

Operating the Rancilio Silvia after PID kit modification

Version 4

After retrofitting the Rancilio Silvia with the PID controller kit, the espresso machine should be operated in the same manner as the original machine with the exception that you should now pull the espresso shot when the boiler temperature is within ± 1 degree of your chosen set temperature (set value or SV).

When the machine is turned on, the controller will display the boiler temperature in the machine. The temperature reading will start to increase after 30-60 seconds. As the temperature approaches the set value, you will notice that the panel light next to the power switch will start to flash. This flashing indicates that the controller is cutting the power to the heater such that the temperature will not overshoot as it approaches SV. After the temperature has stabilized within ± 1 degree of SV **AND** the machine has been "on" for 45 minutes, it is ready to produce espresso.

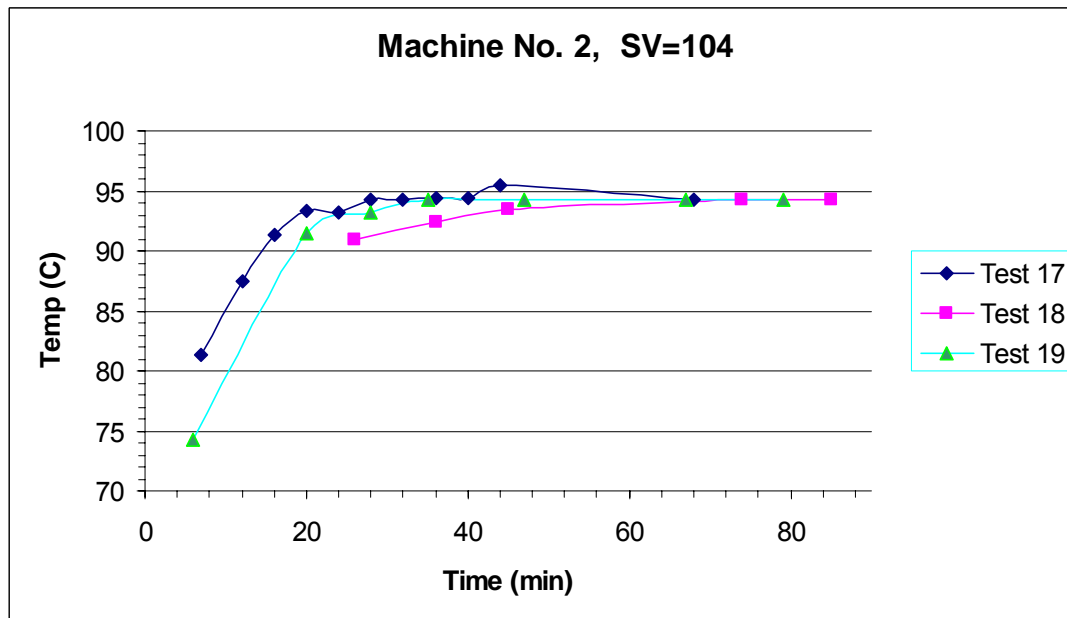


Figure 1 shown the brew water temperature changes with time. The reason for such delay is due to the structure of the Silvia machine. The boiler of the machine has only a thin section connected to the grouphead. It will take a while for the heat in the boiler to transfer to the grouphead. In general, it takes 25 to 45 minutes to get the brew water temperature stabilized. During the warming up period, we suggest user to install the empty portafilter on the machine. After the controller stabilized at SV, run the pump for 4 to 6 fluid oz of water (120-180 ml) to flush the grouphead and portafilter. That will speed up the warming up process.

Brew Water Temperature Setting

Table 1. SV for different kit

Part Number	Description	SV value in °C	SV value in °F
KIT-RSRTD(N)	Rancilio retrofit kit with RTD sensor	105	221

Table 1 lists default settings for the SV of the controller.

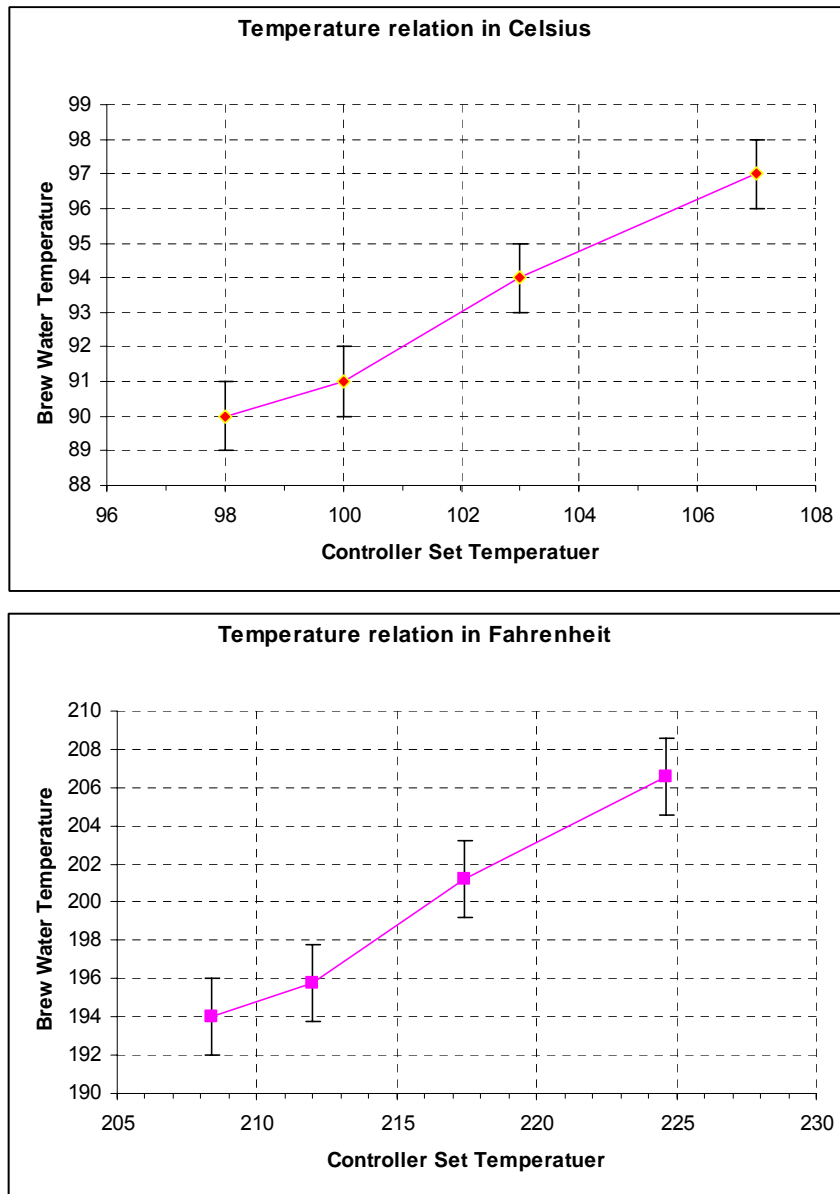


Figure 2 Correlation between PID controller set temperature and brew water temperature detected at grouphead measured by Scace Thermofilter. Top, display in degrees Celsius. Bottom, Display in degrees Fahrenheit.

Figure 2 shows the correlation between the PID controller set temperature and brew water temperature. The controller in the Auber instruments' PID kits has been calibrated with its sensor to the accuracy of 1 degree C before shipping. However, due to the machine structure variations, the brew water temperature of

different machine can have 1-2 C difference when controlled by the same PID controller kit. For detailed relationship between the PID setting temperature and brew water temperature, please read the file named "Temperature Performance Study" in the CD that came with the kit.

It should be noted that the setting temperature we recommended is lower than some people suggested on the internet forums. As SV can be easily changed, it will up to the user to decide what the best temperature is for their espresso.

Changing Brew Water Temperature Setting

There are two ways in which SV may be changed:

- 1) Press the ▼ or ▲ key once and release it. The display will change from measured temperature (process value, PV) to flash the SV. Then press the ▼ or ▲ key to change SV until the desired value is displayed. There is no need to press the SET key as the display will change back to reading the boiler temperature automatically after no keys are pressed for 8 seconds.
- 2) Press the SET key and enter the code 0001. Press SET again. The controller will display the current setting for SV. Use the ▼, ▲, and > keys to change the SV to the desired value. Press the SET again. Then use the ▼ and ▲ keys until the controller displays "END". Press SET to complete the process. While this setup method is more complicated than the previous method, it is faster and more reliable when the temperature change is very large. However, this would not typically be required in an espresso machine installation.

Fine tuning the PID Constants

The parameters for the PID controller have been optimized for Rancilio Silvia with extensive testing. For most users, there is no need to fine tune the machine. For some machines, the temperature might oscillate 2 degrees occasionally. The recovery time might increase to 3-4 minutes when it is cold. These differences are not critical to most users because it might take that much time to prepare the next shot. As the machine warms up, the performance will improve. A warmed up machine could take less than 40 seconds to recover after pulling a shot. We found the most noticeable performance differences were between new machines and some old, poorly maintained machines. This is believed to be due to internal scale build-up in older machines which slows the response time. If you are technically adept and willing to read through the controller instruction manual, below are some hints that may help you fine tune the controller. Should you ever want to set the controller to its original state, Table 2 lists the default settings that come with the controller.

1) Changing the P constant **MAY** improve performance. We found for kits using the RTD sensor the P value should be between 1.8 and 2.5 (the default is 2.0). In general, a lower P value will speed up the recovery after a shot. However, a lower P value can also cause the temperature to oscillate. For older machines, 2.5 may provide better results. For kits using the K type thermocouple, the P value should be between 0.9 and 1.4 (the default is 1.1).

2) For older machines, changing the integral constant, I, from 60 seconds to up to 75 seconds may improve performance. However if I is set too short the temperature will oscillate and when I is set too long the recovery speed will be slower.

Table 2. Controller Parameters For Silvia

	KIT-RSRTD(N) F	KIT-RSRTD(N) C
Code 0036		
P	2	2
I	60	60
d	15	15
Code 0001		
SV	221	105
AH1	350	175
AL1	320	160
Code 0089		
Corf	1	0

Controller Instruction Manual

A copy of the instruction manual for the controller is included in the kit. For most users, there is no need to read it. If you decide to read the manual we want to point out that this controller is modified after the manual was created. We have added two control parameters to balance the requirement for cold start speed, shot recovery speed and long term stability. These parameters are proprietary and are not accessible by the user. In addition, the dampening factor, SovF, has been deactivated. Other than that, the remaining control functions are the same.

Change the Display to 0.1 Degree Resolution.

For the kits with RTD sensor, it is possible to display the temperature in 0.1 degree (F or C) resolution. The controller will be able to hold the temperature at ± 0.1 degree range. However, with 0.1 degree resolution, the machine will take much longer to reach the set point. Should you decide to use the 0.1 degree resolution, you will need to use the code 0089 to change the Inty parameter from PT100 to PT10.0. Then, use code 0001 to reset SV, AH1 and AL1.

Frothing the Milk by Steam.

You should froth the milk in the same way as before the PID kit was installed. The steam temperature is not controlled by the PID controller. When frothing the milk, the heater of Silvia does not have enough power to maintaining a stable temperature. Even the heater is powered 100% on; the temperature of the boiler will still drop. Commercial espresso machines have separate steam boiler with heater that is 2 to 3 times more powerful than the brewing heater for this reason. To PID control the frothing temperature of Silvia will make the steam much weaker.

The PID controller, however, will help you to “surf” the best time for frothing because you can read the temperature of the boiler. The steam thermostat of the Silvia is designed to turn off when the temperature reaches 284 F (140C) and on again when temperature dropped to below 265 F (130C). If you start the froth after the heater is turned off at 284F, the heater will not be on until it drops below 265 F. Because the delays of heat transfer, the new steam won't come until even lower temperature. When the heater is off, the steam is weak even the temperature reading might be high. The ideal condition to start the frothing is when the heater is on and temperature of the boiler is high. Normally, you should start steaming somewhere around 260-270F during the rise phase of the heating. This temperature range can vary due to the variation of frothing method among the users. Since the controller displays the actual temperature of the boiler, you can find the highest temperature to start frothing without letting the thermostat to turn the heater off until the frothing is finished.