

# Basic Lunar Environment Simulator System (BLESS™)

## Introduction of the Basic Lunar Environment Simulator System (BLESS™)

(BLESS™) is designed for pumping out using a single turbo pump, has one door for servicing and installing and replacing samples and a platform for fixing samples, heating and cooling them. This modular design allows to increase the size of the vacuum chamber by adding another vacuum chamber, additional testing equipment and an additional pumping system. The BLESS™ system is designed to use a standard lunar soil/lunar dust simulant, JSC-1AF or similar.

The design of BLESS™ shown in Figure 1 consists of a vacuum chamber that is pumped out by two vacuum pumps (one turbo pump and one scroll pump). Inside the vacuum chamber are:

- Filtration system that protects the pumps from dust ingress;
- Dust source combined with a dust preparation device;
- Two VUV lamps for charging dust using ultraviolet light;
- Heating/Cooling platform for mounting and thermal treatment of samples;
- Or some other device chosen by the Customer.

6" Access Door

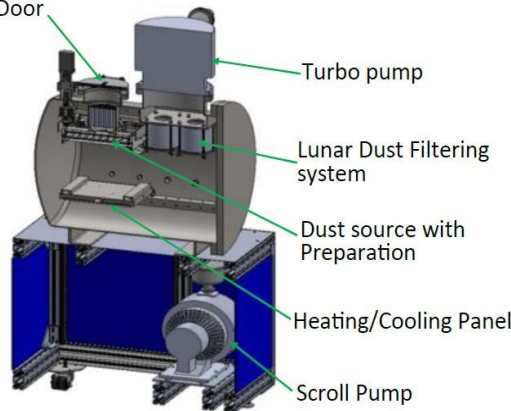
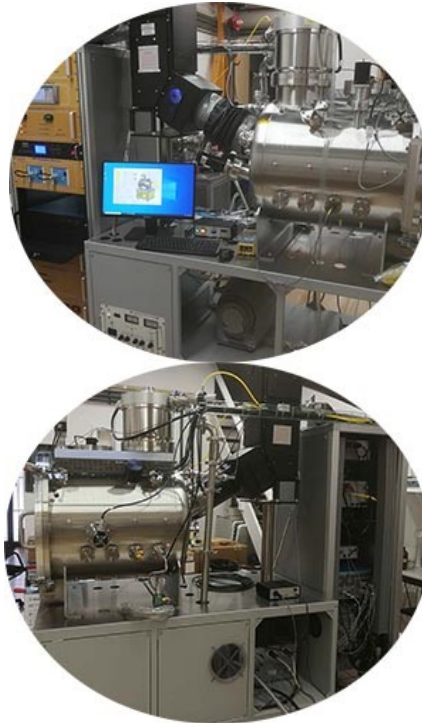


Figure 1: Cross-section view of BLESS™

Table 1. Technical specifications of the BLESS™ system

BLESS™ Parameter	Specification
BLESS™ Dimensions (length x width x height)	4' x 3' x 5'
Pressure in the vacuum chamber (without dust)	5x10 <sup>-7</sup> Torr
Time to reach the working vacuum level	1 hour
Minimum room size for BLESS™	8' x 10' (80sq.ft.)
Electrical Power	One phase, 120V 30A, or 220V 15A
Dimensions of the surface covered with dust	12" x 12"
Uptime before maintenance	40-60 hours

Website: [www.simultek.ca](http://www.simultek.ca); Email: [info@simultek.ca](mailto:info@simultek.ca)



## Lunar Dust Filtering System

The filtering system of the pumped-out air from dust is an extremely important component of any simulator of the lunar environment. The filters should not severely reduce the pumping speed and be able to work for a long time without replacement. Filters should be easily removable and have a reliable dust-proof seal.



Figure 2: Lunar Dust Filtering System

## Dust Source

The dust source consists of two units: a dust preparation unit and the dust sprinkling mechanism. The main advantage of this design is that no separate chamber for preparing the dust is needed (see Figure 3). This is achieved by using a special cellular dust “cleaning” unit being part of the dust source.



Figure 3: Design of Lunar Dust Filtering System. A special cellular dust cleaning system (Top). Dust sprinkling mechanism (Bottom).

Dust sprinkling mechanism is designed so that dust does not spill into the chamber when this mechanism switched off. The dust sprinkling mechanism allows to uniformly cover an area of 12"x12" with dust. Moreover, changing the vibration parameters (frequency, amplitude) can be used to modify and adjust the shape of the dust cloud to the conditions of the experiment.

**Vacuum Tribometer**

Figure 4: Rotating head of tribometer with a plate for heating and cooling the sample



SimulTek is able to offer a unique, vacuum- and dust-compatible tribometer, which allows the abrasive and wear testing per ASTM G65 in a standardized wear test when abrasive lunar or Martian dust simulant is loaded from the dust source and introduced between the specimen and a rotating rubber wheel. Under these conditions, the specimen is subject to constant wear, as the abrasive is pulled between the rubber surface and the surface of the specimen. The specimen is held in contact with the rubber wheel under a constant load, and the sand flows at a constant rate (see Figure 4).

Table 2: Eight main parameters for Vacuum Dust Protected Temperature Tribometer

Main Parameters	SimulTek Tribometer
Vacuum Rate	10 <sup>-8</sup> mbar
Friction Force Range	0.01-15N
Rotating Speed Range	0.1-800rpm
Radius	0.1mm-40mm
Maximum Torque	850mN.m
Wear Depth	Up to 2.5mm
Temperature Range	-90°C ≤ T ≤ 150°C
Dust protection Rate	100%

**Heating/Cooling**

Figure 5: Heating and cooling plate



The Heating/Cooling Platform is an ultra-high vacuum set-up installed inside the simulator chamber and designated for sample holding and fast sample exchange. Differences in technical specifications of the platforms can be seen from Table 3.

Table 3: Specifications of Heating/Cooling Platforms

Parameter	Stainless Steel Platform	Aluminum Alloy Platform
Temperature range, C <sup>0</sup>	150≤T≤450	150≤T≤200
Temperature rate, C <sup>0</sup> /min	3-4	6-10
Dimensions used for the samples placing, inch	16x12	12x12
Temperature control accuracy	±1	±3
Electrical Power, kW	1.5	1.0
Weight, kg	23	12

**Summary**

The BLESS™ system is a new generation lunar environment simulator offered by SimulTek. This conclusion can be made thanks to new solutions that have not yet been used on other models of the lunar environment simulators. These solutions include primarily the following:

- Lack of an additional chamber for dust preparation and a gate valve between it and the main vacuum chamber.
- Application of a new filtration system to protect vacuum pumps from dust ingress. This system is compact, fully dust-proof and easy to service.
- The ability to use a unique vacuum tribometer that has no analogues in the world.
- Use of a self-cleaning sample holder.

This allowed to create an inexpensive, compact, and reliable system, which is the BLESS™.