VACUSHUT, A PRESSURE DEPENDENT SELF-OPENING AND 
-CLOSING VACUUM CONTAINER FOR SAMPLES WHICH ARE 
SENSITIVE TO THE ATMOSPHERE

Ref-No: TA-11/110TLB

BACKGROUND

Materials that are sensitive to the atmosphere are used in a multitude of areas, 
for example in battery and fuel cell technology, photovoltaics, bio-hazardous 
materials, sensor materials, optical components, in genetics and medicine, 
nuclear technology etc. To analyze for example the quality of such materials, it is 
necessary to introduce a sample that has been manufactured under vacuum or 
an inert gas atmosphere into a measurement chamber of the analytical 
instrument.

PROBLEM

Introducing the sample into the measurement chamber usually requires a 
complicated air-lock arrangement or manipulator which generally costs several 
tens of thousands of dollars. Alternatively, the sample has to be exposed to the 
atmosphere for at least a short period before the analytical instrument can re-
establish a vacuum. This makes it often impossible to obtain reliable 
measurement results because the sample, particularly on its surface, will have 
commenced to deteriorate.

SOLUTION

A novel device for handling samples sensitive to the atmosphere has been 
developed at the Karlsruhe Institute of Technology (KIT). It allows samples 
prepared under vacuum or inert gas atmosphere to be stored safely for 
introduction into the measurement chamber of an analytical instrument. The 
device opens and closes itself automatically in response to external atmospheric 
pressure (vacuum) or temperature. This makes it possible to introduce the 
sample into the measurement chamber without air contact. A complex and 
expensive air-lock or manipulator is thus not required.

Simplified, the vacuum box consists of a lid, expansion device, spiral spring and 
base plate with sealing ring (see figure). 
Under normal conditions (one bar atmospheric pressure, normal room
(temperature) the lid (1) of the vacuum box containing the sample (not shown) is closed (picture on the right). The expansion device (2) is relaxed and the lid is pressed down against the sealing ring (5) on the base plate (4) by means of a spiral spring (3). By means of the spindle (6) of the hinge assembly the lid closes parallel to the base plate and the sealing ring in such a way as to seal the space hermetically. The vacuum box can then safely be transported and introduced into the measuring chamber of the analytical instrument.

The expansion device (2) is made of a gas-impermeable, closed membrane containing a small quantity of fluid, e.g. water/alcohol. As the vacuum is being created in the measuring chamber, the fluid in the expansion device starts boiling, increasing its volume more than a thousand times. The expansion device expands (in volume) which makes it contract lengthwise so that the lid is pulled open. The measurement can now take place.

When the vacuum is removed, e.g. by introducing an inert gas into the measuring chamber, the expansion device deflates, reduces its pulling force and the lid of the vacuum box is closed by the spiral spring. The reduced pressure remaining in the vacuum box, which corresponds approximately to the evaporation pressure of the fluid within the expansion device, results in an increased closing force between the lid and the base plate. The vacuum box closes again. A manual valve (not shown) to equilibrate the pressure between the inside of the vacuum box and the outside environment can be installed at a suitable position. Additionally, a locking mechanism can also be installed. The opening and closing can be repeated at will. Depending on the fluid used and by modifying pressure and/or temperature it is possible to control the closing and opening. The base plate can be heated.

---

ADVANTAGES

- Simple and cost effective construction
- Reusable
- Functions in any vacuum chamber
• Hermetically sealed and vacuum stable
• Independent automatic and reversible opening and closing of container
• Action adjustable to suit specific requirements
• Can be heated

SCOPE OF APPLICATION

Measurement of samples sensitive to the atmosphere without degradation of the sample due to exposure to the atmosphere.

SERVICE

The Technologie-Lizenz-Büro GmbH is charged with the commercialization of this innovation and now offers companies the opportunity to obtain a license to exploit this new and promising technology.