

# SOLID SEED PARTICLE GENERATOR MODEL 9309

APPLICATION NOTE 9309-001 (US)

Solid seed particle generator model 9309 is ideal for dispersing solid particles in order to seed flow fields in high pressure or high temperature environments, like combustion in open flames. This generator uses  $\text{SiO}_2$ ,  $\text{TiO}_2$ , and  $\text{Al}_2\text{O}_3$  dry powders. The generator is designed to be operated at high pressures and it must be kept dry in order for the powders to disperse properly.

The working principle of the generator is the fluidized bed of solid particles (e.g.  $\text{SiO}_2$ ) with a typical size of 0.5 to 1.0  $\mu\text{m}$ . Since the generator can be used in high pressure environments, the input operating pressure ranges up to 16 bar, with outlet pressure ranging up to 8 bar. The seed particle output rate is typically very constant under this type of pressure environment. The powder should also be kept dry to prevent any agglomeration.

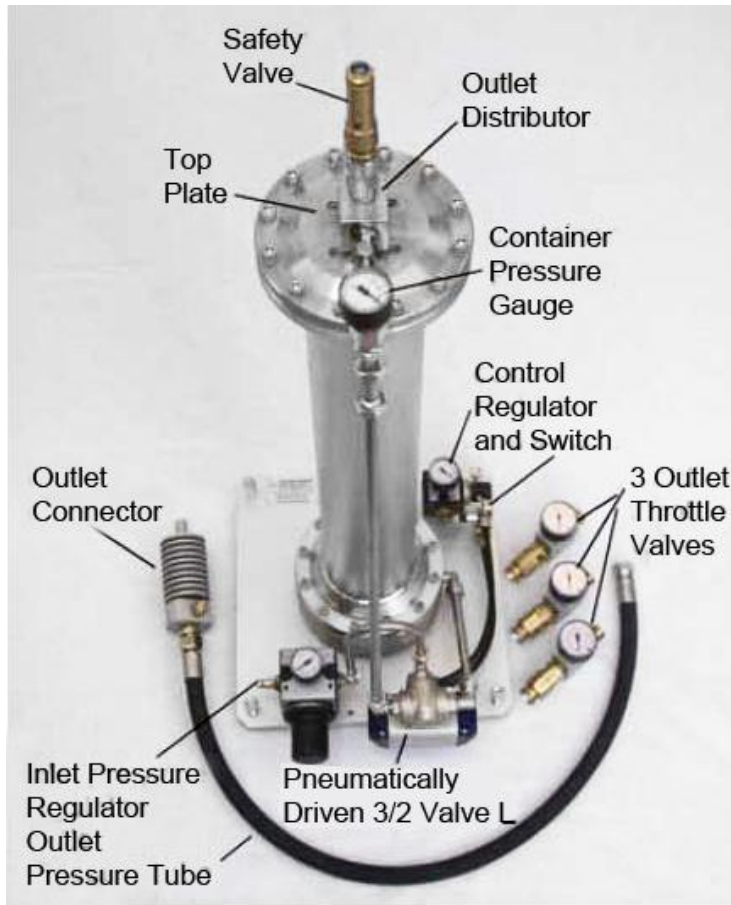


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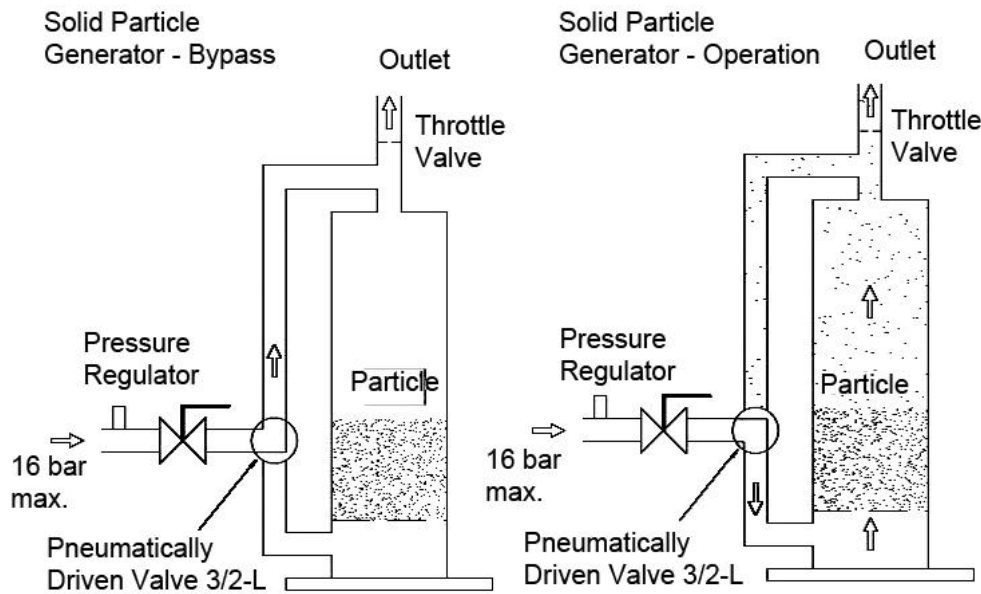
## Operation Instructions

The generator can be filled with a dry powder, like  $\text{SiO}_2$ ,  $\text{TiO}_2$ , or  $\text{Al}_2\text{O}_3$ . The powder level should be in the range between 100mm and 200mm above the container's bottom plate. The inlet pressure ( $P_E$ ) should be adjusted at twice the outlet pressure ( $P_A$ ), which is controlled by each outlet throttle valve as shown in Figures 1 and 2. The outlet pressure must not exceed 8 bar. Two safety valves at the outlet connector (Figure 1) can be adjusted to the maximum outlet pressure for each given experiment. When the container pressure is at least twice the outlet pressure, sonic flow velocity is obtained in the outlet throttle valve. The switch regulates two modes of operation, which controls the pneumatically-driven 2/3 valve (Figures 1 and 2). When switching the control towards the container, the bypass is closed and the air flows through the bottom of the container and through the fluidized bed of particles. The mass flow is limited by the inlet pressure regulator, the outlet throttle valve mounted to the outlet distributor, and the outlet pressure pipe. Sonic air speed in the throttle chops the agglomerates in order to ensure small particle size. When switching the control away from the container, the bypass is open and the same quantity of air leaves the outlet without particles.





**Figure 1: Solid Particle Generator Showing the Various Controls**



**Figure 2: Mode of Operation**

The 3/2 valve can be used to implement a remote control via two flexible pressure tubes with an outer diameter of 8 mm. The pressure range for the control of the valve must be between 5.5 and 10 bar. The pressure attached to the control regulator must not exceed 16 bar.

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## Outlet Throttle Valves

One of the outlet throttle valves must be mounted between the outlet distributor (Figure 1) and the outlet pressure tube. The throttle valve with the smallest cross section is marked “1” and is equivalent to an orifice with a diameter of  $d_a \sim 1$  mm (smallest particle flow rate). The second throttle valve is marked with a “2” and is equivalent to an orifice with a diameter of  $d_a \sim 1.4$  mm. The third throttle valve is marked with a “4” and is equivalent to an orifice with a diameter of  $d_a \sim 2$  mm. Measured values for the mass flow rate at 1 bar outlet pressure can be found in the following table:

Throttle #	Equivalence Diameter $d_e$ in mm	Measured Mass Flow Rate in g/s at $T_1=20^\circ$ , $P_e=2\text{bar}$ , $P_a=1\text{bar}$
1	1	0.30
2	1.4	0.59
4	2.0	1.38

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## Safety Precautions

The solid seeding generator container is made from stainless steel for pressurized operation. The container pressure must never exceed 16 bar. Only dry air must be used for operation. Temperature in the outlet connector and tube must not exceed 30° Celsius.

It is important to operate the generator in a well-ventilated area and make sure that the solid particles will not be inhaled by the operator(s).

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