

## **REPORT**

**describing**

### **Measurements of solvent concentrations in the atmosphere surrounding a Labelling Device -Type IPC/IPS**

Client: Leica Microsystems Nussloch GmbH  
Heidelberger Straße 17 - 19  
69222 Nussloch

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## TABLE OF CONTENTS

	Page
<b>1 Preface and definition of the assignment</b>	<b>3</b>
<b>2 Description of the Labelling Unit</b>	<b>3</b>
<b>3 The testing procedure</b>	<b>4</b>
<b>4 The measurement procedure and the equipment used</b>	<b>5</b>
<b>5 Material Characteristic Values</b>	<b>5</b>
<b>6 Results obtained</b>	<b>6</b>
<b>7 Assessment and Summary</b>	<b>7</b>
<b>8 Appendix - Photographs</b>	<b>8</b>

## **1 Preface and definition of the assignment**

The Leica Microsystems Nussloch GmbH, Heidelberger Straße 17 - 19 of 69222 Nussloch commissioned DEKRA Umwelt GmbH, Messstelle für Gefahrstoffe, to undertake the determination of the ambient concentrations of 1-methoxy-2-propanol in the atmosphere generated by the operation of a printing unit. The specific objective was to determine the mean exposure level over a working shift which results from normal operation of the equipment.

A further agreed requirement was to investigate the worst-case situation in the atmosphere of the workroom if, as the result of a mishap, the entire contents of the ink container escaped into the base area of the unit housing.

The measurement programme was discussed in advance with Mr. Laudat.

## **2 Description of the Labelling Unit**

The printer is used to label cassettes or glass slides for medical purposes with e.g. patient data. The cassettes are loaded into a tower-like unit (Load Station) from which they slide down a chute into a securing clamp and then move under the printing head to undergo the printing operation.

After this, they are released from the securing clamp and moved into the Drying Station. This hot air unit serves as pre-drying stage which provides a temperature of 42°C over a period of 3 secs. The greater part of the hot air is removed by suction and blown down to the base plate of the printer. After the pre-drying treatment the cassettes are then exposed to a Xenon-flash to effect complete drying by UV- and IR radiation. Finally the fully-dried cassettes are ejected through a flap. The output of the printer is approximately one cassette every 5 seconds.

The printer is provided with a cartridge which contains 210 ml of ink. At an above-average operation, the mean level of output consumes a little less than 5 ml of ink a day. The printing ink is supplied by Xennia Technology Ltd., UK; the product designation is GAF63 and the main constituent of the ink is 1-methoxy-2-propanol to the extent of between 50 and 70%.

After some 20 cassettes have been printed, the print quality deteriorates and consequently both the printing head and the nozzle are then cleaned by sucking ink through the printing head. This procedure takes place automatically with the ink being pumped back into the ink cartridge in order that it can be used again. The ink cartridge is provided with a minute breathing hole so that any air which is pumped into the cartridge may escape from it.

If a large number of cassettes are to be printed without interruption, constant attendance at the printer is necessary in order to re-load the slides.

### **3 The testing procedure**

The investigation was carried out in a test room having a floor surface of about 18 sq. m. and a height of about 2.5 m. The natural ventilation of the room was provided by a window and two doors opening into the corridor or a neighbouring room. However, the window and the doors were kept closed during the time the measurements were being made. The room was not equipped with a mechanical ventilation facility and, consequently, there was only a minimal rate of change of air inside the room.

The room was occupied by one to three persons while the measurement programme was under way and their movement to and fro caused some displacement of air in the room. The door to the corridor was opened infrequently to permit entry into and exit from the room. The measurements were made within the breathing space occupied by the operator positioned in front of the printer to maintain the supply of cassettes.

In order to ensure a high consumption of ink the blackness degree of the printed image was programmed to be more or less 80% of maximum.

Sample collection was carried out using activated charcoal as the adsorption medium in order that further examination could be made in the laboratory. At the same time, measurements were made using a direct-display flame ionisation detector (FID) to ensure that short-lived concentration peaks could be recognised. In addition, the measurement of any ozone produced by the Xenon-flash was undertaken.

The measurement period over which the shift mean value was determined lasted from 10.16 to 12.05 hours.

Finally, the mishap situation was simulated by pouring 350 ml of the ink into a tray with dimensions of approx. 80 x 60 cm. In this case, too, measurement was made of the air above the liquid by adsorption of the solvent vapour by activated carbon and this was accompanied by parallel sampling with a FID. Measurement of this worst-case scenario situation continued from 13.12 to 14.48 hours.

#### **4 The measurement procedure and the equipment used**

The determination of the solvent concentration was carried out by making measurements with the directly-indicating, portable flame-ionisation detector (FID). It is recognised that this only indicates the sum of the hydrocarbons present. The display of the detector is valid for propane and adjustment factors are used to convert the display for other hydrocarbons.

Subsequently, the solvent concentration was established in terms of the shift mean value and peak limit value using small-gauge adsorption tubes. To accomplish the latter, the air was led over activated carbon used as an absorbent material. A DuPont Alpha 1 unit was used as a sample-taking pump. The solvent was recovered from the activated carbon in the laboratory and evaluated by a gas-chromatographic technique using the flame-ionisation detector.

The ozone concentrations were measured by direct-display equipment of the type Horiba APOA 360E. The measurement principle for this is based upon the absorption of light in the UV-zone by ozone molecules. The concentrations were displayed with the aid of the in-built plotter.

#### **5 Material Characteristic Values**

##### **1-Methoxy-2-propanol**

Maximal permissible value - workplace concentration:	100 ppm = 370 mg/m <sup>3</sup>
Peak permissible value :	Overshoot factor 1
Permissible duration of peak value:	Max. 1 hour per shift

A value of 5.11 was calculated for the conversion factor to be applied to the display given by the FID when measuring the concentration of 1-methoxy-2-propanol.

In other words, the figure displayed by the FID in ppm is multiplied by 5.11 to provide the concentration of 1-methoxy-2-propanol in mg/m<sup>3</sup>.

## 6 Results obtained

### Mean Shift Value

Time	Concentration in mg/m <sup>3</sup>	Permissible upper limit in mg/m <sup>3</sup>	k	Evaluation index
10:16 – 12:05	3.8 Activated carbon < 5 FID	370	1	0.01

The above concentration data relate to measurements made at 20 °C and 1013 hPa.

k = Factor for short periods of exposure  
assuming shift duration of 8 hours, therefore k = 1

Evaluation Index =  $\frac{k \cdot \text{measured concentration}}{\text{permissible upper limit}}$

Conversion factor for 1-methoxy-2-propanol:

FID display value in ppm x 5.11 = concentration in mg/m<sup>3</sup>

### Peak concentration level (PCL) in the case of an abnormal occurrence

Time	Concentration in mg/m <sup>3</sup>	Permissible upper limit in mg/m <sup>3</sup>	k	Evaluation Index
13:12 – 14:48	163 Activated carbon 123 FID	370	PCL	PCL in room does not exceed permissible upper limit

## 7 Assessment and Summary

The solvent concentration measurements made to determine the mean shift value during normal operation of the printer and obtained by absorption by activated carbon produced a result of 3.8 mg/m<sup>3</sup>. The parallel measurement made with the FID confirmed this result and also revealed that no concentration peaks occurred during normal operation.

The measurements made by directly-indicating ozone measuring equipment showed that there was no increase in ozone concentrations beyond the general background level. The concentration of ozone in the room before the equipment was started up amounted to around 25 ppb and did not increase during the time the printer was running.

On this basis, the evaluation index amounted to 0.01, i.e 1% of the maximal permissible value. Measured results of this order of magnitude mean that there is no requirement for control measurements or other measures to be undertaken.

To determine the peak concentration level, a measurement was made of the atmosphere in the room after a mishap had been simulated by spilling the complete volume of ink. This followed absorption by activated carbon and the atmospheric concentration amounted to 163 mg/m<sup>3</sup>. This corresponds to 44% of the permissible peak concentration level or, in other words, well below the prescribed limit. The FID indicated a rise in concentration from 40 to 160 mg/m<sup>3</sup>.

Total assessment made in accordance with TRGS 402 therefore justifies the following conclusion:

### **No infringement of the upper limit value**

The low concentrations which were determined justify a grading of "Safe for long-term / sustained operation". Consequently, regular control measurements are not required.

The results of this investigation refer exclusively to the specified measurements. Abstracts of this report may only be replicated with the written approval of DEKRA Umwelt GmbH.

Karlsruhe, 28<sup>th</sup> June 2005  
WIE/bl

**DEKRA Umwelt GmbH**  
Messstelle für Gefahrstoffe

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## 8 Appendix - Photographs

