HEALTH AND SAFETY IN EMPLOYMENT ACT 1992

CODE OF PRACTICE FOR SAFETY IN PHOTOENGRAVING AND LITHOGRAPHIC PROCESSES

OCCUPATIONAL SAFETY & HEALTH SERVICE

DEPARTMENT OF LABOUR
TE TARI MAHI

ISSUED AND APPROVED BY THE MINISTER OF LABOUR JUNE 1993

Published by the Occupational Safety and Health Service,
Department of Labour,
Wellington,
New Zealand.

October 1993

ISBN 0-477-03534-5

$10.00 (GST incl.)

Contents

NOTICE OF ISSUE 5

FOREWORD 6

SUMMARY OF THE HEALTH AND SAFETY IN EMPLOYMENT ACT 1992 7

Approved Codes of Practice 7
Employers' Duties 7
Hazard Management 8
Where the Hazard is Significant 8
Information for Employees 8
Employers to Involve Employees in the Development of Health and Safety Procedures 9
Training of Employees and the Safety of Others 9
Employees' Duties 9
Accidents and Serious Harm (Records and Notification) 9

1.INTRODUCTION 11

1.1 Parties Involved in Production of this Code 11
1.2 Definitions 11

2. PROCESSES DISCUSSED IN THIS CODE 12

2.1 Brief Description 12
2.2 Recommended Measures Common to the Three Processes 12

3. BRIEF SUMMARY OF OSH POLICY 13

3.1 Policy in Relation to Photoengraving 13

4. GENERAL PRECAUTIONS AND SAFE WORK METHODS 14

4.1 Handling of Acids 14
4.2 Handling of Organic Solvents 14
4.3 Machines Having Condensing Systems 15

5. ETCHING OF MAGNESIUM AND ZINC PLATES 16

5.1 The Process. 16
5.2 Controls. 16

6. WASHOUT OF PHOTOPOLYMER PLATES 19

6.1. The Processes 19
6.2 Controls 19

7. LITHOGRAPHIC ETCHING WITH CORROSIVE FLUIDS 22

7.1 The Process 22
7.2 Controls 22

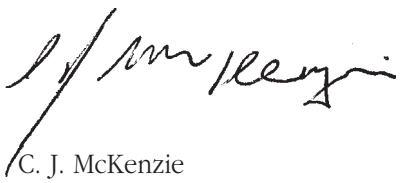
APPENDIX1: LITHOGRAPHIC PLATE-MAKING CHEMICALS 24

APPENDIX 2: THE CONCEPT OF WES 25

Introduction 25
Using the Listed Values 25

NOTICE OF ISSUE

I have issued this *Approved Code of Practice for Photoengraving and Lithographic Processes*, being a statement of preferred work practices or arrangements for the purpose of ensuring the health and safety of persons to which this code applies and persons who may be affected by the activities covered by the code.



C. J. McKenzie
Secretary of Labour
June 1993

FOREWORD

I have approved this statement of preferred work practices, which is an *Approved Code of Practice for Photoengraving and Lithographic Processes*, under section 20 of the Health and Safety in Employment Act 1992. When a code is approved a Court may have regard to it in relation to compliance with the relevant sections of the Health and Safety in Employment Act. This means that if an employer in an industry or using a process to which an approved code applies can show compliance with that code in all matters it covers, a Court may consider this to be compliance with the provisions of the Act to which the code relates.

Hon. Maurice McTigue
Minister of Labour
June 1993

SUMMARY OF THE HEALTH AND SAFETY IN EMPLOYMENT ACT 1992

The principal object of the Health and Safety in Employment Act 1992 is to prevent harm to employees at work. To do this it imposes duties on, and promotes excellent health and safety management by, employers. It also provides for the making of regulations and codes of practice.

APPROVED CODES OF PRACTICE

The Act provides for the development and approval of statements of preferred work practice or arrangements that may be approved as "approved codes of practice". These are recommended means of compliance with provisions of the Act, and may include procedures which could be taken into account when deciding on the practicable steps to be taken. Compliance with codes of practice will not be mandatory. However, they may be used as evidence of good practice in Court.

EMPLOYERS' DUTIES

Employers have the most duties to perform to ensure the health and safety of employees.

If you are an employer then you have a general duty to take all practicable steps to ensure the safety of employees while at work. (This is set out in section 6.) In particular, you are required to take all practicable steps to:

- Provide and maintain a safe working environment;
- Provide and maintain facilities for the safety and health of employees at work;
- Ensure that machinery and equipment in the place of work is designed, made, set up, and maintained to be safe for employees;
- Ensure that employees are not exposed to hazards in the course of their work; and
- Develop procedures for dealing with emergencies that may arise while employees are at work.

HAZARD MANAGEMENT

Employers must identify hazards in the place of work (previously existing, new and potential) and regularly review them to determine whether they are significant hazards and require further action. Where there occurs any accident or harm in respect of which an employer is required to record particulars, the Act (section 7 (2)), requires the employer to take all practicable steps to ensure that the occurrence is so investigated as to determine whether it was caused by or arose from a significant hazard.

"Significant hazard" means a hazard that is an actual or potential cause or source of—

(a) Serious harm; or

(b) Harm (being more than trivial) the severity of whose effects on any person depend (entirely or among other things) on the extent or frequency of the person's exposure to the hazard; or

(c) Harm that does not usually occur, or usually is not easily detectable, until a significant time after exposure to the hazard.

WHERE THE HAZARD IS SIGNIFICANT

The Act sets out the steps an employer must take.

- Where practicable, the hazard must be eliminated.
- If elimination is not practicable, the hazard must be isolated.
- If it is impracticable to eliminate or isolate the hazard completely, then the employer must minimise the hazard to employees. In addition, the employer must, where appropriate:
- Ensure that protective clothing and equipment is provided, accessible and used;
- Monitor employees' exposure to the hazard;
- Seek the consent of employees to monitor their health; and
- With informed consent, monitor employees' health.

INFORMATION FOR EMPLOYEES

(a) Before an employee begins work, their employer must inform them of:

- Emergency procedures;
- Hazards the employee may be exposed to while at work;
- Hazards the employee may create while at work which could harm other people;
- How to minimise the likelihood of these hazards becoming a source of harm to others; and
- The location of safety equipment.

(b) The employer is also required to inform employees of:

- The results of any health and safety monitoring. In doing so, the privacy of individual employees must be protected.

EMPLOYERS TO INVOLVE EMPLOYEES IN THE DEVELOPMENT OF HEALTH AND SAFETY PROCEDURES

Employers need to ensure that all employees have the opportunity to be fully involved in the development of procedures for the purpose of identifying hazards and dealing significant hazards or dealing with or reacting to emergencies and imminent dangers (section 14).

TRAINING OF EMPLOYEES AND THE SAFETY OF OTHERS

The employer must ensure employees are either sufficiently experienced to do their work safely or are supervised by an experienced person. In addition, the employee must be adequately trained in the safe use of equipment in the place of work, including protective clothing and equipment (section 13).

An employer is also responsible for the health and safety of people who are not employees. An employer must take all practicable steps to ensure that an employee does not harm any other person while at work, including members of the public or visitors to the place of work (section 15).

EMPLOYEES' DUTIES

If you are an employee, the Act gives you responsibility for your own safety and health while at work. You must also ensure that your actions do not harm anyone else.

ACCIDENTS AND SERIOUS HARM (RECORDS AND NOTIFICATION)

The Act defines "accident" as an event that—

(a) Causes any person to be harmed; or

(b) In different circumstances, might have caused any person to be harmed.

This means that "accident" includes both near-misses and accidents that result in harm to a person or might have caused any person to be harmed.

Every employer is required to maintain a register of accidents and serious harm; and record particulars relating to—

(a) Every accident that harmed (or, as the case may be, might have harmed)

(i) Any employee at work; or

(ii) Any person in a place of work controlled by the employer; and

(b) Every occurrence of serious harm to an employee at work, or as a result of any hazard to which the employee was exposed while at work, in the employment of the employer.

Where there occurs any serious harm or accident an employer must—

(a) As soon as possible after its occurrence, notify the Secretary of the occurrence; and

(b) Within 7 days of the occurrence, give the Secretary written notice, in the prescribed form, of the circumstances of the occurrence.

The notification to the Secretary applies to—

(a) Every occurrence of serious harm to an employee at work, or the occurrence of serious harm as a result of any hazard to which the employee was exposed while at work, in the employment of the employer; and

(b) Accidents of a kind or description required by regulations.

NOTE: Regulations have yet to be promulgated.

1. INTRODUCTION

1.1 PARTIES INVOLVED IN PRODUCTION OF THIS CODE

The production of the document arose from discussions involving the Graphic Arts Platemakers Federation, the New Zealand Federated Newspaper Publishers and Proprietors Industrial Association of Employers, and the New Zealand Photoengravers Industrial Union of Workers (now the New Zealand Photo Litho, Art Design and Platemaking Industrial Union of Workers). All of the above parties agreed with the provisions of the Code, and consented to its approval by the Minister of Labour.

NOTE: It is appropriate to note that because of the continually changing nature of photoengraving and lithographic technology, it is very likely that at least some of the processes discussed below will undergo modification in the future. Since this may, therefore, invalidate certain of the following provisions, it is proposed that the contents of this document be reviewed on request from the industry.

1.2 DEFINITIONS

Act:	Means the Health and Safety in Employment Act 1992.
Department:	Means the Occupational Safety and Health Service of the Department of Labour.
Inspector:	Unless specified means an inspector appointed under the Act.
MSDS:	Material Safety Data Sheet.
WES:	Workplace Exposure Standards. The booklet *Workplace Exposure Standards and Biological Exposure Indices for New Zealand* is a guideline for assessing the adequacy of the measures taken to limit exposure to airborne substances in the workplace. The WES booklet is obtainable from any branch office of the Occupational Safety and Health Service.
BEI:	Biological Exposure Indices as described in the WES booklet.
TLV:	Threshold Limit Value as described in the WES booklet.
TWA:	Time-Weighted Average as described in the WES booklet.
STEL:	Short-Term Exposure Level as described in the WES booklet.

2. PROCESSES DISCUSSED IN THIS CODE

2.1 BRIEF DESCRIPTION

The particular process types to which this code of practice applies are as follows:

2.1.1 Etching of metal plates, in particular those made of either magnesium or zinc, with a corrosive fluid which is most often nitric acid.

2.1.2 Washout of photopolymer plates with an organic chemical as a solvent. The plates may be wholly of photopolymer material and hence flexible (e.g. Cyrel process), or they may have a metal backing with a photopolymer upper layer as the soluble surface (e.g. Nyloprint process).

2.1.3 Lithographic processes which involve etching with corrosive fluids. It must be pointed out that this does not apply to all lithographic processes, but generally to the so-called "multi-metal" systems where an upper plate layer of chromium is partially removed by etching to reveal the underlying copper or brass layer which provides the image. The deep-etch plate process, involving a single metal layer, is a further example of a process in this category.

2.2 RECOMMENDED MEASURES COMMON TO THE THREE PROCESSES

There are a substantial number of recommended control measures which are common to the three process types being considered, even though the chemical nature of the hazard is different in each case. Although some repetition is involved, it is thought advisable to give a complete list, for each process, of the measures considered necessary to combat the known hazards so that each set of guidelines may stand alone.

3. BRIEF SUMMARY OF OSH POLICY

3.1 POLICY IN RELATION TO PHOTOENGRAVING

3.1.1 In photoengraving and lithographic processes, the concentration in the workroom air of vapours which emanate from chemicals either used as part of the process or arising as by-products from the process is the major standard to be met. This concentration must be maintained below the relevant WES or, where applicable, at a level which is not "offensive" to workers.

3.1.2 The Act requires "all practicable steps" to be taken to protect employees from inhalation of steams, fumes, dusts, or other impurities which are likely to be "injurious or offensive".

3.1.3 The WES value is the yardstick used to determine whether or not the air concentration of a particular contaminant will be injurious to health. A fuller description of the WES concept and the measurement of air concentrations of contaminants is given in Appendix 2, together with a list of current WES for the major chemicals and by-products to be encountered in photoengraving and lithography.

3.1.4 Because the processes under discussion may vary widely in terms of chemicals used, concentrations, environmental conditions, and equipment design, it follows that it is more appropriate to use the WES as an indication of air contamination and consequently of the need for any remedial action, rather than to set an arbitrary standard rate of air movement through the workroom.

4. GENERAL PRECAUTIONS AND SAFE WORK METHODS

4.1 HANDLING OF ACIDS

4.1.1 In processes where acids are used for etching, tasks such as replenishing of acid supplies must be carried out with due care and attention. In particular, adequate protective clothing must be made available by employers, and must be worn by employees. Suitable clothing for the job would consist of PVC (or neoprene) apron and gloves, and goggles or preferably a full face shield.

4.1.2 In addition, workers should be aware that the basic first aid measure for acid burns on the body is to immediately flush the affected part with copious quantities of cold running water.

4.1.3 On no account should acids or other chemicals be carried about the workroom in open containers such as buckets. A closed container is essential.

4.1.4 Plastic jerrycans used to store concentrated acids will become brittle after extended storage times and may fracture if subjected to mechanical shock. Care must be taken when handling these containers.

4.2 HANDLING OF ORGANIC SOLVENTS

4.2.1 Organic solvents such as perchloroethylene and trichloroethylene have no corrosive potential but they do pose a hazard from inhalation of toxic vapour, particularly if a spillage of solvent occurs.

4.2.2 Large spills of solvent should be soaked up with absorbent material which is afterwards removed to an outside site to evaporate. The area of the spill should be well ventilated to assist in complete evaporation. The person doing the cleaning up should be supplied with respiratory protection.

4.2.3 Rags used for mopping up small-scale spills should be placed in a closed container with a tight-fitting lid or be allowed to evaporate at an outside site chosen to minimise the potential nuisance to others.

4.2.4 Solvents such as ethyl alcohol or isopropyl alcohol should be handled with due regard for their flammability. Smoking must be clearly prohibited where flammable solvents are in use.

4.2.5 Where non-flammable solvents such as trichloroethylene and perchloroethylene are concerned, smoking represents a hazard due to the

breakdown of vapours from these solvents into toxic by-products when inhaled through a lighted cigarette. Again, smoking must be prohibited in areas where trichloroethylene and perchloroethylene vapours are likely to be present.

4.2.6 Hot metal surfaces and arc welding operations also result in decomposition to form highly toxic by-products, most notably phosgene gas and hydrochloric acid. Trichloroethylene forms phosgene in much greater concentrations than other chlorinated hydrocarbons and hence represents the greatest hazard in this context. Clearly, welding or excessively hot surfaces should not be allowed in areas where chlorinated hydrocarbon vapours may be present.

4.3 MACHINES HAVING CONDENSING SYSTEMS

4.3.1 Certain equipment used in these processes may operate with organic solvents above room temperatures. In such cases a water-cooled condenser must be part of the design to ensure that solvent vapour is retained within the system.

4.3.2 A regular check on the condenser water flow rate should be part of normal work practice. The flow should be adequate to produce normal condensing action: the best check on this is that the outflowing water should be no warmer than just tepid to the touch. The company supplying the equipment should be able to advise on an adequate flow rate and outflow temperature.

5. ETCHING OF MAGNESIUM AND ZINC PLATES

5.1 THE PROCESS.

The overall process involves plate pre-treatment, the actual etching by the action of nitric acid on the metal surface, and the final after-washing treatment. The etching process may result in the evolution of nitric acid mist into the atmosphere. A probable by-product of the etching action is the so-called "nitrous" fume, which is in fact nitrogen dioxide gas.

5.2 CONTROLS.

Control of this etching process may be achieved by attention to the following points:

5.2.1 The various process steps should, where possible, be located in a separate room used for no other purpose and equipped with a self-closing door (or doors). The room should be chosen so as to facilitate ventilation to the outside air, either through an exterior wall if available, or through the ceiling, or in some other manner.

5.2.2.1 Efficient mechanical exhaust ventilation should be provided on or near the etching bath itself. One appropriate type of ventilation system will be ducting of the lip type taking the form of a narrow slot situated at the bath rim and extending along, say, two opposite sides, or perhaps the back edge of the tank. Figures 1 and 2 are sketches to give a starting point for further design.

5.2.2.2 The further provision of a canopy over the bath will improve the efficiency of this exhaust facility. If made of clear plastic material (e.g. Perspex), visibility will not be hindered.

5.2.2.3 Both the lip ventilation ducting and the ducting attached to the canopy should then be linked to a suitable master duct which conveys the offending fumes to a safe exterior site.

5.2.2.4 In summary, although the discussion above refers to lip ventilation hoods and canopies, this in no way precludes the use of other types of ventilation systems if these can be designed to provide a satisfactory ventilation standard.

5.2.3 Although the nature of evolved fumes is different, conditions at the developing tank may also be improved by providing effective exhaust ventilation. The judgement of whether or not such ventilation is necessary will require measurements of air concentrations for chemicals used in

Sketches of Possible Ventilation Systems

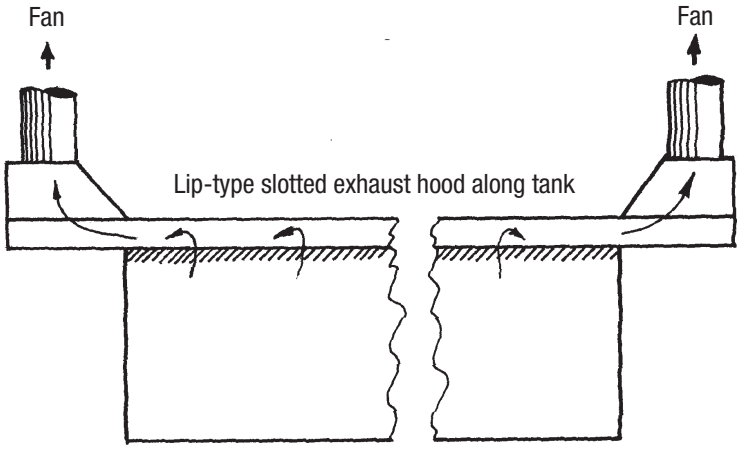


Fig. 1

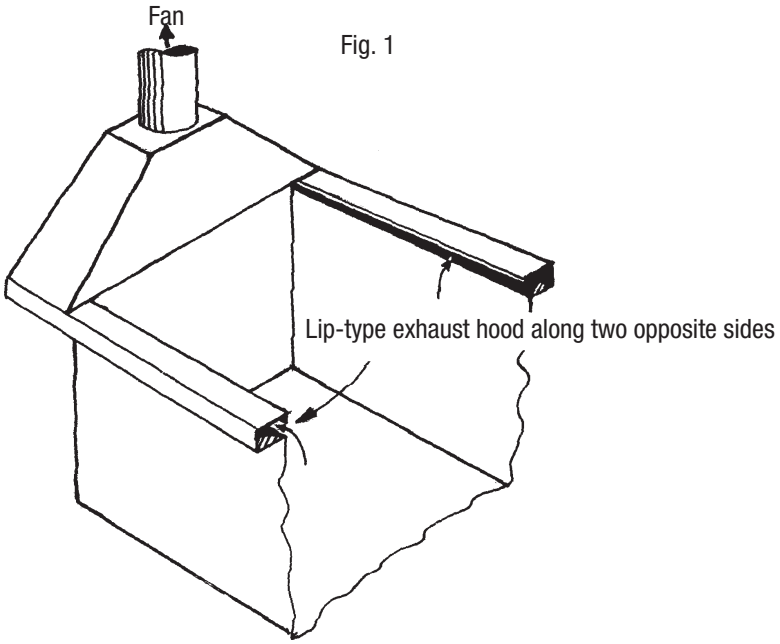


Fig. 2

development, and comparison of these measurements with the appropriate WES.

5.2.4 Care should be taken that fumes removed by ventilation in the manner discussed above are discharged into the outside air at such a point and in such a way that they do not re-enter the workroom or other parts of the factory. In this context, regard should be paid to prevailing wind conditions. Discharges should comply with the relevant legislation administered by territorial authorities.

5.2.5.1 The overriding factor which will determine the effectiveness of the applied ventilation measures will be the residual concentrations in the workroom air of the expected nitrous fumes and nitric acid mist. Thus, measurement of these concentrations and comparison with the appropriate WES will determine the ventilation efficiency and consequently any need to boost the rate of this ventilation.

5.2.5.2 It is worth noting that the mechanically assisted air velocity in the exhaust ducting may have to be boosted to cope with "worst possible" climatic conditions which might otherwise restrict the adequate removal of contaminated air.

5.2.5.3 As noted earlier (section 3.1.4) it is not possible to set down a particular rate of air movement which will be adequate for every unit, and clearly each situation must be treated in an individual manner.

5.2.6 Evolution of contaminant fumes will only occur when the bath is open for loading and unloading of plates. In general, an adequate ventilation rate can readily be obtained to remove any evolved contaminants, but depending on local conditions in any particular case, initial opening of the machine may cause fume evolution at a rate which the ventilation system cannot totally cope with. For such a situation, the room should be further provided with a variable-speed extraction fan to improve general room ventilation.

5.2.7 The contaminant fumes evolved by this etching process are highly corrosive, and due regard must be paid to this when providing exhaust ventilation ducting, canopies and fans. Acid-resistant PVC plastic would be an appropriate material to use.

5.2.8 The protective clothing discussed in section 4.1.1. must be provided for, and be worn by, employees required to handle nitric acid. Gloves provided should be of a type that helps the operator to grip potentially slippery plates.

6. WASHOUT OF PHOTOPOLYMER PLATES

6.1. THE PROCESSES

6.1.1 Generally the processes in this category involve the washing of a photopolymer surface with an organic solvent. The further treatment of the plates differs according to whether a flexible (e.g. Cyrel process) or metal-backed (e.g. Nylo-print process) plate is used.

6.1.2 The finishing step when a metal-backed plate is being processed involves removing the chemically attacked polymer by rotation of the plate against a mildly abrasive surface, normally a brush.

6.1.3 In the flexible plate type of process, the plates are given a "curing" period in a drying unit after the surface areas which have been chemically attacked are removed by washing in a chemical solution.

6.2 CONTROLS

Many of the ventilation measures recommended in section 5 for magnesium or zinc plate etching are applicable to the processing of photopolymer plates (see section 2.2).

6.2.1.1 The various process steps should, where possible, be located in a separate room used for no other purpose and equipped with a self-closing door (or doors). In the case of flexible plate processing, both hazard control and the work itself will be facilitated by having all equipment used in the process steps within easy reach in one area.

6.2.1.2 The room should be chosen so that ventilation to the outside air may be readily accomplished, either through an exterior wall if available, or through the ceiling, or in some other manner.

6.2.2.1 In the washout treatment, solvent vapour will be evolved when the lid of the unit is open for loading or unloading. One type of ventilation system suitable for the control of this vapour will be of the lip type (see figs 1 and 2 for sketches), in the form of a narrow slot at the bath rim, and extending along two opposite sides. This ventilation should be interlocked with the opening mechanism for the lid.

6.2.2.2. Although lip ventilation hoods have been suggested above as a suitable means of ventilation for this process, it should be noted that this in no way precludes the use of other types of ventilation systems if these can be designed to provide a satisfactory ventilation standard.

6.2.2.3 Depending on local conditions in any particular case, it may be that initial opening of the lid causes vapour evolution at a rate which the lip ventilation cannot totally cope with. For such a situation, the room should be provided with a variable-speed extraction fan to improve general room ventilation. Further, this fan should be so sited that evolved vapours are drawn away from the operator.

6.2.2.4 Some premises have extraction fans installed at floor level. These serve to provide general room ventilation and are also useful for rapid room ventilation in the event of a spillage of solvent, the vapours of which are considerably heavier than air.

6.2.3 Care should be taken that fumes removed by ventilation in the manner discussed above are discharged into the outside air at such a point and in such a way that they do not re-enter the workroom, or indeed other parts of the factory. In this context, due regard should be paid to prevailing wind conditions. Discharges should comply with the relevant legislation administered by territorial authorities.

6.2.4 Where flammable solvent mixtures (e.g. ethanol/water) are in use then electrical apparatus within the workroom shall comply with the relevant legislation, standard or classification for hazardous locations. The hazard classification given to the process will determine the standard required.

6.2.5 If flammable solvents are present, smoking shall be prohibited and suitable signs erected to publicise the fact.

6.2.6 The following provisions refer to additional steps in the processing of flexible photopolymer plates.

6.2.6.1 The plate drying facility, which is most usually but not exclusively an oven, should be equipped with adequate mechanical exhaust ventilation.

6.2.6.2 The rinsing solution applied to the developed plate should be used only in a suitable fume cupboard which is provided with efficient exhaust ventilation to remove chlorine gas evolved during the rinse cycle. During operation, the fume cupboard slide should be placed as low as possible to produce adequate through-ventilation.

6.2.6.3 The hypochlorite/hydrochloric acid solution used as the plate rinsing agent must be mixed under controlled conditions, in the fume cupboard, and with the operator suitably equipped with adequate protective clothing as discussed in section 4.1.1.

6.2.6.4 After the final rinse, any clean-up of the plate backing with an organic solvent such as perchloroethylene should be carried out with due regard for the potential toxicity hazard from the vapours. Suitable precautions should include using the minimum of solvent, wearing gloves to eliminate dermatitis, and carrying out the operation at a suitably ventilated site, or with the provision of a suitable ori-nasal respirator having an appropriate filter.

6.2.6.5 As noted earlier (section 4.2.3), rags soaked in solvent and used to wipe down plates should be placed in a closed container with a tight-fitting lid, or be allowed to evaporate at an outside site chosen to minimise the potential nuisance to others.

6.2.7 In summary, for both types of process involving photopolymer plates the overriding factor determining the application of ventilation control measures will be whether the air concentrations for the particular chemicals used at various stages of each process exceed the relevant WES.

7. LITHOGRAPHIC ETCHING WITH CORROSIVE FLUIDS

7.1 THE PROCESS

7.1.1 This section refers specifically to processes where lithographic plates are etched by corrosive fluids. These plates may be either the "multi-metal" type, where partial removal of the upper chromium layer reveals the underlying copper layer which when inked will print the desired image, or the "deep-etch" type where a single metal layer is etched.

7.1.2 The etching process may give rise to the evolution of toxic fumes and this is the principal hazard encountered. However, several of the preliminary and finishing processes involve the mixing and use of solutions of hazardous chemicals such as caustic alkalis, potassium permanganate and oxalic acid. Skin or eye contact with such materials would be highly hazardous and appropriate precautions as noted below will be essential. A list of these chemicals is given in Appendix 1, and this also describes the use of each material in lithographic plate making, and its likely toxic effect.

7.1.3 The etching fluid used in multi-metal and deep-etch plate lithography is based on hydrochloric acid, and thus the air contaminant which gives rise to the known fume problem in this process is hydrochloric acid mist. This compares with magnesium or zinc plate etching using nitric acid, discussed previously in section 5, where nitrous fumes, and nitric acid mist are the contributors to fume problems.

7.2 CONTROLS

As in section 6, concerning photopolymer plates, many of the ventilation provisions previously given for magnesium or zinc plate etching are also applicable to multi-metal and deep-etch plate making.

7.2.1 The various process steps should, where possible, be located in a separate room used for no other purpose, and equipped with a self-closing door (or doors). The room should be chosen so as to facilitate ventilation to the outside air, either through an exterior wall if available, or through the ceiling, or in some other manner.

7.2.2.1 Efficient mechanical exhaust ventilation should be provided on or near the etching bath itself. One appropriate type of ventilation system will be ducting of the lip type, taking the form of a narrow slot situated at the bath rim and extending along, say, two opposite sides, or perhaps the back edge of the tank. Figures 1 and 2 are sketches to give a starting point for further design.

7.2.2.2 The further provision of a canopy over the bath will improve the efficiency of this exhaust facility. If made of clear plastic material (e.g. Perspex), visibility will not be hindered.

7.2.2.3 Both the lip ventilation ducting and the ducting attached to the canopy should then be linked to a suitable master duct which conveys the offending fumes to a safe exterior site.

7.2.2.4 In summary, although the discussion above refers to lip ventilation hoods and canopies, this in no way precludes the use of other types of ventilation systems if these can be designed to provide a satisfactory ventilation standard.

7.2.3 Care should be taken that fumes removed by ventilation are discharged into the outside air at such a point, and in such a way that they do not re-enter the workroom, or indeed other parts of the factory. In this context due regard must be paid to prevailing wind conditions. Discharges should comply with the relevant legislation administered by territorial authorities.

7.2.4 Contaminant fumes evolved during etching will be corrosive, and due regard to this must be paid when providing exhaust ventilation ducting, canopies and fans. Acid-resistant PVC plastic would be an appropriate material to use.

7.2.5 The overriding factor which will determine the effectiveness of the applied ventilation measures will be the residual concentration in the workroom air of the expected hydrochloric acid mist. The measurement of this concentration and comparison with the WES will determine the ventilation efficiency and consequently any need to boost the rate of this ventilation.

7.2.6 The protective clothing discussed in section 4.1.1 must be provided for, and be worn by, employees required to handle the various chemicals used in lithographic multi-metal and deep-etch plate making. Gloves provided should be of a type that helps the operator to grip potentially slippery plates.

APPENDIX 1: LITHOGRAPHIC PLATE-MAKING CHEMICALS

Besides the corrosive etching solution, which contains hydrochloric acid, other potentially hazardous chemicals are used in various stages of the preparation of multi-metal and deep-etch lithographic plates.

Examples of such chemicals, their use in lithography, and possible hazards are:

(a) Potassium hydroxide (caustic potash): used to remove "stopping out" compounds. The solution can cause severe skin and eye burns.

(b) Potassium permanganate (Condy's crystals): used as a stencil removing agent. The solution is a strong oxidising agent and can cause skin and eye burns.

(c) Oxalic acid: used to activate the copper image area so as to render it ink-receptive. This solution is highly toxic if taken by mouth.

(d) Ammonium dichromate: may find use as a plate sensitising agent. This material can cause dermatitis in certain sensitive individuals.

These solutions do not present any hazard from vapour evolution and hence it is not necessary to measure air concentrations or for WES to be listed.

APPENDIX 2: THE CONCEPT OF WES

INTRODUCTION

In order to have a basis for making decisions on whether or not the concentration of a contaminant in the workroom air is at, or above a level likely to adversely affect the health of persons employed, the concept of a WES value has gained acceptance.

The WES is defined as the airborne concentration of a substance to which nearly all workers may be exposed for an 8-hour day and 5 days per week without any adverse health effect. The words "nearly all" are necessary because in any group of individuals there will always be a small number who are hypersensitive to any particular material. To protect such people would require reducing exposure to zero and in virtually all cases this is simply impractical.

USING THE LISTED VALUES

The first step in assessing whether or not air contaminants are present in hazardous concentrations is to identify the chemical giving rise to the problem and then to apply a relevant testing method to measure the concentration in the air of this chemical.

It would be preferable to either take a number of tests and use the average value for the concentration, or alternatively to take a measurement under "worst possible" operating conditions.

It is important to note also that the air concentration of the contaminant under investigation should be measured in the breathing zone of the operator.

The actual value found can then be compared with the figure given in the WES booklet. If the value is similar to, or greater than, the published figure then a health risk is likely to exist, and remedial action to reduce the concentration of the contaminant is necessary. If the value is below the WES but still significant (say 50%) then steps should be taken to check existing procedures and equipment, and the situation should be regularly reviewed.

To sum up, the WES does not represent a precise figure at or above which health is threatened but below which no risk exists. It must be used as a guide to contaminant control, with the overruling object always being to reduce air contaminant concentrations to the lowest practicable level regardless of how these compare with the published WES.

NOTE: The following references, standards and associated information has been updated at the time of publication, however it is subject to change without notice at any time.

WES for Likely Air Contaminants in Photoengraving and Lithography

	WES ppm	mg/m^3	STEL ppm	mg/m^3
Etching of Magnesium and Zinc Plates				
Nitrous fumes (nitrogen dioxide)	3	5.6	5	9.4
Nitric acid	2	5.2	4	10
Washout of Polymer Plates				
Trichloroethylene	50	269	200	1070
Perchloroethylene	50	339	200	1370
Isopropyl alcohol (isopropanol)	400	983	500	1230
Ethyl alcohol (ethanol)	1000	1880	—	—
n-Butyl alcohol (butanol) (skin)	—	ceiling	50	150
sec-Butyl alcohol	100	303	—	—
tert-Butyl alcohol	100	303	150	455
Chlorine	0.5	1.5	1	2.9
Lithographic Etching With Corrosive Fluids				
Hydrochloric acid	—	ceiling	5	7.5