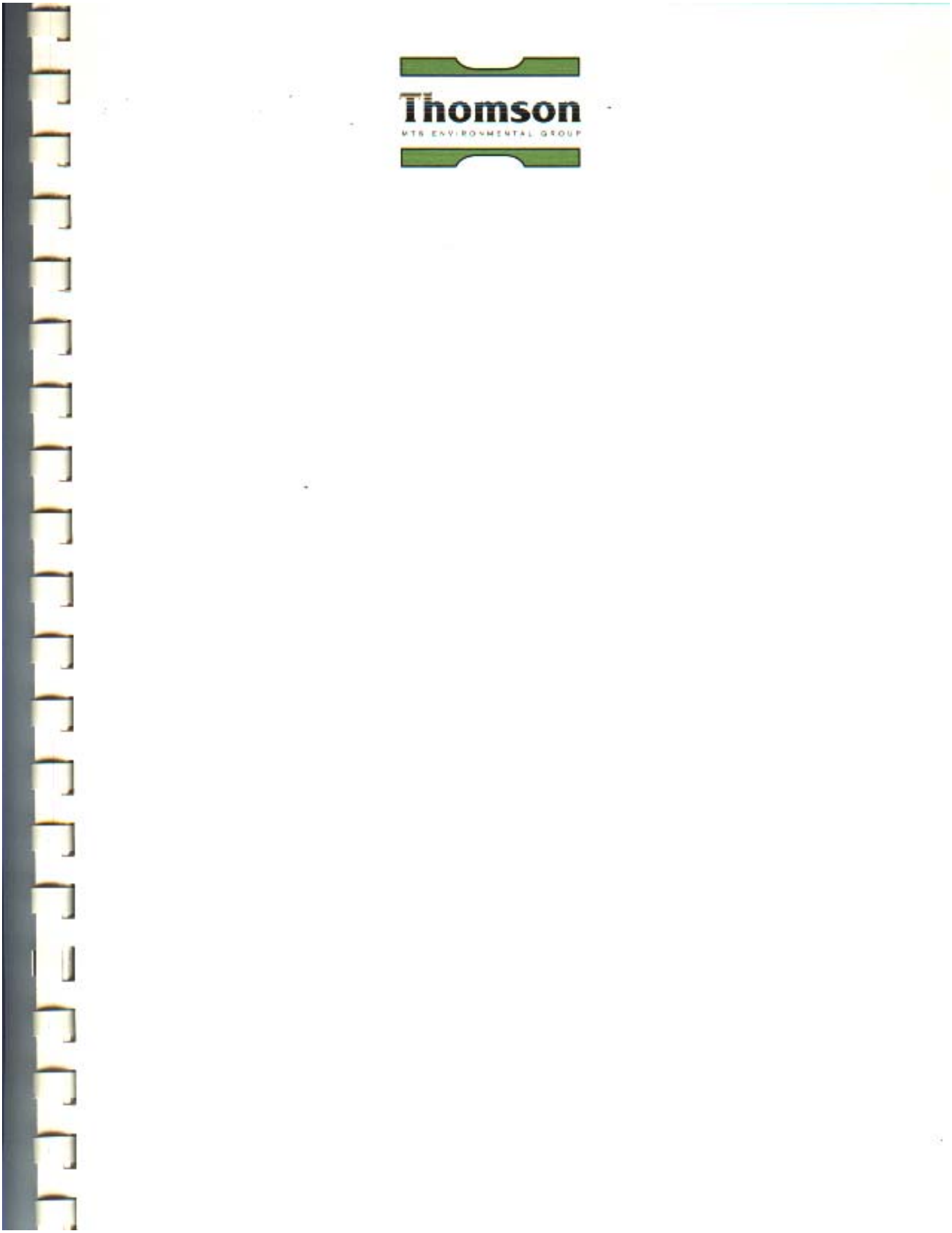
MEGA ELECTRONICS LIMITED.

THE GRIP INDUSTRIAL ESTATE,
LINTON, CAMBRIDGE,
ENGLAND.
CB21 4XN
TELEPHONE: +44 (0) 1223 893900
FAX: +44 (0) 1223 893894
email: sales@megauk.com
web: www.megauk.com

REPORT ON:
AN AIR QUALITY ASSESSMENT OF THE OPERATION OF THE MEGA ELECTRONICS PRINTED CIRCUIT BOARD LABSTATION

Issue 0893 / 1


Thomson
MTS ENVIRONMENTAL GROUP

Report on: An Air Quality Assessment of The Operation Of The MEGA Electronics Printed Circuit Board Labstation.

Prepared for: Mr M Hall, MEGA Electronics, Grip Industrial Estate, Linton, Cambridge.

Prepared by .....
Jeremy Owens
Laboratory Manager

Reviewed by .....
Dr Paul Leinster
Managing Director

TL 99216/JPO
August 1993
Thomson-MTS Limited

TL 99216/JPO
Thomson-MTS Limited

Introduction

At the request of Mark Hall of MEGA Electronics, Thomson-MTS carried out an air quality assessment of the PCB Labstation.

The PCB Labstation is supplied in several versions by MEGA Electronics to schools, colleges and small scale producers of printed circuit boards. The unit consists of a series of baths and spray rinse boxes designed for processing exposed boards through photoresist development, etching, tinning and resist stripping. The baths, which are normally covered with close fitting lids, are thermostatically controlled and the etching baths are equipped with air sparge agitation. Full details of the chemicals and operating conditions recommended for each bath are listed in Table 1.

Thomson-MTS visited the Labstation facility at MEGA Electronics on 27 July 1993 to inspect the equipment and to conduct air quality monitoring while it was in use.

Investigation

The air quality was assessed in terms of the specific compounds identified in Table 1. Hydrogen chloride levels were measured over the ferric chloride bath, 2-butoxyethanol levels were measured over the resist strip bath, (ethanolamine was not measured because it is present in smaller amounts in the solution and is less volatile than 2-butoxyethanol). In addition, because of its toxic properties, tests were made for thiourea even though it is not considered to be volatile under normal operating conditions. No testing was carried out in relation to the developer bath or the persulphate etch bath as neither of these solutions were considered to contain hazardous volatile compounds.

The investigation was conducted in a room measuring approximately 7 metres by 12 metres by 3 metres high. There was no extract ventilation in operation and no natural ventilation through external doors or windows. The process was operated for a period of 90 minutes by a single operator. Two circuit boards were processed during this time. Air quality was monitored using a combination of static air samplers located within 1 metre of the Labstation and air samplers attached to the operator. Air samples were collected and analysed in accordance with recognised procedures as follows:

Acid chloride concentrations over the ferric chloride etcher bath were measured by drawing air through silica gel sorbent at 600 cm^3 per minute with determination of the retained chloride by ion chromatography.

Thiourea concentrations over the tinning bath were measured by drawing air through a preweighed glass fibre filter at 2000cm^3 per minute with gravimetric determination of the retained material.

Butoxyethanol concentrations over the resist stripping bath were measured by drawing air through charcoal sorbent at 100 cm^3 per minute with determination of the retained solvent by gas chromatography.

Observations

It was noted that the persulphate etchant and the tinning solution were prepared by dissolving the powdered reagent in water and considerable care was needed to prevent some of the powder from dispersing into the air.

During the processing of the circuit boards the lids on the baths appeared to be effective in containing the vapours from the solutions: there was no visible evidence of fumes escaping and very little odour from the chemicals.

Evaluation Criteria

For 2-butoxyethanol, ethanolamine and hydrogen chloride, the relevant legal requirements are set out in the Control Of Substances Hazardous To Health (COSHH) Regulations 1988. Regulation 7 of COSHH requires that exposure to hazardous substances is adequately controlled. Guidance on how this may be achieved is provided by the accompanying General Approved Code of Practice which refers to Occupational Exposure Limits (OELs). These limits are published by the Health and Safety Executive (HSE) in Guidance Note EH40/93 'Occupational Exposure Limits 1993'.

The limits are broadly classified as Maximum Exposure Limits (MELs), which are also listed in Schedule 1 of the regulations, or Occupational Exposure Standards (OES). The majority of limits are expressed in terms of 8 hour time weighted average (TWA) concentrations, ie. the average concentration over a standard working day. Where brief exposures may cause acute effects, short term limits expressed as 10 minute time weighted average concentrations may also be quoted.

The exposure limits assigned to 2-butoxyethanol, ethanolamine and hydrogen chloride are listed in Table 2.

Thiourea is not listed in Guidance Note EH40/93. However, it is known to be capable of causing irreversable damage to DNA structures and is suspected to be a carcinogen. For these reasons it is recommended that exposure is controlled to the lowest level practicable.

Results

The results of the testing are listed in Table 2.

The concentrations of 2-butoxyethanol and hydrogen chloride vapour measured were substantially lower than the respective occupational exposure limits. The concentrations of ethanolamine vapour would have been lower than the concentrations of 2-butoxyethanol. Ethanolamine is less volatile than 2-butoxyethanol and accounts for a much smaller proportion of the process solution. Thus the concentration of ethanolamine vapour would have been less than 3 mg m^{-3} which compares with an ocupational exposure standard of 8 mg m^{-3}.

The concentrations of thiourea (as total inhalable dust) measured in the area of the Labstation were below the limit of detection of 0.2 mg m^{-3}.

Conclusions

During the test period when two circuit boards were processed, the air quality in the area around the Labstation was satisfactory with respect to hydrogen chloride, 2-butoxyethanol and ethanolamine. The airborne concentration of thiourea was less than the limit of detection of the method used.

Recommendations

On the basis of the tests carried out on 27th July 1993, the MEGA Electronics Labstation can be operated with no local exhaust ventilation provision without generating concentrations of vapours that are considered to be hazardous to the health of the operator. If the apparatus is installed in an area which is substantially more confined than that described above or if it is to be used on a sustained continuous basis (for example,6 to 8 hours per day on a regular basis) then a separate assessment will be necessary.

Care should be taken over the handling of powders during the preparation of the solutions. In particular, the powder used to prepare the tinning solution is toxic and control measures such as local extract ventilation or respiratory protection may be required to ensure adequate control of exposure during this operation. If granular reagents can be obtained they should be used in preference to powders.

Table 1 Assessment Of Chemicals Used In The MEGA Electronics Labstation

Process	Chemical	Operating Temperature (°C)	Air Sparge ?	Hazardous Volatile Compounds
Developer	Alkaline silicate	22	No	None
Etcher (I)	Ferric chloride	45	Yes	Hydrogen chloride
Etcher (II)	Sodium persulphate	45	Yes	None
Tinning	Tin chloride	27	No	None
	Thiourea	27	No	None
Resist-stripping	2-Butoxyethanol (12%)	45	No	2-Butoxyethanol
	Ethanolamine (5%)	45	No	Ethanolamine

Table 2 Results Of Air Quality Testing Carried Out During The Operation Of A MEGA Electronics Labstation On 27 July 1993

Sample Type	Sample Volume (litre)	Compound	Measured Concentration (mg m^{-3})
Ferric etch bath (static)	54	Hydrogen chloride	< 0.002
Personal Exposure	54	Hydrogen chloride	< 0.002
Tinning bath (static)	180	Thiourea	< 0.2
Resist strip bath (static)	0.99	2-Butoxyethanol	< 3
Personal exposure	1.25	2-Butoxyethanol	< 3

Notes

Occupational Exposure Standards

Hydrogen chloride	7 mg m^{-3}	(8 hour time weighted average)
Ethanolamine	8 mg m^{-3}	(8 hour time weighted average)

Maximum Exposure Limit

2-Butoxyethanol	120 mg m^{-3}	(8 hour time weighted average)

MEGA ELECTRONICS LTD.,
Mega House,
Grip Industrial Estate,
Linton, Cambridge.
England, CB21 4XN

Telephone: +44 (0) 1223 893900
Fax +44 (0) 1223 893894
email: sales@megauk.com
web: www.megauk.com