconds when Scott Rao first introduced the profile on the Decent DE1 espresso machine.

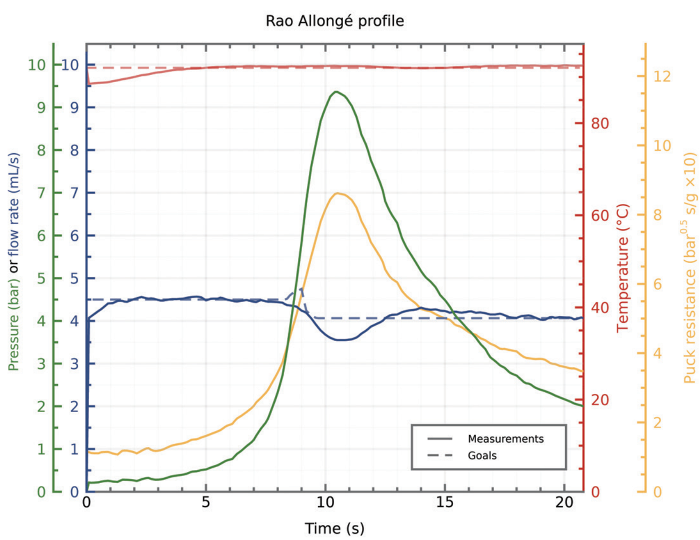


An example of a blooming shot featuring a medium fill rate (4 mL/s) followed by a 30-second blooming phase and a flow-controlled (2.2 mL/s) main extraction phase at a slightly decreased temperature to achieve a pressure peak slightly above 5 bar. (The typical range is 3–8 bar.) *Data are original to this work*

The Rao Allongé

Scott Rao introduced the Rao Allongé at Café Myriade in Montreal in 2008. His idea was to coarsen the grind size significantly to achieve a much lower puck resistance and a constant 4 mL/s flow rate to produce an espresso shot, typically with a 1:5 ratio, within approximately 30 seconds. This profile differs from traditional allongés because of its coarser grind size and faster flow rate.

Rao Allongés lead to a much cleaner flavor profile less prone to astringency and harsh flavors generally, as compared with a typical allongé pulled at the same ratio with slower drip rates. This is likely caused at least in part by the more even flow through the coarser grounds. This leads to better overall evenness of extraction, and it fits into the general understanding of how the best-tasting



An example of a Rao Allongé profile. The flow rate was kept constant at 4 mL/s for most of the shot, except where the puck resistance peaked and the machine would have required a pressure much greater than 9 bar to maintain the flow rate. *Data are original to this work* drip rates tend to be affected by the shot ratio. The faster flow rates involved tend to favor the faster-diffusing chemical compounds in extraction, and this often leads to subjectively increased acidity. This profile is often paired with lighter roasts, and it can highlight the bright acidity of light-roasted Kenyan coffees.

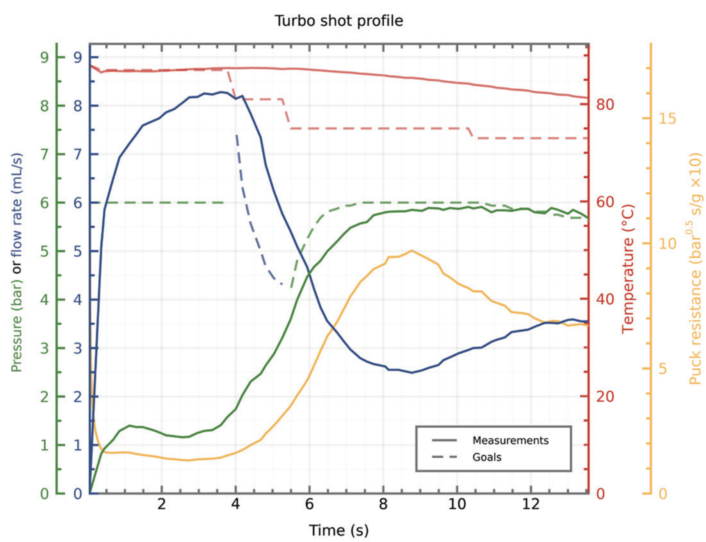
Turbo Shots

Turbo shots follow an architecture similar to that of the Rao Allongé, but with flow rates of 2–5 mL/s and ratios shorter than Rao Allongés (1:2 to 1:3). They became increasingly popular after the findings of Cameron et al. (2020), wherein faster drip rates were found to plausibly lead to a more even flow of water through the espresso puck (although their observations were likely related to edge underextraction, a topic we explored in Chapter 6). Turbo shots are often paired with light roasts and unimodal burrs, and they highlight the acidity and clarity of a shot.

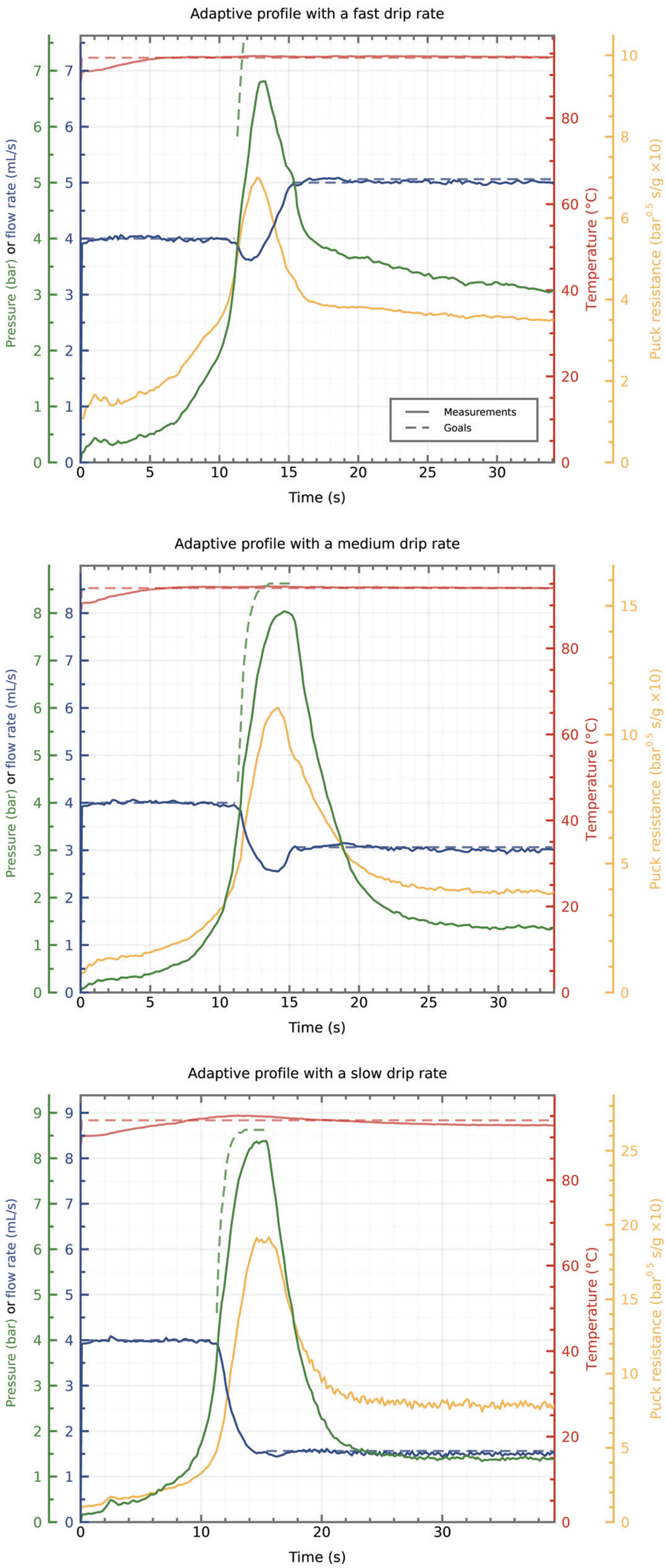
Interestingly, the extraction profile for espresso pods is similar to that of turbo shots. Pod coffees are often ground on high-efficiency roller mills that tend to produce extremely unimodal particle size distributions (Eiermann et al. 2020), leading to efficient extraction yields, even with shorter shot times. It is not uncommon to find pod coffees with extraction yields of 22%, even in the case of dark-roasted coffees.

Adaptive Shots

Adaptive shots generally use a variable preinfusion or blooming stage, and they initiate the main percolation phase of a shot when the group head achieves a fixed pressure drop. For example, an initial blooming phase may be initiated when the pump first arrives



An example of a turbo shot profile. *Data courtesy of Rohan at Pocket Science Coffee*



Three example of a single adaptive shot profile that determines the required flow rate in the main extraction phase from its value at peak pressure. The coarser grind size (top) resulted in a shot similar to a Rao Allongé, the middle case resulted in a flow-controlled, traditional lever-style espresso, and the finer grind size (bottom) resulted in a ristretto profile, assuming the machine was stopped at the appropriate ratios. ***Data are original to this work***

at a fixed pressure such as 6 bar and stopped when the pressure falls back to 2 bar, at which time the main percolation phase will be initiated.

The main advantage of adaptive shots is that they allow the machine to automatically adjust the extent to which a coffee bed becomes prewetted. This makes it possible to obtain the desired average puck resistance across a wider range of grind sizes, allowing for an easier dialing in of the coffee. Moving toward the finer end of acceptable grind sizes will lengthen the blooming phase and produce shots with more flavor clarity and higher extraction yields, similar to blooming shots, whereas moving to the coarser end of acceptable grind sizes will shorten the blooming phase and produce more traditional espresso shots.

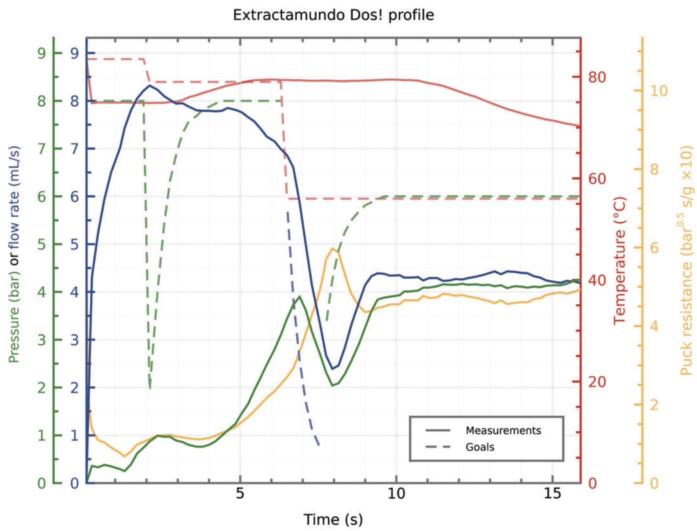
Pulling adaptive shots requires the same espresso machine controls that blooming shots do, with the caveat that the blooming phase must be halted based on the pressure drop reading at the group head, either manually or via a computer control. The subsequent extraction phases may use any of a variety of pressure curves.

Other styles of adaptive shots may involve a step where the flow rate is detected at the pressure peak and then maintained using a flow-controlled step. This can allow the user to obtain a more repeatable espresso shot; the resulting properties of the shot are determined by the grind size. (Coarser grounds will produce an allongé, whereas finer grounds will produce a flow-controlled ristretto.) This strategy can help in mitigating coffee waste by producing drinkable beverages even when the grind size suffers unexpected changes.

Extractamundo!

The Extractamundo! profile, developed by Joe Duncan, combines the concepts of the turbo shot and the blooming shot to achieve a higher-extraction yield while preserving the flavor separation of turbo shots. The filling rate of 6 mL/s allows rapid filling of the headspace, especially in machines with a large headspace, such as the Decent DE1. The main extraction phase takes advantage of the "range of action" limiters of the Decent DE1 machine to produce a decline in pressure that is steeper for faster drip rates (Rohan 2022a).

A further idiosyncrasy of the Extractamundo! profile is the use of lower-than-typical brew temperatures (85°C, or 185°F, measured at the group head), combined with a temperature decline to approximately 80°C, or 176°F, as the shot progresses. This profile is usually pulled with a short beverage ratio, such as 1:2, and is often paired with unimodal grinders and a water alkalinity of approximately 90 ppm as $CaCO_3$, higher than is typically used for filter coffee.



An example of a shot pulled with the second version of the Extractamundo! profile, named "Extractamundo Dos!". *Data courtesy of Joe Duncan*

Filter Brewing with Espresso Machines

Recently, espresso machines have been put to use to brew coarser-ground beverages at very long ratios to achieve a beverage similar to filter coffee in a repeatable and relatively simple manner. This can be particularly interesting for coffee shops, where the preparation of pour-over coffee is inefficient and time consuming, or in a context where a home barista wishes to achieve an even extraction, with most of the water flowing through—rather than around—the coffee bed.

Typical filter brewing profiles are based on the use of a preinfusion followed by a lengthy bloom, which may be slowly replenished as it drips out, followed by a main percolation phase that aims for drip rates in the range of 1–2 mL/s with a small pressure drop at the group head, typically below 2 bar. Short ratios, in the range 1:3–1:5, can be combined with a fine grind size and a dilution step, up to ratios typical of filter coffee (1:15–1:18), to obtain beverages with filter coffee's characteristic strength and extraction yield. These types of profiles were popularized under the name "Filter 2.0" by Scott Rao and subsequently as "Filter 3.0" when paired with a specialized brew basket. They are sometimes also referred to as a "sprover" (a pour-over–style espresso), especially in reference to using a wider range of pressure profiles.

The Nomacano/Noruego

The Nomacano was originally developed under the name "Noruego" (a nod to its Norwegian origin) by Tim Wendelboe to be served as an alternative to americano in his coffee shop in Norway. The beverage was first trialed at the Noma restaurant in Copenhagen, Denmark, whose owners were searching for an efficient method to serve high-quality filter coffee on demand at the end of a meal. They wanted to rapidly brew small batches of filter coffee at a slightly higher concentration to overcome palate fatigue, in order to offer their diners an optimal sensorial experience. The Noruego achieved just that. The Noruego acquired the name Nomacano because of its first use at Noma (Hedrick 2023c).

Here's the recipe: A coffee concentrate is prepared with a traditional espresso machine, using a ratio of 1:7 to 1:8, light-roasted coffee, and a 23- to 24-gram dose pulled in a 25-gram basket with a bottom paper filter in 45–60 seconds with a fast, 3–4 mL/s flow rate (similar to the Rao Allongé) and a flat, 9-bar profile. To slightly increase its clarity, the resulting extraction, with a typical concentration of 3.0–3.2%, is poured through a V60 equipped with a paper filter. The filtered extraction is then diluted to a total ratio of 1:12–1:14 to achieve a concentration in the range 1.7–1.9%, depending on the coffee. (See Wendelboe 2023 for more details.)