THE HONG KONG POLYTECHNIC UNIVERSITY 香港理工大學

PolyU Technology & Consultancy Company Limited 理大科技及顧問有限公司

CONSULTANCY SERVICE

FOR

YORK INTERNATIONAL (NORTHERN ASIA) LTD.

Antibacterial Study of Nano Technology Coated Titanium Dioxide Device
Project No. P04-0521

Prepared by:

Dr. Li Chi Kwong
Dept. of Electronic & Info. Engineering
The Hong Kong Polytechnic University

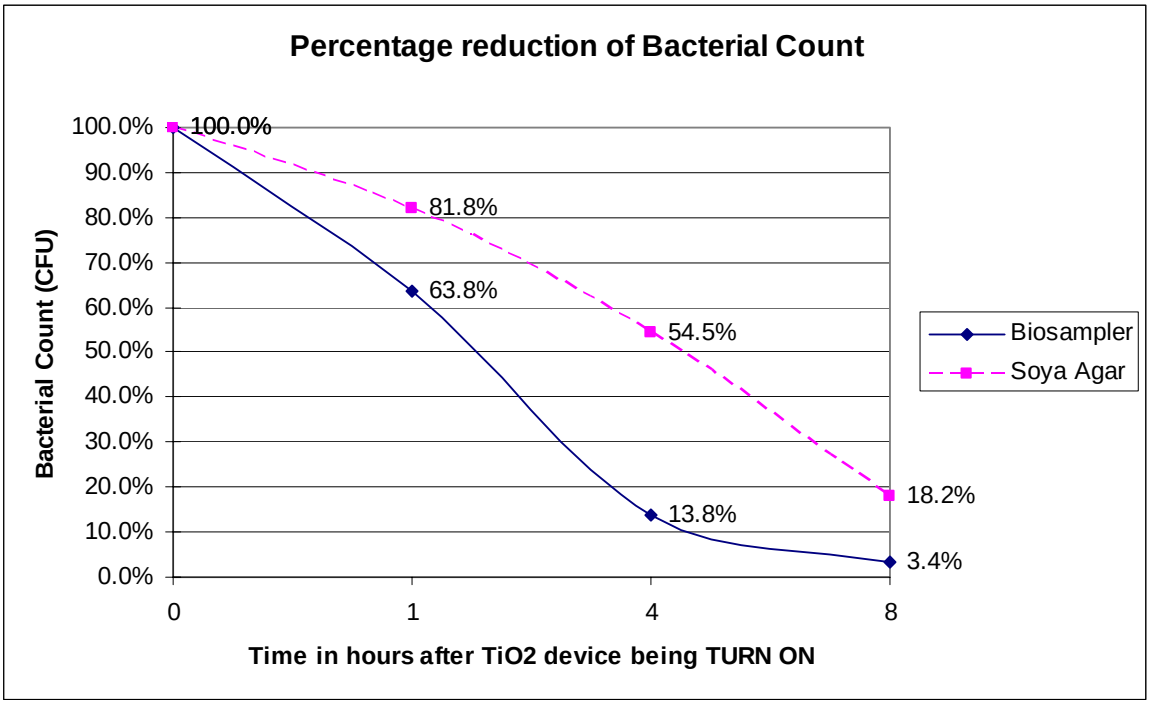
ANTIBACTERIAL STUDY OF NANO TECHNOLOGY COATED TITANIUM DIOXIDE DEVICE

Prepared
by
Ir Dr Chi Kwong LI,
CEng, FIEE, MIMechE, FHKIE, RPE(CAI, ENS, INF, MCL)

CONTENTS

I. REPORT SUMMARY

The experimental result indicated that the titanium dioxide device is an effective air purification device which can reduce the bacterial count to 43% and 3% after being turn on for 2 and 8 hours respectively. The effectiveness of the titanium dioxide device can be demonstrated by the following graph and the detail result is presented in section V. of this report.



II. INTRODUCTION

This is a test report by Dr. C. K. Li on the test conducted on the 25 March 2005. This report is a record and findings of the Indoor Air Quality in Room LG110, K. K. Leung Building, The Hong Kong University. (Refer to Annex A for detail site location.)

The test is conducted to investigate the effectiveness of the York's Titanium Dioxide (TiO2) Devices which are fitted inside the air ventilation system of the above test site. The principle of the test is based on the bacteria count, i.e. as recommended in "BS EN14583:2004 - Workplace atmospheres - volumetric bioaerosol sampling".

III. MEASUREMENT INSTRUMENT AND PARAMETERS

1. SKC VAC-U-GO Sampling Pump model 228-9605B
2. SKC BioSampler model 225-9594B
3. HOBO Data Loggers, model U12-013
4. Soya Agar based sampling discs.
5. IBM 570E computer with GreenLine™ Software and USB interface.

IV. METHODOLOGY

1. Test was conducted according to the recommendation in the following standards as far as possible

   a. GB/T18883-2002, Indoor Air Quality Standard (中华人民共和国国家标准).

   b. BS EN14583:2004, Workplace atmospheres – volumetric bioaerosol sampling devices – Requirements and test methods.

   c. BS EN13098:2001, Workplace atmosphere – Guidelines for measurement of airborne micro-organisms and Endotoxin.

2. The test was to collect sufficient samples for bacteria counts with and without the TiO_2 being turned on. Two different sampling methods were used simultaneously, for backup as well as for comparison purposes. The first method is based on a set of sampling pump and sampler. The second method is based on free falling of bacteria on a Soya based agar disc.

3. For the first sampling method, air was forced into a sampler using a sampling pump. Refer to Annex C and D for detail. The flow rate of air was set at the maximum for the Biosampler at 12.4 liter/minute. A 30 minutes sampling is equivalent to approximately 370 liter of air. Two samples were taken for a 30 minutes period with the TiO_2 device not being turned on. Then four other samples were taken for the same duration after the TiO_2 device being turned on for 1/2/4/8 hours respectively

4. For the second sampling method, two identical agar discs were placed near the air path for 60 minutes with the TiO_2 device not being turned on and 30 minutes coincided with the first and last samples of the first sampling method with the TiO_2 filter being turned on.

5. Samples collected were placed into an incubator for a period of 3 days, followed by the bacteria count on each of the sample. The results of the counts were recorded as the following section (Section V.).

V. MEASURED RESULT AND CONCLUSION

After collecting the specimens, the collected samples were incubated at 30 degree C for 3 days and the bacterial count in colony forming unit (cfu) was performed. The counting result is presented in the following subsection V.1.

V.1 Bacteria Counts

Method 1 – using Air pump and Biosampler at 12.4 l/min.

Status of TiO_2 Filter	Sample number	Time after the Filter being turn on	Bacteria Counts (CFU) in 30 minutes sample	Percentage of reduction
OFF	Sample 1	-	69	-
	Sample 2	-	47	-
	Average	-	58	-
ON	Sample 1	1.0 hour	37	36.2%
	Sample 2	2.0 hours	25	56.9%
	Sample 3	4.0 hours	8	86.2%
	Sample 4	8.0 hours	2	96.6%

Method 2 – Free falling on soya agar discs

Status of TiO_2 Filter	Sample number	Time after the Filter being turn on	Bacteria Counts (CFU)	Percentage of reduction
OFF	1	-	11	-
ON	2	1.0 hour	9	27.3%
	3	2.0 hours	6	45.5%
	4	8.0 hours	2	81.8%

Signature:

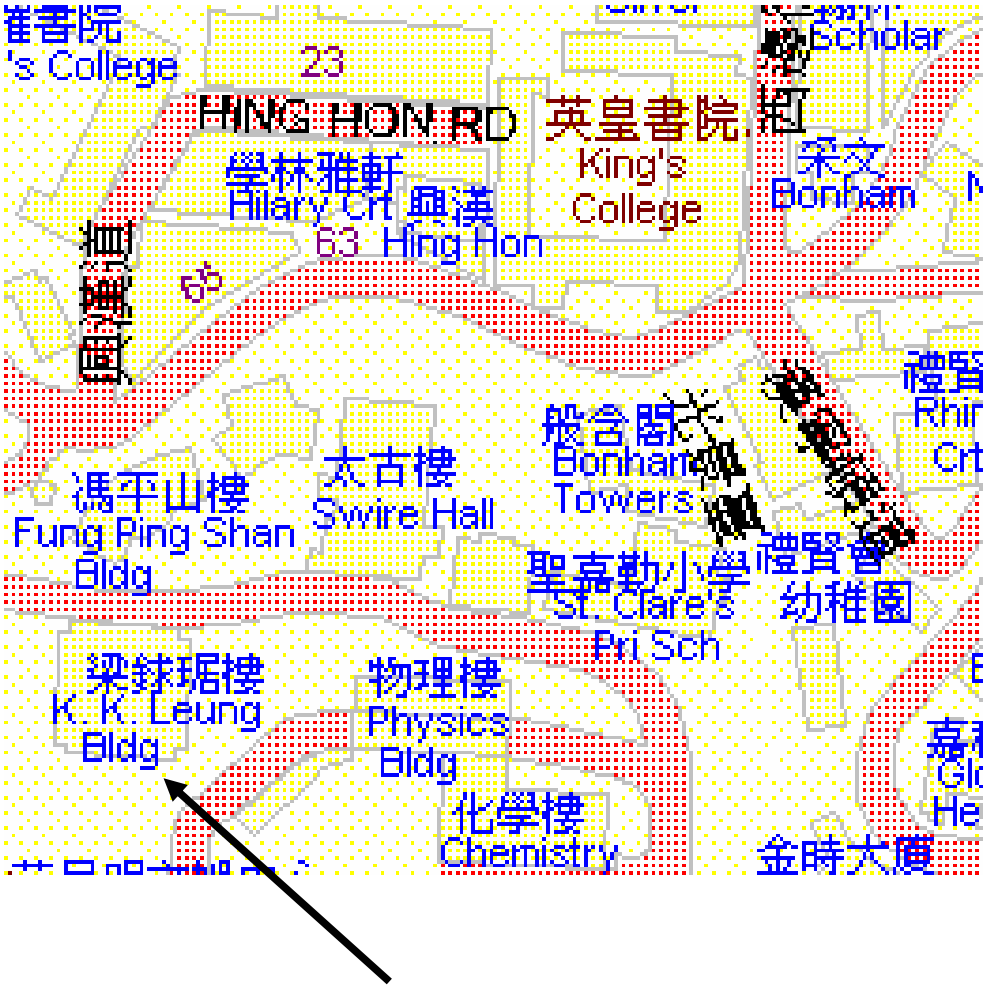
Date: April 7, 2005

Disclaimer

The set of analysis results presented herein this report are prepared to the best of PTeC's knowledge and integrity. Under no circumstances shall PTeC or the project team compensate for loss sustained by its client or any other third parties as a result of any errors or omissions.

VI. ANNEX A-E

Annex A. Location of Test Site



Test Site (Room LG 110 inside K. K. Leung Building)

Annex B. Photos of the Lecture Room LG110

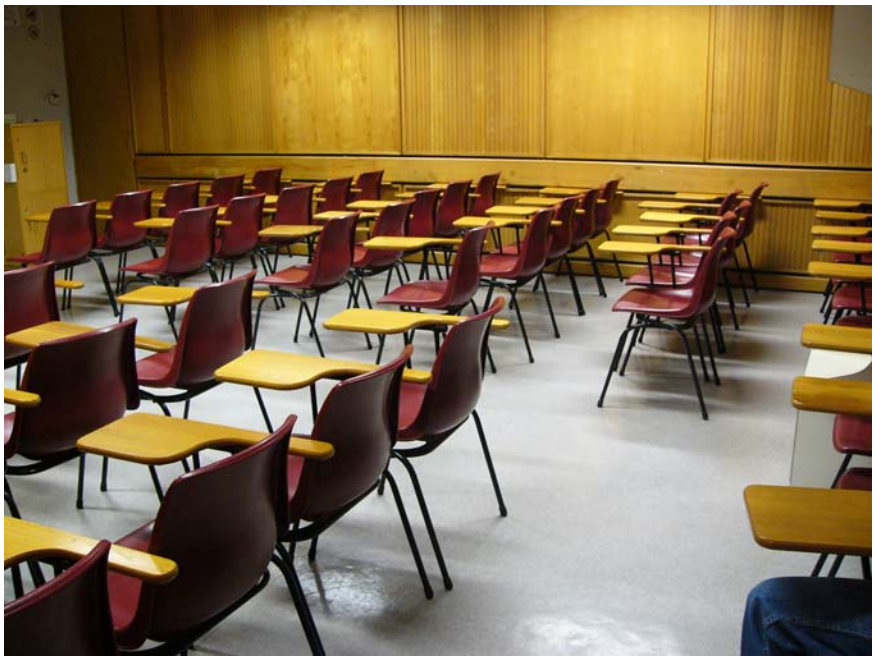
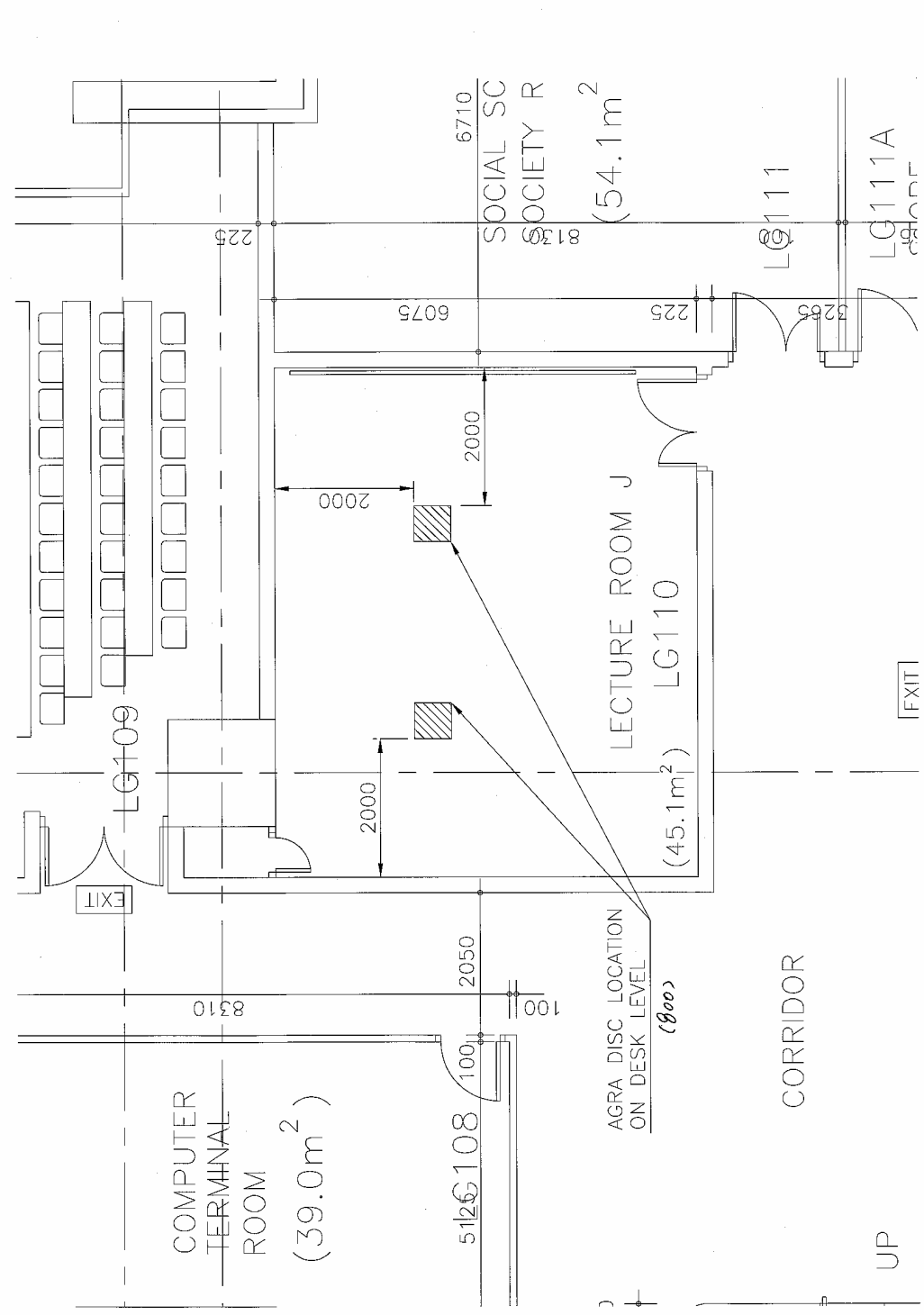


Photo B.1 Test Site (reference KK_LG110_1.jpg)

Photo B.2 Test Site (reference KK_LG110_2.jpg)

Annex C. Approximate Location of Agar Discs



Annex D. Detail of BioSampler

Description

The patented* SKC BioSampler is a highly efficient bioaerosol and biologically inert airborne particle collection device that traps airborne microorganisms into swirling liquid for subsequent analysis. The BioSampler is made of glass and consists of three parts: inlet, nozzle section (with three tangential sonic nozzles), and collection vessel (Figure 1). The collection vessel can be filled with a liquid collection medium or coated with a sticky medium. The BioSampler can be used with water or non-evaporating liquids up to 1,000 times more viscous than water for sampling up to eight hours. The BioSampler requires a high-volume sonic flow pump such as the SKC VAC-U-GO Sampler.

Performance Profile

Flow rate:	Approximately 12.5 L/min
Medium:	Water or more viscous liquids such as ViaTrap® mineral oil
Collection Efficiency:	Nearly 100% over a wide range of particle sizes; decreases to approximately 90% at 0.5 µm.
Pump:	Sonic flow pump such as the SKC VAC-U-GO Sampler

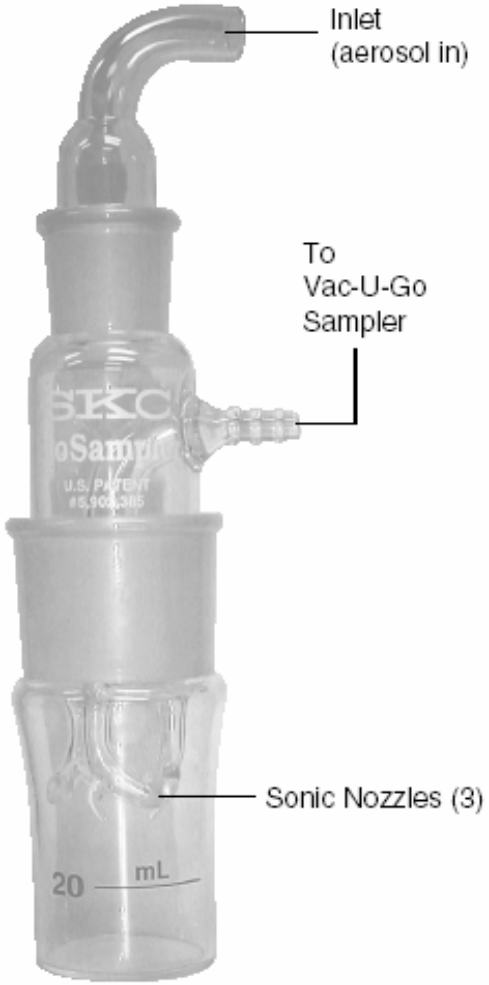


Figure 1. BioSampler with 20 ml vessel (5 ml vessel available)

*Patent Nos. 5,902,385 and 5,904,752

1


SKC
U.S. PATENT

Annex E. Detail of VAC-U-GO Sampling Pump

Operating Instructions

863 Valley View Road, Eighty Four PA 15330 USA
skctech@skcinc.com

VAC-U-GO® Sampling Pump
Catalog No. 228-9605 (120V, 60 Hz)
228-9605B (240V, 50 Hz)

The VAC-U-GO non-compensating vacuum pump is a rotary vane-type pump that provides flows up to 30 L/min and maintains sonic flow when used with a critical orifice. AC-powered and portable, the VAC-U-GO Sampling Pump can be used for a variety of ambient and indoor air sampling applications including asbestos, bioaerosol, stack, VOC, and fenceline monitoring. It is ideal for sampling bioaerosols using the SKC BioSampler or the AGI-30 Impinger.

The line-operated VAC-U-GO Sampling pump has a permanently lubricated motor that is mounted in a housing with a vacuum pressure gauge to indicate sonic flow and a throttling valve to adjust flow. Both models are supplied with an extension rod for mounting media and a power cord. Critical orifices in flow rates ranging from 2 to 12 L/min are available as accessories. No critical orifice is needed if using the VAC-U-GO Sampler with the SKC BioSampler.

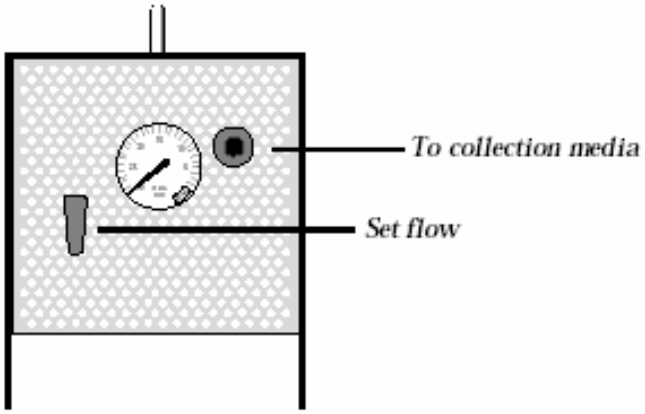
Performance Profile

Flow range:	Free air flow up to 30 L/min Sonic flow 5 to 13 L/min dependent on critical orifice
Accuracy:	±5% of specified flow rate with orifice at room temperature and no sample medium in place.
Motor:	Permanently lubricated
Power:	120 V, AC, 60 Hz (Model 228-9605) 240 V, AC, 50 Hz (Model 228-9605B)
Size:	5.5 x 10.5 x 6.5 inches (13.9 x 26.7 x 16.5 cm)
Weight:	12 lbs (5.4 kg)

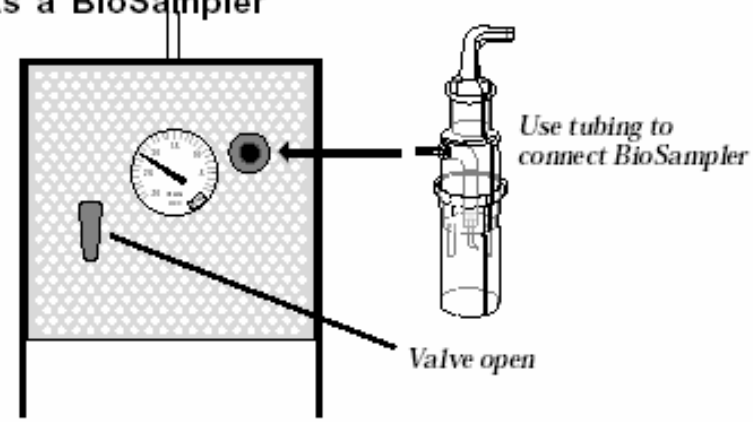
Three Modes of Operation

Caution: Use only a three-wire grounded cable.

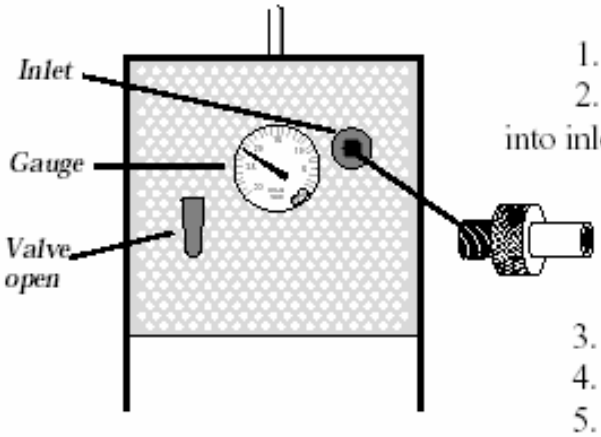
1. As a Vacuum Sampling Pump in Non-compensating Mode



2. As a BioSampler*



3. As a Sonic Sampler (*Orifice Accessory Required*)*



1. Remove inlet.
2. Select and thread orifice into inlet.
3. Reinsert inlet.
4. Valve should be open.
5. Gauge should read between 15 and 30.


SKC
Air Sampler
Cat. No. 228-9605B
SKC Inc. Eighty Four, PA