

## SPS(Spark Plasma Sintering) manual

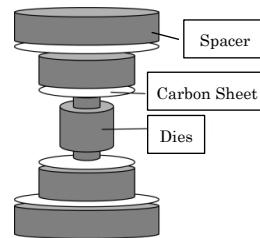
### 【Before Starting Sintering】

Check that the chamber knobs and program settings are correct.

If any abnormalities are found, turn off the SINTER button to stop the operation.

### 【Machine Startup, Sample Installation, and Setup】

1. Turn on the power switch on the back of the main machine.
2. Open the cooling water valve and check that the valve at the bottom of the machine is operating.
3. Turn on the MAIN button (not POWER. If an alarm sounds, press the reset button below TEMP. CONTROL and turn off the MAIN button.
4. Unlock both sides of the chamber and open the vacuum leak valve at the bottom of the machine.
5. After venting, set the chamber knob to CHAMBER & DOWN, and press both two switches
6. Place the dies and the spacers as shown in the figure, aligning the center of the dies with the center of the electrodes.
7. After CHAMBER & UP, continue MAIN & UP until the Z-AXIS POSITION reading stops moving.  
Warning: If the dies are damaged, the Z-AXIS POSITION will suddenly drop. If abnormal noise occurs, check inside the chamber.
8. Close the vacuum leak valve, press VAC. PUMP I → VAC. VALVE to evacuate the chamber.  
Confirm that the vacuum gauge reading decreases.
9. Lock both sides of the chamber.
10. Set the chamber knob to MAIN & UP.
11. Ensure PSET is set to 0.
12. Press CONT on Z-AXIS CONTROL, then set to UP.
13. Set up the pyrometer. Use a light to ensure the reticle is centered on the die hole. Check the movable range to accommodate position changes during sintering. Confirm that it is in continuous measurement mode.

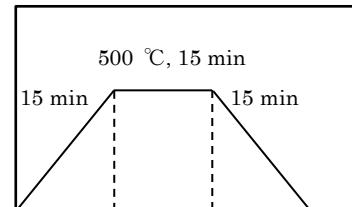


### 【Program Operation】 (Manual operation is described on the following page.)

14. If the pattern display is not "RESET", press RESET.
15. Press MODE → Select MODE 2 → Press SEL.
16. Select the desired PTN number.

\*Example Program:

- STP 0: SV 0000, START, press ENT
- STP 1: SV 0500, TIM 000:15, press ENT
- STP 2: SV 0500, TIM 000:15, press ENT
- STP 3: SV 0000, TIM 000:15, press ENT
- STP 4: SV 0000, TIM END:00, press ENT



17. Press MODE twice.
18. Press FNC (FNC lamp on) → Press PTN to select the desired pattern.
19. Press FNC again (lamp off).
  
20. Set SPS POWER to AUTO and dial value to **8** (max 10 if output is insufficient).
21. Set load using P.SET (ignore decimal point; unit is kgf). The digital display to the left of the knob shows the actual load (not the dial scale).
22. Press the “C” button on Z-AXIS POSITION to reset it.
23. Turn on the PIRANI GAUGE switch; green light should turn on, and vacuum should be below 10 Pa. After confirming, immediately turn the switch off (easily damaged).  
\*Vacuum can reach up to 3 Pa in 2024/10/22.
24. Confirm that the chamber knob is set to MAIN & UP.
25. Perform a final check:
 

Top lamp is OFF (lamp on if error)	Z-AXIS CONTROL: CONT and UP
Z-AXIS POSITION is 0	SPS POWER: AUTO, value 8
Vacuum gauge reads -0.1	PIRANI GAUGE: $\leq$ 10 Pa
SPS PRESSURE matches target	Pyrometer centered on die hole in Continuous measurement mode ("Meas" on screen)

TEMP CONTROL:

  - ① PV  $\approx$  573°C (if not, check pyrometer cable)
  - ② Correct PTN selected
  - ③ In RESET state

26. Turn on the SINTER button to begin sintering.

⚠ If CURRENT exceeds 1000, immediately turn SINTER OFF to stop sintering.

⚠ During sintering, continuously check that the pyrometer reticle is on the die hole and that the pyrometer and PV readings do not deviate.

#### 【Shutdown Procedure】

1. Turn off the SINTER button, set SPS POWER to 0, switch AUTO → MANUAL.
2. Press and hold RESET until the pattern display shows RESET.  
~~~ Let the system cool down for about 1 hour ~~~
3. Press STOP → STEP → Reset P.SET to 0.
4. Press VAC. VALVE → VAC. PUMP I to stop vacuuming, then open the vacuum leak valve.
5. Unlock both sides of the chamber → CHAMBER DOWN.
6. Remove dies, clean the stage and glass window using ethanol.(do not drop powder inside).
7. CHAMBER UP → Lock both sides → Close leak valve → VAC. PUMP I → VAC. VALVE to evacuate chamber again.

20250728 (LMSM · Sei) Removed description related to thermocouples, other corrections

8. Confirm PIRANI GAUGE reads below 10 Pa.
9. Turn off MAIN switch on the front of the machine.
10. Close cooling water valve and turn off power on the back of the main machine.

#### 【Manual Operation】

Follow steps 1–13 and 21–26 in 【Program Operation】

but, in step 7, set SPS POWER to MANUAL and dial value to 0.

27. Gradually increase SPS POWER to raise temperature.
28. Turn the dial 30–50 units at a time so the target temperature is reached in about 15 minutes.  
(Make it so that you can see the temperature rising by 1°C at a time.)
29. CURRENT must not exceed 1000A.
30. Reduce the heating rate near the target temperature.
31. Adjust power to maintain steady temperature during holding period.

#### 【Using the Pyrometer】

\* Pyrometer usually remains powered on.

1. Set up the pyrometer.
2. While pressing Measure, press POWER to turn it on (continuous measurement mode).
3. Press Measure to begin continuous measurement.  
※Ensure “Meas” is displayed at the top-left of the screen.
4. Look through the pyrometer to align the reticle with the die hole  
※Make sure the SPS chamber window is clean. If cloudy, clean it.
5. Before sintering, the temperature is low and “UFL” may be displayed. As the temperature exceeds about 600°C, the temperature will be displayed. If the pyrometer and device temperature readings differ, check for setup errors.