

TEST REPORT: 7191011687-CHM11-CYT

Date: 05 AUG 2011

Tel: +65 68851214 Fax: +65 67784301

Client's Ref:

Email: yan-thim.choong@tuv-sud-psb.sg

Note: This report is issued subject to TÜV SÜD PSB's "Terms and Conditions Governing Technical Services".
The terms and conditions governing the issue of this report are set out as attached within this report.



PSB Singapore

Choose certainty.
Add value.

SUBJECT

Indoor air quality assessment was conducted for German European School Association Singapore

CLIENT

German European School Association Singapore
72 Bukit Tinggi Road
Singapore 289760

Attn: Mr Carlos Ong

TEST DATE

29 Jul 2011

SAMPLING LOCATIONS

The indoor air quality monitoring was conducted at the air conditioned areas. The sampling locations are labelled as '1' to '3'.

Sampling Point	Sampling Location
1	Room I104
2	Room I105
3	Room I106



TÜV SÜD PSB

Laboratory:
TÜV SÜD PSB Pte. Ltd.
No.1 Science Park Drive
Singapore 118221

Phone : +65-6885 1333
Fax : +65-6776 8670
E-mail: testing@tuv-sud-psb.sg
www.tuv-sud-psb.sg
Co. Reg : 199002667R

Regional Head Office:
TÜV SÜD Asia Pacific Pte. Ltd.
3 Science Park Drive, #04-01/05
The Franklin, Singapore 118223
TÜV[®]



METHODS OF TEST

Grab samples were collected and tested for parameters as given in the Guidelines for Good Indoor Air Quality in Office Premises:

I. Specific Indoor Air Contaminants:

Carbon dioxide (CO₂), ppm

The carbon dioxide content was monitored by means of an Indoor Air Quality Monitor. Instant readings were recorded and the average was reported.

Carbon monoxide (CO), ppm

The concentration of carbon monoxide was determined by means of a Tetra Multigas Monitor with CO Sensor. Instant readings were recorded and the average was reported.

Formaldehyde (HCHO), ppm

The concentration of formaldehyde was determined by means of a Formaldemeter 400. Instant readings were recorded and the average was reported.

Ozone (O₃), ppm

The concentration of Ozone in air was measured by means of an Eco Sensor Ozone Monitor. Instant readings were recorded and the average was reported.

II. Specific Classes of Contaminants:

Suspended particulate matter, µg/m³

The respirable suspended particulate was measured by means of a Grimm Portable Monitor at 10 µm size.

Volatile organic compounds (TVOCs), ppm

The total volatile organic compounds were determined by means of a Portable Photo-ionization Detection System with a 10.6eV lamp.

Total bacterial and fungal counts, cfu/m³

The indoor air was sampled by means of a Bio-test RCS Centrifugal Air Sampler at a sampling volume of 160 litres. The agar strips were incubated and the amount of colony forming units was determined.

III. Specific Physical Parameters:

Relative Humidity and Temperature

The relative humidity and the air temperature were measured by means of a QUESTemp 32 Thermal Environment Monitor.

Air movement

The air velocity was measured by means of an anemometer.

TEST REPORT: 7191011687-CHM11-CYT
05 AUG 2011



PSB Singapore

RESULTS

Test Parameter		Point 1 Room I104	Point 2 Room I105	Point 3 Room I106	Guideline values
Time of measurement,	hr	1315	1334	1353	-
Temperature,	°C	25.9	24.5	24.8	22.5 – 25.5 °C
Relative humidity,	%	65	72	78	≤ 70
Average air velocity,	m/s	0.21	0.24	0.24	≤ 0.25
Carbon monoxide,	ppm	< 1	< 1	< 1	9 ⁺
Carbon dioxide,	ppm	700	425	425	1,000 ⁺
Ozone,	ppm	< 0.01	0.01	0.01	0.05 ⁺
Total volatile organic compounds,	ppm	0.5	0.6	0.6	3
Suspended particulate matter,	µg/m ³	11	10	11	150
Formaldehyde,	ppm	0.02	0.02	0.02	0.1 ⁺
Total bacterial counts (TSA, 35°C 48 hours),	cfu/m ³	160	310	240	500
Total fungal counts (RBA, 25°C 5 days),	cfu/m ³	88	130	180	500

Note: TSA - Tryptone Soya agar
RBA - Rose Bengal Agar
< - Less than
+ - Denotes guideline values for 8-hr averaging time. The results for these parameters were obtained based on instantaneous measurement. Therefore the results are not strictly comparable to guideline values and should be used as an estimate only.



CONCLUSION

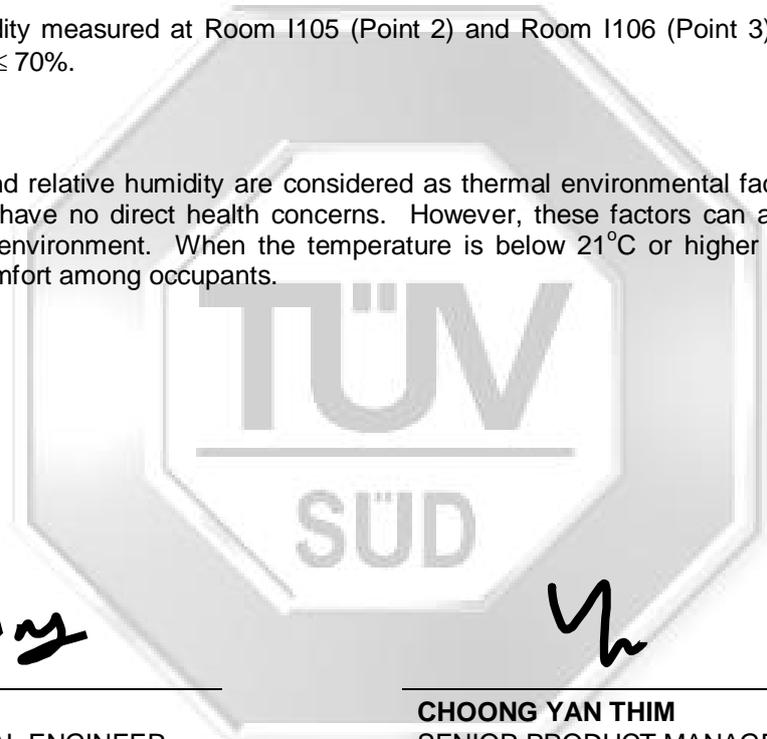
Generally, most of the results were within the acceptable values of Guidelines for Good Indoor Air Quality in Office Premises. The parameters where the values were not within the range or exceeded the acceptable values are highlighted below.

Air Temperature and relative humidity

The air temperature tested at Room I104 (Point 1) was found to be 25.9°C, which is not within the acceptable range of 22.5° C to 25.5° C for air-conditioned office.

The relative humidity measured at Room I105 (Point 2) and Room I106 (Point 3) had exceeded the guideline value of $\leq 70\%$.

Air temperature and relative humidity are considered as thermal environmental factors. They are not air pollutants and have no direct health concerns. However, these factors can affect an occupant's perception of the environment. When the temperature is below 21°C or higher than 27°C, it could cause some discomfort among occupants.



Huang

NG KIAN HOCK
ENVIRONMENTAL ENGINEER

Yh

CHOONG YAN THIM
SENIOR PRODUCT MANAGER
ENVIRONMENTAL MONITORING
CHEMICAL & MATERIALS

APPENDIX 1

GUIDELINES FOR GOOD INDOOR AIR QUALITY IN OFFICE PREMISES

Table 1 - Guideline maximum concentrations for specific indoor air contaminants

Parameter	Averaging time	Limit for acceptable indoor air quality
Carbon dioxide, ppm	8 hours	1000
Carbon monoxide, ppm	8 hours	9
Formaldehyde, ppm	8 hours	0.1
Ozone, ppm	8 hours	0.05

Note: The guidelines specified have a wide margin of safety such that even if they are exceeded occasionally, toxic effects are unlikely to occur.

Table 2 - Recommended maximum concentrations for specific classes of contaminants

Parameter	Limit for acceptable indoor air quality
Suspended particulate matter, $\mu\text{g}/\text{m}^3$	150
Volatile organic compounds, ppm	3
Total bacterial count, CFU/m^3	500
Total fungal count, CFU/m^3	500

Table 3 - Guideline values for specific physical parameters

Parameter	Range for acceptable indoor air quality
Air temperature, $^{\circ}\text{C}$	22.5 - 25.5
Relative humidity, %	≤ 70
Air movement *, m/s	≤ 0.25

* At workstation within occupied zone

APPENDIX 2

SOME COMMON INDOOR AIR CONTAMINANTS

1. Carbon dioxide

Carbon dioxide is present in the unpolluted atmosphere at a concentration of about 0.03% but since about 5% of the air we breathe out are carbon dioxide, the level increases in inadequately ventilation occupied rooms. The level of carbon dioxide is therefore often used to assess the efficiency of ventilation. Outside sources include vehicle exhaust fumes or other exhausts.

2. Carbon monoxide

Any process of combustion can produce carbon monoxide, including cooking and tobacco smoking. A major source of carbon monoxide is vehicle exhaust.

3. Formaldehyde

Formaldehyde is a colourless gas with a pungent odour. It is found in hundreds of different products, including insulation material, ceiling tiles, particle board, plywood, office furniture, carpet glues, various plastic, synthetic fibres in rugs, upholstery and other textiles, pesticides, paint and paper. Levels of emission increase with temperature.

4. Ozone

Ozone is naturally present in the air since it is produced from oxygen by ultraviolet radiation. However, it can also be produced by electrical discharges and is emitted by some items of electrical equipment such as photocopiers and electrostatic precipitator devices used to clean the air by removing dust.

5. Suspended particulate matter

Respirable particles, released from incomplete combustion, can deposit in the respiratory tract or lungs depending upon the size of the particles. Indoor air particulate may come from outdoor or indoor sources. Respirable particulate (10 micrometers and smaller) are those that can penetrate into the lungs.

6. Volatile organic compounds

Volatile organic compounds are found in tobacco smoke, solvents, inks, glues, paints, room deodorizers, photocopier toners and other organic products used in offices. Furnishings such as carpets and furniture also emit volatile organic compounds.

7. Biological contaminants

Biological contaminants include bacteria, fungi, viruses, algae, insect parts, and dust, which may result in allergenic or pathogenic reactions. There are many sources for these pollutants: pollens from outdoors, viruses and bacteria from humans, hair and skin flakes from household pets, etc.

Many biological pollutants can multiply in standing water, in cooling towers, in water-damaged ceilings, walls, and carpets. Biological pollutants may be distributed through HVAC system.

TEST REPORT: 7191011687-CHM11-CYT
05 AUG 2011



PSB Singapore

This Report is issued under the following conditions:

1. Results of the testing/calibration in the form of a report will be issued immediately after the service has been completed or terminated.
2. Unless otherwise requested, this report shall contain only technical results carried out by TÜV SÜD PSB. Analysis and interpretation of the results and professional opinion and recommendations expressed thereupon, if required, shall be clearly indicated and additional fee paid for, by the Client.
3. This report applies to the sample of the specific product/equipment given at the time of its testing/calibration. The results are not used to indicate or imply that they are applicable to other similar items. In addition, such results must not be used to indicate or imply that TÜV SÜD PSB approves, recommends or endorses the manufacturer, supplier or user of such product/equipment, or that TÜV SÜD PSB in any way "guarantees" the later performance of the product/equipment. Unless otherwise stated in this report, no tests were conducted to determine long term effects of using the specific product/equipment.
4. The sample/s mentioned in this report is/are submitted/supplied/manufactured by the Client. TÜV SÜD PSB therefore assumes no responsibility for the accuracy of information on the brand name, model number, origin of manufacture, consignment or any information supplied.
5. Additional copies of the report are available to the Client at an additional fee. No third party can obtain a copy of this report through TÜV SÜD PSB, unless the Client has authorised TÜV SÜD PSB in writing to do so.
6. TÜV SÜD PSB may at its sole discretion add to or amend the conditions of the report at the time of issue of the report and such report and such additions or amendments shall be binding on the Client.
7. All copyright in the report shall remain with TÜV SÜD PSB and the Client shall, upon payment of TÜV SÜD PSB's fees for the carrying out of the tests/calibrations, be granted a license to use or publish the report to the third parties subject to the terms and conditions herein, provided always that TÜV SÜD PSB may at its absolute discretion be entitled to impose such conditions on the license as it sees fit.
8. Nothing in this report shall be interpreted to mean that TÜV SÜD PSB has verified or ascertained any endorsement or marks from any other testing authority or bodies that may be found on that sample.
9. This report shall not be reproduced wholly or in parts and no reference shall be made by the Client to TÜV SÜD PSB or to the report or results furnished by TÜV SÜD PSB in any advertisements or sales promotion.
10. Unless otherwise stated, the tests were carried out in TÜV SÜD PSB Pte Ltd, No.1 Science Park Drive Singapore 118221.

March 2010