

# MICRO-SCALE BUBBLE GENERATOR MODEL BG-1000

GENERATE THE IDEAL SEED PARTICLES FOR  
WIND TUNNEL AND AERODYNAMIC FLOWS  
IN PLANAR AND VOLUMETRIC PIV



The Bubble Generator Model BG-1000 is a surfactant/water-based bubble generator (patent pending\*) designed to produce large amounts of bubbles as seed particles for Particle Image Velocimetry (PIV): planar and volumetric, for flow measurements in wind tunnels (opened or closed type) or open environment. The bubbles with mean diameter of 15 microns are excellent to follow the flow, around small structures or in boundary layer, to provide measurement with the highest accuracy and spatial resolution. The high concentration output of  $10^7$  bubbles/s and the long residence time make this generator the best generator for your flow applications.

## Features and Benefits

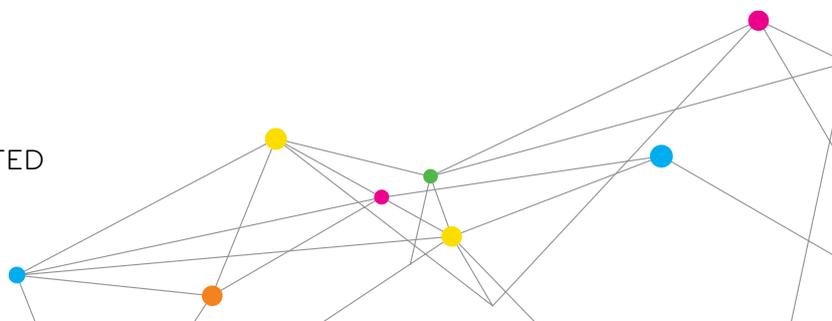
- + Bubbles with size of  $15\mu\text{m}$  and neutrally buoyant in air flow environment
- + Bubbles spherical in shape generating high intensity for large field of view or volume, at magnification of 0.025 or higher, without any glared point
- + Long residence time of more than 30 minutes, making long time duration measurements feasible
- + Short settling velocity of 0.18 mm/s giving the fidelity for the bubbles to follow flow even around small structures
- + High bubble output of more than  $10^7$  bubbles/s and high concentration of 20,000 bubbles/cc at the exit of nozzle, allowing the extraction of the smallest flow structure in your measurements
- + Non-toxics and non-stick on window surfaces due to the low viscosity of the surfactant/water mixture
- + Easy to operation with generator ready to be used in less than 5 minutes
- + Low Cost of operation and ownership with simple and easy maintenance procedure with no extra gas to purchase

## Ideal seed particles for wind tunnel and aerodynamic flows

For wind tunnel and aerodynamic flow measurements, the common seed particles employed are olive oil droplets of 0.5 to 1.0 micron in size. The small size in the olive oil droplets give good fidelity with the flow but the small scattering intensity limits the size of the measurement in both planar and volumetric PIV. The surfactant/water based bubbles with 15 micron mean size remove such limitation, allowing planar PIV measurement with field of view up to 1.5 m by 1.5 m and volumetric PIV with volume size of more than  $6000\text{ cm}^3$ , while having excellent fidelity to resolve small structures of the flow.



UNDERSTANDING, ACCELERATED



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## Applications

- + Wind tunnel flows
- + Airflows in large scale facilities
- + Two phase flows
- + Turbulent boundary layers
- + Flows around airfoil or objects
- + Wake flows

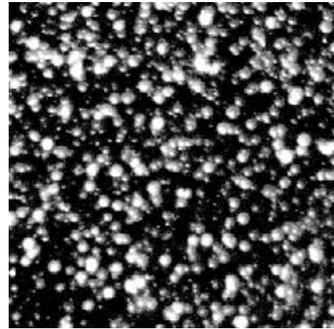
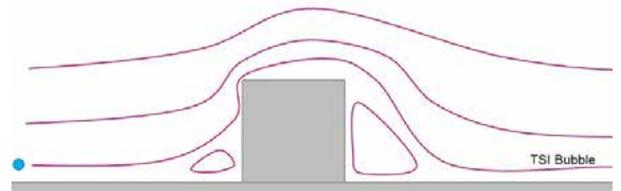


Image of bubbles showing spherical in shape and high intensity



High fidelity to follow the flow even around small structure

## Specifications

**Bubble size**  
15 microns

**Bubble shape**  
Spherical

**Bubble density**  
0.04 g/cc

**Settling velocity**  
0.18 mm/s

**Particle images**  
9-16 pixels Gaussian

**Residence time**  
>30 minutes

**Relaxation time**  
~10s of microseconds

**Bubble output**  
>10<sup>7</sup> bubbles/sec

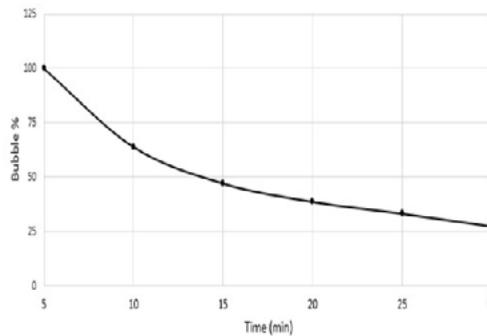
**Number of nozzles**  
10

**Concentration at Nozzle exit (#/cm<sup>3</sup>)**  
10<sup>5</sup>

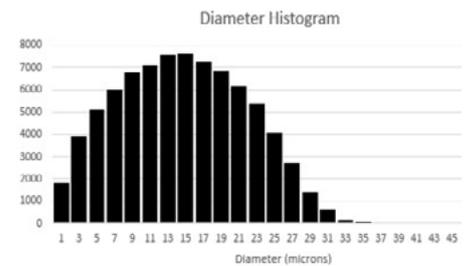
**Operating cost**  
Soap and water solution (<\$20)

**Operation time**  
Solution lasts for more than 8 hours of continuous operation w/o any refill

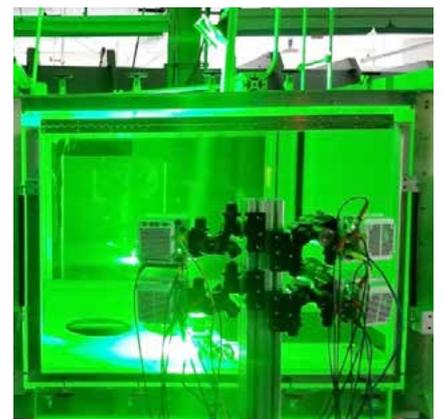
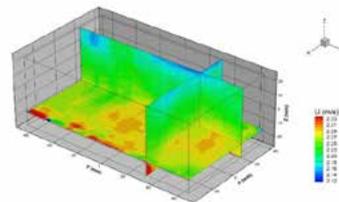
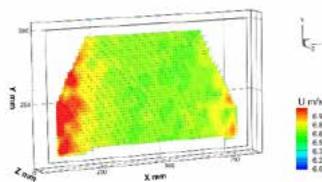
**Upkeep cost**  
\$0



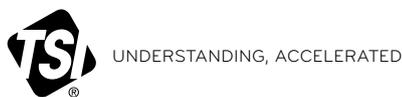
Bubbles with long residence time



Size distribution measured by Phase Doppler system



Volumetric PIV measurements and results in wind tunnel flow



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Patent pending US 2011/0284648 A1

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