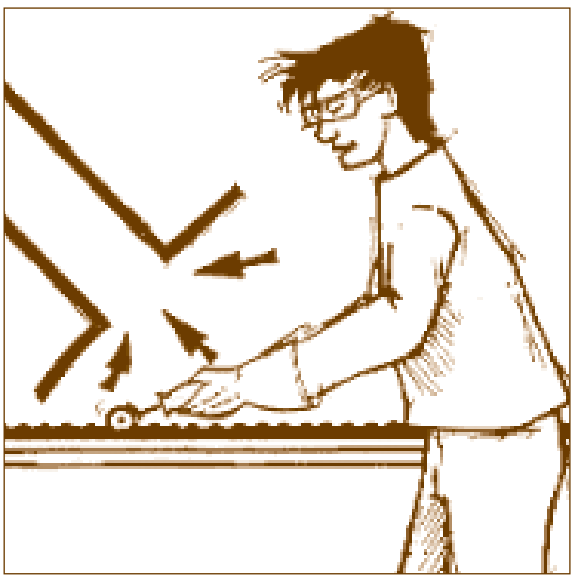
Government of
Western Australia

Code of Practice

Styrene



December 1996

WorkSafe Western Australia Commission

FOREWORD

The introduction of the *Occupational Safety and Health Act 1984* enabled the establishment of the tripartite WorkSafe Western Australia Commission. The Commission, which comprises representatives of employers, unions, government and experts, has the function of developing the legislation and any supporting guidance material and making recommendations to the Minister for implementation. TO fulfil its functions the Commission is empowered to establish advisory committees, hold public enquiries and publish and disseminate information.

This code of practice has been developed through the tripartite consultative process and the views of the employers and unions along with those of government have been considered.

The Commission's objective is to promote comprehensive and practical preventive strategies that improve the working environment of Western Australians.

The information presented in this booklet should be read by employers and employees as background for understanding and implementing this code of practice.

THE ACT

The *Occupational Safety and Health Act 1984* (the Act) provides for the promotion, co-ordination, administration and enforcement of occupational safety and health in Western Australia.

The Act places certain duties on employers, employees, self employed persons, manufacturers, designers, importers and suppliers.

It also places emphasis on the prevention of accidents and injury.

In addition to the broad duties established by the Act, it is supported by a further tier of statute, commonly referred to as regulations, together with lower tiers of non-statutory codes of practice and guidance notes.

REGULATIONS

Regulations have the effect of spelling out the specific requirements of the legislation.

Regulations may prescribe minimum standards and have a general application or they may define specific requirements related to a particular hazard or particular type of work. They may also be for the licensing or granting of approvals, certificates etc.

CODES OF PRACTICE

A code of practice is defined in the Act as a document prepared for the purpose of providing:

- practical advice on preventive strategies; and
- a practical means of achieving any code, standard, rule, provision or specification relating to occupational safety or health in Western Australia.

A code of practice may contain explanatory information.

The preventive strategies outlined in a code of practice do not represent the only acceptable means of achieving the standard to which the code refers. A code of practice does not have the same legal force as a regulation and is not sufficient reasons, of itself, for prosecution under the Act.

GUIDANCE NOTES

The next tier in this process comes in the form of guidance notes prepared by the WorkSafe Western Australia Commission.

A guidance note is an explanatory document providing detailed information on the requirements of legislation, regulations, standards, codes of practice or matters relating to occupational safety and health as approved by the Commissioner.

Code of Practice

Styrene

WorkSafe Western Australia Commission

Authority

This code of practice was approved pursuant to section 57 of the *Occupational Safety and Health Act 1984* by the Hon Minister for Labour Relations on 23 December 1996.

This code supersedes the *Code of Practice on Styrene in the Fibreglass Industry* published in the Government Gazette on 7 June 1991.

Scope

Styrene is a solvent that is used widely in the fibreglass reinforced plastics industry. Most polyester resins used in this industry contain substantial amounts of styrene, ranging from 40-60%.

Styrene is a major hazard as it can enter the body through the lungs or the skin. Exposure to styrene has the potential to damage the health of workers over both the short and long term.

This code of practice provides practical guidance and strategies to reduce exposure to styrene of persons in the fibreglass reinforced plastics industry. The code is intended to assist in the control of levels of styrene monomer to as low as reasonably practicable below the occupational exposure standard of 50 ppm (TWA)*.

Who should use this Code of Practice?

This code of practice should be used by all persons involved in any aspect related to the usage of styrene in the fibreglass reinforced plastics industry, including employers, contractors, self employed persons, employees, safety and health representatives, suppliers, designers, manufacturers, etc.

Other legislation

The *Environmental Protection Act 1986* and Regulations have specific provisions relating to premises where resin is used to prepare or manufacture reinforced plastics or reinforced plastic products.

For further information on this code of practice, contact the Chamber of Commerce and Industry of Western Australia (Tel. 9365 7577), the Trades and Labor Council of Western Australia (Tel. 9328 7877) or WorkSafe Western Australia (Tel. 9327 8777).

*TWA – Time Weighted Average

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1.1 LEGISLATIVE FRAMEWORK IN WESTERN AUSTRALIA

The *Occupational Safety and Health Act* sets objectives to promote and improve occupational safety and health standards. The Act sets out broad duties and is supported by more detailed requirements in the *Occupational Safety and Health Regulations*. The legislation is further supported by guidance material such as approved Codes of Practice. This legislative framework is depicted below.

OCCUPATIONAL SAFETY AND HEALTH ACT

Major provisions:
- The General Duties
- Resolution of Issues
- Safety and Health Representatives
- Safety and Health Committees
- Enforcement of Act and Regulations

supported by

OCCUPATIONAL SAFETY AND HEALTH REGULATIONS

The *Occupational Safety and Health Regulations* set minimum requirements for specific hazards and work practices, including reference to National Standards developed by the National Occupational Health and Safety Commission and Australian Standards developed by Standards Australia.

and

GUIDANCE MATERIAL

- Codes of Practice approved for Western Australia in accordance with Section 57 of the Act.
- Guidance Notes developed by the WorkSafe Western Australia Commission.
- National Codes of Practice and National Standards developed by the National Occupational Health and Safety Commission.
- Australian Standards developed by Standards Australia.

GENERAL PRINCIPLES FOR MANAGING OCCUPATIONAL SAFETY AND HEALTH IN WORKPLACES

1.2 ACCESS TO ACT, REGULATIONS AND OTHER RELEVANT DOCUMENTS

Employers are required to provide information to employees, to alert them to areas where hazards may exist and to improve their understanding of safe work practices. Regulations specify documents which must be made available upon request for perusal by employees at the workplace.

Persons at workplaces to have access to Act etc.

Regulation 3.2 states

A person who, at a workplace, is an employer or the main contractor must ensure that, as soon as practicable following a request from a person who works at the workplace, there is available for that person's perusal an up to date copy of –

(a) the Act;

(b) these regulations;

(c) all Australian Standards, Australian/New Zealand Standards and NOHSC documents or parts of those Standards or documents referred to in these regulations that apply to that workplace;

(d) all codes of practice approved under section 57 of the Act that apply to that workplace; and

(e) guidelines or forms of guidance referred to in section 14 of the Act –

  (i) the titles of which have been published in the Government Gazette and which are set out in Schedule 3.1; and

  (ii) which apply to that workplace.

Copies of the *Occupational Safety and Health Act, Occupational Safety and Health Regulations*,Codes of Practice and Guidance Notes published by the WorkSafe Western Australia Commission can be purchased from WorkSafe Western Australia, Westcentre, 1260 Hay Street, West Perth [Tel. (08) 9327 8777].

GENERAL PRINCIPLES FOR MANAGING OCCUPATIONAL SAFETY AND HEALTH IN WORKPLACES

1.3 THE GENERAL DUTIES – AN OVERVIEW

The Act contains general duties which describe the responsibilities of people who affect safety and health at work. Employers must, so far as is practicable,

- provide a workplace and safe system of work so that, as far as practicable, employees are not exposed to hazards;
- provide employees with information, instruction, training and supervision to enable them to work in a safe manner;
- consult and co-operate with safety and health representatives in matters related to safety and health at work;
- provide adequate protective clothing and equipment where hazards cannot be eliminated; and
- ensure plant is installed or erected so it can be used safely.

Employees are required to take reasonable care to ensure their own safety and health at work and the safety and health of others affected by their work.

Self-employed persons also must take reasonable care to ensure their own safety and health at work and, as far as practicable, ensure their work does not affect the safety and health of others.

Designers, manufacturers, importers and suppliers of plant must ensure that plant intended for use in a workplace is safe to install, maintain and use at workplaces. Safety and health information must be provided when plant and substances are supplied for use at work.

Designers or builders of a building or structure for use as a workplace must ensure, so far as is practicable, that persons constructing, maintaining, repairing, servicing or using the building or structure are not exposed to hazards.

The WorkSafe Western Australia Commission Guidance Note The General Duty of Care in Western Australian Workplaces provides detailed information on the 'duty of care'. The Guidance Note can be purchased from WorkSafe Western Australia, Westcentre, 1260 Hay Street, West Perth [Tel. (08) 9327 8777] or is available via the Internet Service on Safetyline [www.safetyline.wa.gov.au].

1.4 HAZARD IDENTIFICATION, RISK ASSESSMENT AND RISK CONTROL

The Act: Section 19 states (in part)

(1) An employer shall, so far as is practicable, provide and maintain a working environment in which his employees are not exposed to hazards and in particular, but without limiting the generality of the foregoing, an employer shall –

(a) provide and maintain workplaces, plant, and systems of work such that, so far as is practicable, his employees are not exposed to hazards.

Under Section 19(1)(a) of the *Occupational Safety and Health Act*, employers have a duty to ensure, as far as practicable, that employees are not exposed to hazards at the workplace. The *Occupational Safety and Health Regulations 1996* require employers to identify hazards and assess and control risks.

Identification of hazards, and assessing and addressing risks, at workplaces

Regulation 3.1 states

A person who, at a workplace, is an employer, the main contractor, a selfemployed person, a person having control of the workplace or a person having control of access to the workplace must, as far as practicable -

(a) identify each hazard to which a person at the workplace is likely to be exposed;
(b) assess the risk of injury or harm to a person resulting from each hazard, if any, identified under paragraph (a); and
(c) consider the means by which the risk may be reduced.

The regulation outlines three basic steps:

- **Identification of hazards**
  This involves recognising things which may cause injury or harm to the health of a person, such as flammable materials, ignition sources or unguarded machinery.

- **Assessing risk**
  This involves looking at the possibility of injury or harm occurring to a person if exposed to a hazard.

- **Controlling the risk of injury or harm**
  This involves introducing measures to eliminate or reduce the risk of a person being injured or harmed.

It is important to regularly review the steps, especially if there are changes in the work environment when new technology is introduced, or standards are changed.

Employers should consult with safety and health representatives, if any, and employees during these steps.

1.4.1 Identifying hazards

A HAZARD MEANS ANYTHING THAT MAY RESULT IN INJURY OR HARM TO THE HEALTH OF A PERSON

There are a number of ways of identifying potential sources of injury or disease. Selection of the appropriate procedure will depend on the type of work processes and hazards involved.

Procedures may range from a simple checklist for a specific piece of equipment or substance to a more open-ended appraisal of a group of related work processes. A combination of methods may provide the most effective results.

Methods of identifying workplace hazards include:

- developing a hazard checklist;
- conducting walk-through surveys;
- reviewing information from designers or manufacturers;
- analysing unsafe incidents, accident and injury data;
- analysing work processes;
- consulting with employees;
- examining and considering Material Safety Data Sheets and product labels; and
- seeking advice from specialist practitioners and representatives.

Some hazards such as mechanical hazards, noise, or toxic properties of substances are inherent in the work process. Other hazards result from machine or equipment failures and misuse, control or power system failures, chemical spills, and structural failures.

The following table lists some types of hazards and some specific examples.

HAZARD	EXAMPLES	OUTCOMES (examples of injury or harm)
Manual handling	overexertion/repetitive movement	sprains, strains, fractures
Falls	falling objects, falls, slips and	fractures, bruises, lacerations, trips of people dislocations, concussion, permanent or fatal injuries
Electricity	electrical current, lightning	shock, burns, electrocution
Machinery and equipment	being hit, hitting objects, being caught in or between, over-turning vehicles	cuts, bruises, dislocations, fractures, amputation, permanent or fatal injuries
Hazardous substances	chemicals such as acids, hydrocarbons, heavy metals	toxic effects, dermatitis, respiratory illnesses, cancers
Extremes of temperature	effects of heat or cold	burns, frost bite, heat stress, heat stroke
Noise	excessive noise	permanent hearing damage
Radiation	ultra violet, welding arc flashes, micro waves, lasers	burns, cancer, damaged eye sight, blindness
Biological	viruses, bacteria, fungi, toxins	Hepatitis, Legionnaire's Q Fever, tetanus, disease, HIV/AIDS, allergies
Vibration	hands and whole of body	organ, nerve and muscle damage
Psychological stress	intimidation, organisational change, violence, conflict, time pressure	high blood pressure, headaches and migraine, anxiety, depression, absenteeism

1.4.2 Analysing and assessing risks

RISK, IN RELATION TO ANY INJURY AND HARM, MEANS THE PROBABILITY OF THAT INJURY OR HARM OCCURRING.

A risk assessment of the hazards identified in the first step should result in a list of potential injuries or harm and the likelihood of these occurring. The potential for fatal injury should be considered for each identified hazard. If hazards are listed, they should be in the order of the most to the least serious, eg. from fatal to minor injury.

GENERAL PRINCIPLES FOR MANAGING OCCUPATIONAL SAFETY AND HEALTH IN WORKPLACES

In assessing risks, consideration should be given to the state of knowledge about the frequency of injury or disease, the duration of exposure to injury or disease sources and the likely severity of the outcomes. Knowledge gained from similar workplaces or similar processes may be relevant to this risk assessment. Matters to be considered include:

- **frequency of injury** – how often is the hazard likely to result in an injury or disease?
- **duration of exposure** – how long is the employee likely to be exposed to the hazard?
- **outcome** – what are the consequences or potential severity of injury?

Assessing these three factors will indicate the probability or likelihood of injury or harm occurring to workers involved in a particular work process. It will also indicate the likely severity of this harm.

Risk assessment requires good judgement and awareness of the potential risks of a work process. A person undertaking a risk assessment must have knowledge and experience of the work process. The task may be complicated by incomplete data or incomplete information regarding hazards of a work process.

In some cases it may be necessary to break down the activity or process into a series of parts and assess each part separately.

Risk assessment should include:
- assessing the adequacy of training or knowledge required to work safely;
- looking at the way the jobs are performed;
- looking at the way work is organised;
- determining the size and layout of the workplace;
- assessing the number and movement of all people on the site;
- determining the type of operation to be performed;
- determining the type of machinery and plant to be used;
- examining procedures for an emergency (eg: accident, fire and rescue); and
- looking at the storage and handling of all materials and substances.

This step should provide information where and which employees are likely to be at risk of incurring injury or disease, how often this is likely to occur, and the potential severity of that injury or disease risk.

1.4.3 Identifying control measures

The final step in risk assessment is to determine the control measures that need to be taken and the ongoing review of those measures. There is a hierarchy or preferred order of control measures ranging from the most effective to the least effective. The preferred order is outlined in the table below.

The control of occupational injury and disease risks should preferably be dealt with by design, substitution, redesign, separation or administration. These controls generally eliminate, reduce or minimise risk in a more reliable manner than personal protective equipment.

Controls involve implementing measures which reduce the hazard and risk in the workplace.

Where regulations require specific methods to control the risk, these must be complied with.

TABLE 2 – Hierarchy or preferred order of control

elimination – removing the hazard or hazardous work practice from the workplace. This is the most effective control measure;

substitution – substituting or replacing a hazard or hazardous work practice with a less hazardous one;

isolation – isolating or separating the hazard or hazardous work practice from people involved in the work or people in the general work areas from the hazard. This can be done by installing screens or barriers or marking off hazardous areas;

engineering control – if the hazard cannot be eliminated, substituted or isolated, an engineering control is the next preferred measure. This may include modifications to tools or equipment, providing guarding to machinery or equipment;

administrative control – includes introducing work practices that reduce the risk. This could include limiting the amount of time a person is exposed to a particular hazard; and

personal protective equipment – should be considered only when other control measures are not practicable or to increase protection.

Control measures are not mutually exclusive. That is, there may be circumstances where more than one control measure should be used to reduce exposure to hazards.

In some instances, a combination of control measures may be appropriate. Control measures should be designed:

- to eliminate or reduce the risks of a hazardous work process and to minimise the effects of injury or disease; and
- to reduce the risk of exposure to a hazardous substance.

1.4.4 Control through personal protective equipment

Personal protective equipment should be a lat resort only, and be used in circumstances where other methods of control are not practicable. The factors which determine the appropriateness of using personal protective equipment include:

In assessing risks, consideration should be given to the state of knowledge about the frequency of injury or disease, the duration of exposure to injury or disease sources and the likely severity of the outcomes. Knowledge gained from similar workplaces or similar processes may be relevant to this risk assessment. Matters to be considered include:

- the nature of the work or the work process concerned;
- the severity of any potential injury or disease;
- the state of knowledge about the injury or disease related to the work or process;
- information available to employers about methods of preventing injury or disease associated with a particular hazard or risk;
- the availability and suitability of methods to prevent, remove or mitigate causes of injuries or disease associated with a hazard or risk; and
- whether the costs of preventing, removing or mitigating that injury or disease are prohibitive in the circumstances.

There are some situations where temporary use of personal protective equipment may be necessary. These include:

- where it is not technically feasible to achieve adequate control of the hazard by other measures. In these cases, the hazard should be reduced as far as practicable by other measures and then, in addition, suitable personal protective equipment should be used to secure adequate control;
- where a new or revised risk assessment indicates that personal protective equipment is necessary to safeguard safety and health until such time as adequate control is achieved by other methods, for example, where urgent action is required because of plant failure; and

- during routine maintenance operations. Although exposure to hazards occurs regularly during such work, the infrequency and small number of people involved may make other control measures impracticable.

1.4.5 Review of control measures

Constantly reviewing control measures is important to ensure they continue to prevent or control exposure to hazards or hazardous work practices.

Engineering controls should be regularly tested to ensure their effectiveness. Performance testing and evaluation standards should be established.

Repair and maintenance programs should specify:

- where servicing is required;
- the extent of servicing required;
- the nature of the servicing required;
- the frequency of servicing;
- who is responsible for maintaining repair and maintenance programs; and
- how defects will be corected.

In order to keep accurate records, a recording or reporting system should be developed, implemented and maintained.

1.5 THE MEANING OF PRACTICABLE

Some of the general duty provisions in the Act and some requirements in the Regulations are qualified by the words “so far as is practicable”.

“Practicability” applies to general duties for employers, self-employed people, people with control of workplaces, designers, manufacturers, importers, suppliers, erectors and installers, and to certain requirements in the Regulations. These people are expected to take practicable and reasonable measures to comply with the requirements.

If something is practicable, it is capable of being done. Whether it is also reasonable takes into account:

- the severity of any injury or harm to health that may occur;
- the degree of risk (or likelihood) of that injury or harm occurring;
- how much is known about the hazard and the ways of reducing, eliminating or controlling it; and
- the availability, suitability and cost of the safeguards.

2. FIBREGLASS PROCESSES

The risk and severity of injury must be weighed up against the overall cost and feasibility of the safeguards needed to remove the risk.

Common practice and knowledge throughout the relevant industry are taken into account when judging whether a safeguard is “reasonably practicable”. Individual employers could not claim that they did not know what to do about certain hazards if those hazards are widely known by others within industry, and safeguards were available.

The cost of putting safeguards in place is measured against the consequences of failing to do so. It is not a measure of whether the employer can afford to put the necessary safeguards in place.

While cost is a factor, it is not an excuse for failing to provide appropriate safeguards, particularly where there is risk of serious, or frequent but less severe, injury.

Where a regulation exists and is not qualified by the words “as far as is practicable”, the regulation must be complied with as a minimum requirement.

The WorkSafe Western Australia Commission Guidance Note *The General Duty of Care in Western Australian Workplaces* provides detailed information on the ‘duty of care’. The Guidance Note can be purchased from WorkSafe Western Australia, Westcentre, 1260 Hay Street, West Perth [Tel. (08) 9327 8777] or is available via the Internet Service on Safetyline [www.safetyline.wa.gov.au].

2. FIRBREGLASS PROCESSES

The essential materials used in fibre reinforced plastics processing (FRP) are glass reinforcement, resin, accelerators, catalysts, mould release agents, fillers, pigments and cleaning agents. Materials used in the FRP process can pose significant hazards. Material Safety Data Sheets on all the materials to be used must be provided by the supplier. Reference should be made to these Material Safety Data Sheets and the product label before using them.

While there are many FRP processes, they all follow the same basic principle. A styrene based resin, fibreglass reinforcement and a catalyst are all applied to a mould where polymerisation takes place.

In Western Australia, the wet spray-up or hand lay-up processes are used almost exclusively. These involve the application of styrene-based resin to a mould either by spraying or by rollers and brushes. Large amounts of styrene vapour are given off during the application and curing stages of these processes. As a result, laminators will be exposed to excessive amounts of styrene unless adequate ventilation is provided. A typical polyester resin contains 40-60% styrene.

Typically, the spray-up process generates 2-3 times as much styrene vapour as the hand lay-up process.

3. PHYSICAL AND CHEMICAL PROPERTIES OF STYRENE

Styrene is a volatile, highly flammable compound.

- Styrene vapour is heavier than air. At concentrations normally encountered in the workplace, the air and styrene mixture is not significantly heavier than clean air.

- Styrene evaporates more rapidly at high temperatures (eg. the evaporation rate at 30° C is twice that at 20 ° C).

- Styrene can be smelled at very low concentrations. Prolonged exposure to styrene reduces a person's ability to smell it.

Styrene liquid is soluble in body fat and can be absorbed through the skin, however, studies have shown that the styrene present in polyester resin is not easily absorbed through the skin. Inhalation is therefore the major route of exposure.

All resins containing styrene, liquid styrene and styrene vapours are highly flammable. All sources of ignition must be removed from areas where these materials are used or stored. Other safety measures include:

- use of non-sparking ventilation fans and electrical equipment; and

- no smoking permitted.

As styrene vapour is heavier than air, it may travel some distance to an ignition source and flash back.

The *Explosives and Dangerous Goods Act* and *Regulations 1992* cover the storage of flammable liquid.

Resins and liquid styrene should be stored in a cool, dry, well ventilated area, out of direct sunlight and in a part of the workplace separate from the production area. They should be stored away from possible sources of ignition.

Containers must be adequately labelled and tightly closed when not in use.

4. HEALTH EFFECTS OF STYRENE EXPOSURE

4.1 SHORT TERM HEALTH EFFECTS

- Styrene vapour causes mild irritation of the nose and throat at concentrations around 100 ppm, definite irritation at 350-500 ppm and severe irritation at about 500 ppm.
- Symptoms such as headache, dizziness and fatigue are reported at concentrations above 100-200 ppm.
- Other symptoms such as slower reaction times, reduced manual dexterity, and impaired co-ordination and balance can be observed at concentrations above 200 ppm.
- Styrene liquid defats the skin and can cause dermatitis.
- Styrene liquid can cause mild to severe irritation of the eyes if splashing occurs.

4.2 LONG TERM HEALTH EFFECTS

- A number of studies have reported on the effect to the central nervous system of repeated exposure to styrene vapours.
- Slower reaction times have been measured in workers exposed to concentrations of about 55 ppm and even lower over extended periods. This impairment appears temporary, and some of the studies are the subject of debate.
- Increased damage to the genetic material in one type of blood cell (lymphocytes) has been reported at low concentrations in some studies.
- There is inadequate evidence to show that styrene is carcinogenic in humans.

5. SOME RELEVANT REGULATIONS

While the Occupational Safety and Health Regulations include some regulations that relate specifically to styrene, the regulations that apply are not limited to these particular regulations. Employers using styrene need to be aware of other regulations in PART 3 WORKPLACE SAFETY REQUIREMENTS, PART 4 PLANT, and PART 5 HAZARDOUS SUBSTANCES which are relevant to their workplace and whether a certificate of competency is required to operate any of the industrial equipment at their workplace (PART 6).

The following regulations are specific to or particularly relevant to styrene.

Identification of hazards, and assessing and addressing risks, at workplaces

Regulation 3.1 states

A person who, at a workplace, is an employer, the main contractor, a selfemployed person, a person having control of the workplace or a person having control of access to the workplace must, as far as practicable –

"toxic atmosphere", in relation to a workplace, includes –

(a) identify each hazard to which a person at the workplace is likely to be exposed;
(b) assess the risk of injury or harm to a person resulting from each hazard, if any, identified under paragraph (a); and
(c) consider the means by which the risk may be reduced.

Identification and assessment of hazards in relation to atmosphere

Regulation 3.38 states

Without limiting regulations 3.1 and 3.32, a person who, at a workplace, is an employer, the main contractor or a selfemployed person must –

(a) identify each hazard arising from an oxygen deficient atmosphere or a toxic atmosphereto which a person at the workplace is likely to be exposed;
(b) assess the risk of injury or harm to a person resulting from each hazard, if any, identified under paragraph (a); and
(c) consider whether the risk may be reduced by any of the means referred to in regulation 3.39.

Possible means of reducing risks

Regulation 3.39 states

The means referred to in regulation 3.38(c) are –

(a) the use of an effective ventilation system for the workplace;
(b) the provision of an exhaust system that effectively extracts any contaminant and which is arranged so as to prevent reentry of the extracted air into the workplace; and
(c) such other means as would prevent persons at the workplace from being exposed to an oxygen deficient atmosphere or a toxic atmosphere,

as is appropriate to the particular case.

SOME RELEVANT REGULATIONS

Regulation 3.37 states (in part)

"toxic atmosphere", in relation to a workplace, includes –

(a) an atmosphere in which there is an atmospheric contaminant in a concentration exceeding the exposure standard for the contaminant specified in the National Exposure Standards [NOHSC: 1003 (1995)];

(b) where an inspirable dust or respirable dust is not within the scope of the Exposure Standards referred to in paragraph (a), an atmosphere in which a person at the workplace would be exposed to –

(i) the inspirable dust that, when measured in accordance with AS 3640, exceeds 10 milligrams per cubic metre of air; or

(ii) the respirable dust that, when measured in accordance with AS 2985, exceeds 5 milligrams per cubic metre of air,

as an average over a work period of 8 hours;

and

(c) an atmosphere containing gas, vapour, dust or any other particle which is, or is in a concentration that is, a risk to the safety and health of a person at the workplace.

Respiratory protective equipment generally

Regulation 3.40 states

(1) In this regulation –

"toxic atmosphere" means any toxic atmosphere that is of a kind other than a kind referred to in any of paragraphs (b) to (f) of regulation 3.41.

(2) To the extent that it is not practicable to prevent, by any of the means referred to in regulation 3.39, a person at a workplace from being exposed to a toxic atmosphere a person who, at the workplace, is an employer, the main contractor or a selfemployed person must ensure that each person who may be so exposed is provided with respiratory protective equipment –

(a) selected in accordance with AS/NZS 1715 to suit the circumstances of the case and that is used and maintained in accordance with that Standard; and

(b) complying with the relevant requirements of AS/NZS 1716.

(3) Nothing in regulation 3.41 prevents a person from concluding, for purposes of subregulation (2), that the appropriate respiratory protective equipment in a particular case is equipment of a kind referred to in regulation 3.41.

(4) A person who, at a workplace, is an employer, the main contractor or a self-employed person and who provides for use at a workplace respiratory protective equipment of any kind must ensure that the equipment is readily accessible to persons at the workplace who may need to use the equipment.

SOME RELEVANT REGULATIONS

Supplied air respirators required for certain atmospheres

Regulation 3.41 states

To the extent that it is not practicable to prevent, by any of the means referred to in regulation 3.39, a person at a workplace from being exposed to -

(a) an oxygen deficient atmosphere;

(b) an atmosphere in which the level of toxic gases or vapours exceeds the capability of an air-purifying device;

(c) a toxic atmosphere where the level of contamination is not known;

(d) a toxic atmosphere in which the person is required to remain for a period longer than the estimated life of a filter;

(e) an atmosphere that presents an immediate danger to life or health; or

(f) a toxic atmosphere which contains a contaminant against which there is no suitable filter,

a person who, at the workplace, is an employer, the main contractor or a selfemployed person must ensure that each person who may be so exposed is provided with a supplied air respirator.

Styrene vapour to be minimised

Regulation 5.69 states

If styrene monomer vapour is present at a workplace, a person who, at the workplace, is an employer, the main contractor or a selfemployed person must reduce, as far as practicable, the amount of styrene monomer vapour that is released into the workplace.

Extracting styrene vapour from atmosphere

Regulation 5.70 states

A person who, at a workplace, is an employer, the main contractor or a self-employed person must prevent the lower explosive limit of styrene monomer from being reached in the workplace by ensuring, where it is practicable to do so, that there is in place a mechanical exhaust system arranged so as to –

(a) prevent re-entry of the extracted air into the workplace; and

(b) continue to extract air for at least 15 minutes after cessation of any process using styrene monomer.

The lower explosive limit in respect of styrene means the minimum concentration of vapour, gas or dust in the atmosphere of the workplace that will propagate a flame.

6. EXPOSURE STANDARD

The exposure standard for styrene is 50 ppm time-weighted average. This means that the exposure to styrene averaged over an eight hour period would be equivalent to a constant exposure to 50 ppm of styrene (assuming a 40 hour working week).

The term “parts per million” (ppm) refers to the number of parts of styrene (by volume) present in a million parts of contaminated air.

Where workers are exposed to styrene for more than eight hours a day or for more than 40 hours a week, the allowable exposure should be reduced by a suitable factor to ensure adequate worker protection. Such factors require careful consideration, and expert advice should be sought in the specification of modified exposure standards.

7. CONTROLLING EXPOSURE

A number of strategies can be used to reduce styrene exposure. The regulations require the employer to use mechanical ventilation to reduce exposure to below the occupational exposure standard. However, there are methods that can be implemented to reduce the amount of styrene vapour generated in the first instance. These include substitution of materials and redesigning equipment used in the fibreglass process that will reduce styrene vapour emissions. In conjunction with the mechanical ventilation required to control emissions, work practices need to be adopted that maximise the efficiency of the control methods.

Suggested means of controlling exposure are discussed in this section. Personal protective equipment, including respiratory protection which must be used where it is not practicable for mechanical ventilation to reduce styrene below the 50 ppm standard, is also described.

7.1 SUBSTITUTION

While there is no viable substitute for styrene at present, there are alternatives to the conventional resins widely used in the fibreglass industry in Western Australia.

7.1.1 Waxed resins

Waxed resins contain wax additives that rise to the surface during curing and provide a barrier that reduces styrene emission. Waxed resins produce a marked reduction in styrene emissions during the exotherm (curing phase) and only a small reduction during the lay-up phase.

7.1.2 Low styrene emission (LSE) resins

LSE resins contain wax-like additives that produce a marked reduction in styrene emissions during curing and a significant reduction during laminating.

The term ‘low styrene emission’ does not have a formal or legal definition in Western Australia. As a result, there is significant variation among resins carrying the name LSE. The performance of a resin can be determined using a standard test method.*

Other tests may be used to compare resins provided a recognised standard test method is used.

** The method used by the British Federation is described in **Appendix 1** . Only resins producing styrene emissions less than 20 grams/square metre/30 minutes (when tested by this method) are considered to qualify as LSE resins.*

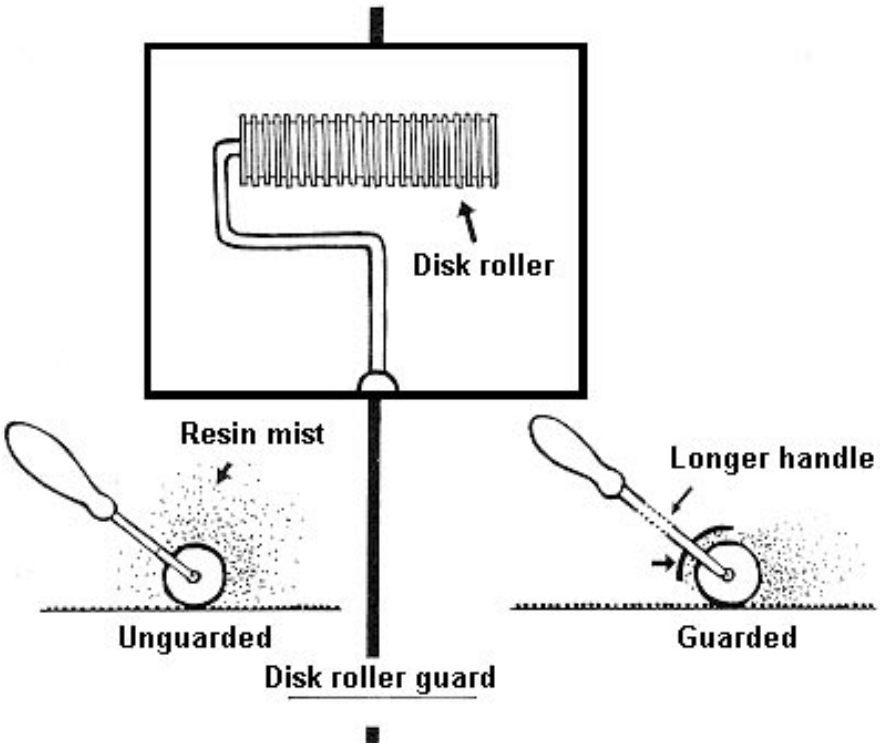
7.2 EQUIPMENT DESIGN

Worker exposure is highest during the spraying and rolling operations. The employer should seek equipment that is designed to minimise vapour emissions.

The following general principles should result in lower styrene emissions during spraying:

- use of airless spraying methods rather than systems which use air to atomise resin;
- use of low pressure systems that produce a coarse spray;
- use of spray guns that combine low pressures with innovative nozzle design. Some models use air to form an envelope around the resin and catalyst, as it is sprayed onto the workpiece, to prevent particles of catalyst and resin escaping the spray pattern.

During rolling operations, rollers fitted with guards to reduce droplet formation will help to reduce styrene emission. Long handled rollers should be used where possible.



7.3 VENTILATION SYSTEMS

Ventilation systems need to be planned and designed carefully to ensure that styrene vapours are removed or reduced to levels that do not pose a hazard to employees. Low air velocities will not remove styrene vapours effectively while very high air velocities can cause excessive styrene loss and so affect the quality of the products. Advice from a ventilation engineer or occupational hygienist is recommended.

In a particular workplace, it will often be appropriate to use more than one type of ventilation system in order to control styrene exposure.

Factors that influence the selection of a ventilation system include:

- requirements of the Department of Environmental Protection;
- size and shape of the workpiece and the type of mould (male or female);
- method of application and the amount of styrene vapour it generates;
- exposed surface area. Workpieces which require large surface areas to be laminated at the same time must have ventilation systems capable of extracting vapour from a large area; and
- type of resin used. LSE resins result in lower concentrations of styrene vapour (particularly during curing). As a result, it may be possible to extract smaller volumes of air and still effectively control styrene concentrations.

The aim must be to reduce styrene exposure to levels as low as reasonably practicable below the occupational exposure standard of 50 ppm (TWA).

The basic components of a mechanical ventilation system are fans, ducting and a capture mechanism (eg. hoods or booths). Scrubbers and filters are sometimes used to remove contaminants before air is discharged.

7.3.1 Fans

It is important to select the correct fan for a particular application. Most fans can be described either as centrifugal or axial flow fans. In broad terms, centrifugal fans are used for high pressure application. Axial fans are used for low pressure, high volume applications.

Other factors to consider are fan efficiency, noise and the ease of access for cleaning (the efficiency of some fans is greatly reduced by dust or other particles that stick to the blades).

7.3.2 Ducting

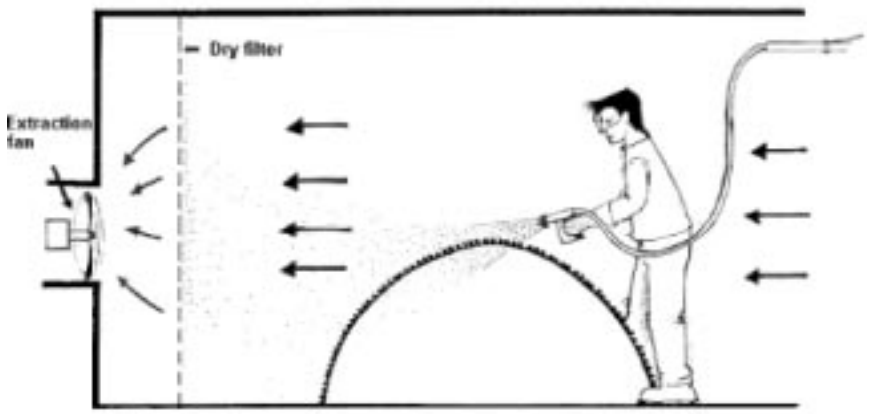
In the selection of ducting, note that energy losses will be minimised by having smooth inside walls and the minimum number of bends.

7.3.3 Booth ventilation

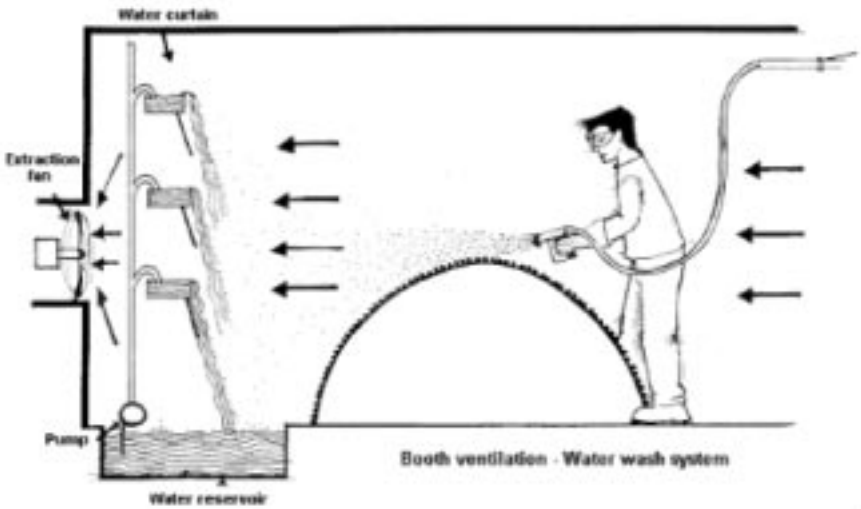
'Spray-up' or 'hand lay-up' may be carried out in a booth fitted with extraction ventilation. It is possible to construct mobile booths and booths with adjustable dimensions. Fan speed can be varied if necessary. Booths may use a dry filter or a water curtain to collect spray.

Booth ventilation is the most desirable form of ensuring effective control of styrene vapours. A carefully planned and designed ventilation system in a booth ensures that the hazardous activity is restricted to a designated area and prevents the rest of the area from being contaminated.

When designing a booth, consideration should be given to the accommodation and the manual handling of workpieces to ensure optimal efficiency of the ventilation system.



Booth ventilation - Dry filter

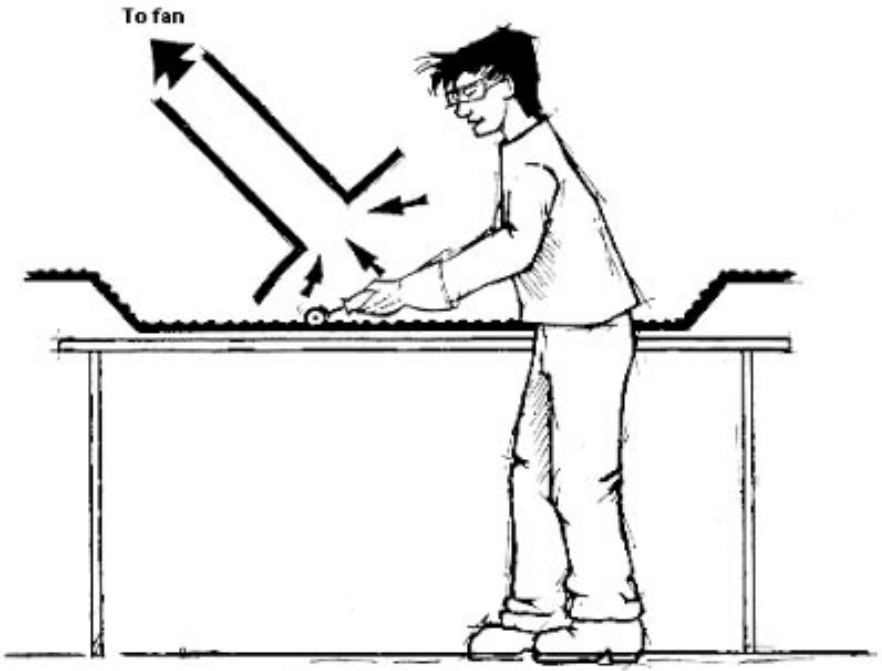


Booth ventilation - Water wash system

7.3.4 Local exhaust ventilation

Local exhaust ventilation allows for vapours to be extracted close to the source and removed from the workplace. Local exhaust ventilation can be highly effective, particularly when the exhaust system is placed close to the source of styrene emission.

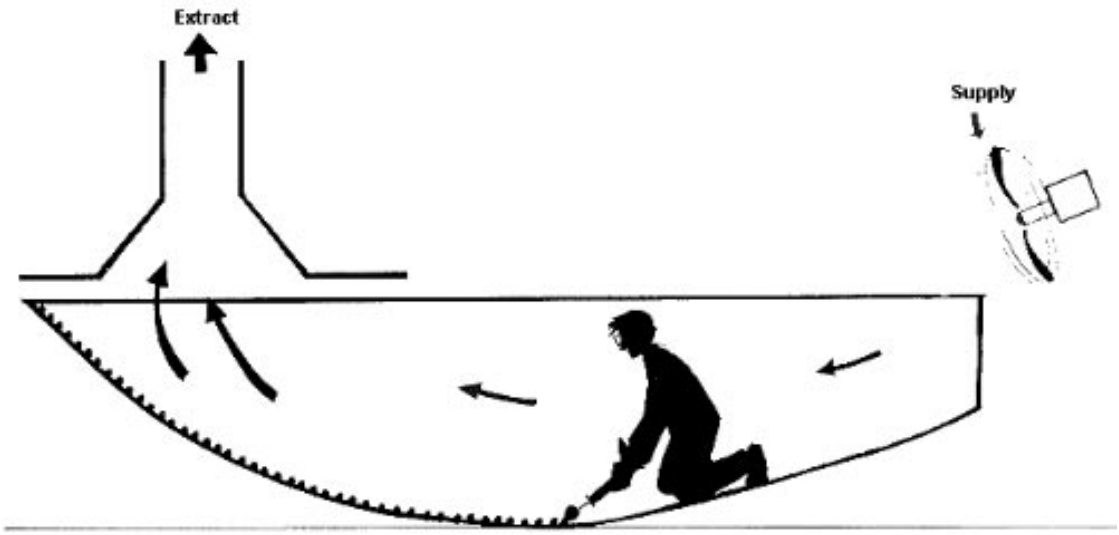
Although local exhaust ventilation can be as effective as a booth ventilation system, it may not be suitable when working on large pieces. Local exhaust ventilation can be difficult to adjust and move around the workplace, and the area exhausted can be small, therefore adequate ventilation for styrene vapours may not be provided.



Local exhaust ventilation

7.3.5 Push-pull ventilation

Fans are used to blow vapours away from the worker's breathing zone and towards an extraction system. Push-pull ventilation systems are suitable for large workpieces, however, designers of the system need to ensure that the air flow is such that employees receive uncontaminated air.

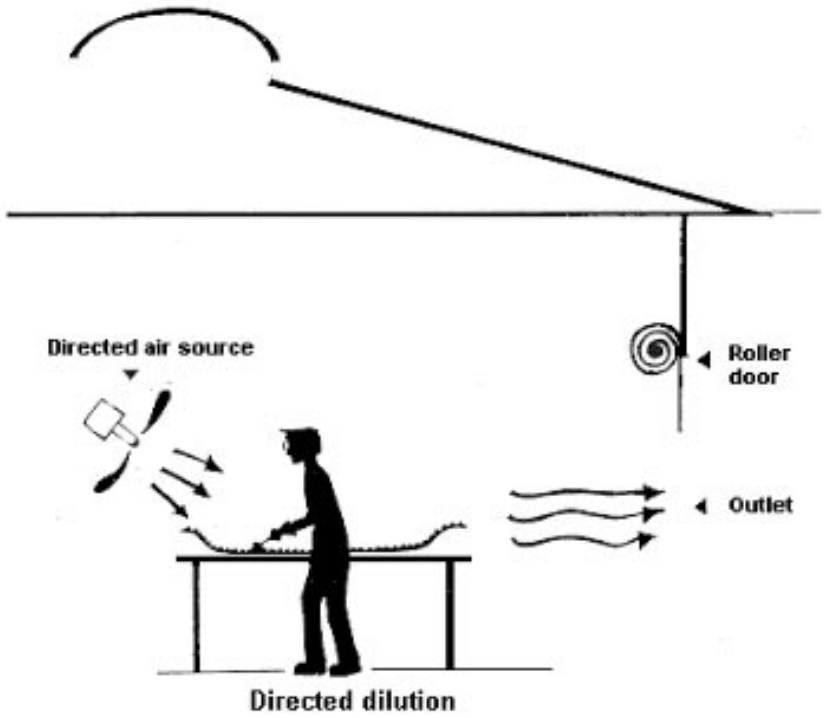


Push-pull ventilation
(Work proceeds towards supply, away from extraction)

7.3.6 Directed dilution ventilation

Directed dilution ventilation is not sufficient as a primary means of controlling the levels of styrene vapour but may be used in conjunction with mechanical ventilation. Department of Environmental Protection requirements need to be taken into consideration.

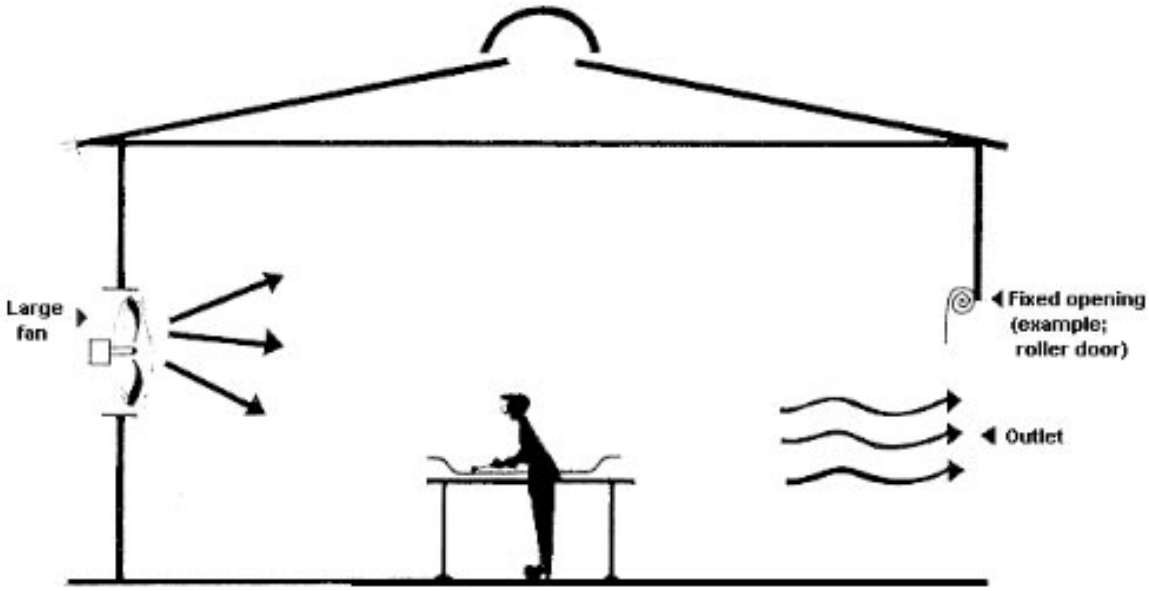
Fans are used to create localised air flow and remove vapours from the worker's breathing zone. This type of ventilation system is not generally recommended for large and ongoing operations as styrene vapour tends to be spread around rather than removed from the immediate workplace. Directed dilution also has the problem of causing excessive loss of styrene, which may affect the quality of the product.



7.3.7 General dilution ventilation

General dilution ventilation is the least favoured option of controlling styrene exposure as it is not sufficient as a primary means of controlling the levels of styrene vapour, however, it may be used in conjunction with mechanical ventilation. Department of Environmental Protection requirements need to be taken into consideration as well.

Fans are used to introduce fresh air into the workplace. This fresh air dilutes contaminated air and reduces the concentration of styrene. Dilution ventilation is of limited effectiveness to employees working close to the source of emission and also contaminates the rest of the workplace.



General dilution ventilation

7.3.8 Natural ventilation

Natural ventilation cannot be used as a primary means of controlling exposure to styrene, but may be used in conjunction with other means of ventilation to ensure the levels of styrene are reduced to as low as possible. In all circumstances, the levels of styrene must be consistent with Department of Environmental Protection requirements.

7.4 WORKING PROCEDURES

Styrene exposure must be an important consideration when planning working procedures. Working procedures should include:

- restricting laminating (particularly spraying) to areas with suitable ventilation systems;
- ensuring the time spent between the workpiece and the extraction system during hand laminating and exotherm (curing phase) is kept to a minimum. Workers should not place themselves between the workpiece and the extraction system during spraying;
- keeping pots or drums of resin closed when not in use; and
- avoiding skin contact with resin.

7.5 MAINTENANCE SCHEDULES

Specific schedules should be prepared for:

- inspection and maintenance of ventilation systems (eg. system performance records);
- maintenance and cleaning of respiratory protection;
- inspection of gloves and other protective clothing; and
- regular cleaning of the factory to remove waste.

7.6 PERSONAL PROTECTION

The Act: Section 19 states (in part)

(1) An employer shall, so far as is practicable, provide and maintain a working environment in which his employees are not exposed to hazards and in particular, but without limiting the generality of the foregoing, an employer shall -

(d) where it is not practicable to avoid the presence of hazards at the workplace, provide his employees with, or otherwise provide for his employees to have, such adequate personal protective clothing and equipment as is practicable to protect them against those hazards, without any cost to the employees.

CONTROLLING EXPOSURE

The Act: Section 20 states (in part)

(1) An employee shall take reasonable care -

(a) to ensure his own health and safety at work; and

(b) to avoid adversely affecting the safety or health of any other person through any act or omission at work.

(2) Without limiting the generality of subsection (1), an employee contravenes that subsection if he –

(b) fails to use such protective clothing and equipment as is provided, or provided for, by his employer as mentioned in section 19 (1) (d) in a manner in which he has been properly instructed to use it;

Responsibilities of persons who require personal protective clothing and equipment to be used

Regulation 3.34 states

(1) If a person is required under any of these regulations to identify a hazard at a workplace and to assess the risk of injury or harm to a person resulting from the hazard and the person concludes from the assessment process that personal protective clothing or equipment should be used at the workplace then the person must ensure that -

(a) the person who uses the clothing or equipment is instructed in relation to the correct fitting, use, selection, testing, maintenance and storage of the clothing or equipment;

(b) the person who uses the clothing or equipment is informed of the limitations in the use of the clothing or equipment;

(c) the clothing or equipment is maintained in good working order;

(d) the clothing or equipment is replaced –

(i) when it no longer provides the level of protection required to protect the wearer or user against the particular hazard;

(ii) when the safe working life, as specified by the person who manufactured the clothing or equipment, has expired; or

(iii) subject to subregulation (2), when it is damaged and cannot be repaired;

and

(e) the area of a workplace at which the clothing or equipment is required to be used by a person other than the person who provides the clothing or equipment is identified by signs in accordance, and complying, with AS 1319.

(2) A person does not commit an offence under subregulation (1)(d) if, proof of which is on the person, the clothing or equipment is repaired rather than replaced and -

(a) the repair is done by a competent person;

(b) the repair is done according to the specifications of the manufacturer of the equipment; and

(c) any replacement part used in the repair is that which is specified by the manufacturer of the equipment as the correct replacement part.

Responsibilities of users of personal protective clothing and equipment

Regulation 3.35 states

A person to whom personal protective clothing or equipment is provided or made available for use at a workplace -

(a) must use the protective clothing or equipment in a manner in which he or she has been properly instructed to use it;

(b) must not misuse or damage the clothing or equipment; and

(c) must, as soon as practicable after becoming aware of any -

(i) damage to;

(ii) malfunction of; or

(iii) need to clean or sterilize,

the clothing or equipment, notify the person providing the clothing or equipment of the damage, malfunction or need to clean or sterilize the clothing or equipment.

Personal protective equipment (PPE) should be considered only:

- when other measures are not practicable; or
- when used in conjunction with other methods to increase protection.

Personal protective equipment must be considered for the:

- head;
- legs;
- eyes;
- ears;
- skin;
- respiratory system;
- feet; and
- hands.

Personal protective equipment must be adequate for each task. People should be trained in the correct selection, use, fit, care, storage and maintenance of the equipment.

The WorkSafe Western Australia Commission *Code of Practice for Personal Protective Equipment* should be referred to for further information on PPE.

7.6.1 Respiratory protection

In most instances, respiratory protection should only serve as a temporary measure until engineering controls are in place.

Several types of respirators are available. The type selected will depend on:

- concentration of styrene vapour;
- duration of exposure;
- presence and concentration of other contaminants such as resin mist and dust;
- nature of the particular operation; and
- likelihood of an oxygen-deficient atmosphere being present.

Suppliers of respiratory equipment should be consulted to determine the most appropriate respirator for a given application. Only equipment complying with *AS/NZS 1716 Respiratory protective devices* and selected in accordance with *AS/NZS 1715Selection, use and maintenance of respiratory devices* may be used.

Nominal protection factors for various types of respiratory protection are listed in *AS/NZS 1715*. For details on the performance of a particular model consult the supplier.

In broad terms, respirators can be divided into “air purifying” or “air supplied” types.

7.6.2 Air purifying respirators

All air purifying respirators use a filter device to purify air as it is breathed in.

With appropriate filters, they can protect against styrene vapour, resin mist and dust. Half face and full face mask models are available.

Respirators with a battery powered air blower are available in half face, full face and helmet or hood models.

- **Half face respirators**
  Most half face respirators provide protection against styrene vapour concentrations up to 10 times the occupational exposure standard when fitted correctly. However, they are easily clogged by resin mist.

- **Full face respirators**
  Most full face respirators will provide protection against styrene vapour concentrations up to 100 times the occupational exposure standard when fitted correctly. However, they are not comfortable to wear, partially restrict vision and they are easily clogged by resin mist.

- **Powered air purifying respirator**
  Most powered air purifying respirators will provide protection against styrene vapour concentrations up to 100 times the occupational exposure standard and draw air from behind the operator, prolonging filter life and avoiding clogging.

  They are relatively comfortable to wear.

  An effective fit is less critical than with non powered air purifying respirators.

  Batteries need regular recharging to maintain performance.

7.6.3 Air supplied respirators

There are several types of air supplied respirators. Each type supplies clean air to the user (rather than purifying contaminated air).

- **Air line respirators**
  Air line respirators supplying clean air to the mask, helmet or hood with an air line are most suited for use in the fibreglass industry.

  The level of protection depends on whether a helmet, hood or mask is used (as well as the type of mask). It can range from below 10 to more than 100 times the exposure standard. Check with the manufacturer for information on the protection factor.

  They are comfortable to wear. However, the lines may severely restrict movement and become caked with resin unless the workplace is designed to overcome these limitations.

7.6.4 Eye protection

Safety glasses with side shields or chemical goggles should be worn. Eye baths should be immediately available in case of eye contact.

7.6.5 Skin protection

Appropriate gloves and protective clothing should be worn to prevent skin contact as styrene defats the skin and can cause dermatitis.

The selection of gloves depends largely on what is being handled. Matching gloves to the many materials, conditions and operations where some degree of hand protection is required is a complex task.

The majority of injuries involving hands and arms are due to chemical action, however cuts, abrasions and temperature extremes must also be considered. Selection plays an important part in ensuring the appropriate level of protection.

No available glove is totally suitable for prolonged contact with liquid styrene. Consult the glove supplier to determine the most appropriate glove for this particular application.

Contaminated clothing should be removed immediately. Any resin in contact with the skin should be removed by washing with water and a mild detergent or solvent-free cleanser. Clothing should be laundered before re-use. Care should be taken to avoid contact with the resin when handling soiled clothing. It is preferable to carry out laundering at the workplace or by a specialist laundry service. If disposable clothing is worn, suitable procedures must be developed to ensure the clothing is appropriately disposed of without risk to the safety and health of others.

7.7 MONITORING

Assessment in relation tohazardous substances

Regulation 5.15 states

(1) Without limiting regulation 3.1, a person who, at a workplace is an employer, the main contractor or a selfemployed person must assess the risk of injury or harm occurring to a person as a result of the person being exposed to a hazardous substance at the workplace.

(2) A person who, at a workplace is an employer, the main contractor or a selfemployed person must ensure, as far as is practicable, that an assessment referred to in subregulation (1) –

(a) includes the identification of each hazardous substance used at the workplace;

(b) includes –

(i) a review of the MSDS for each hazardous substance used at the workplace; or

(ii) where a hazardous substance is included in a consumer package, a review of each label on the package;

and

(c) includes the identification of any likelihood of injury or harm occurring as a result of exposure to each hazardous substance used at the workplace.

(3) If a person is required under subregulation (1) to conduct an assessment in relation to a hazardous substanceat one workplace then the person may, for the purposes of the assessment, have regard to an assessment of representative work with the hazardous substanceat another workplace or other workplaces.

(4) A person who is required under subregulation (1) to conduct an assessment in relation to a hazardous substanceat a workplace must ensure that whatever the outcome of the assessment, a record is made in the register referred to in regulation 5.13 to indicate that the assessment has been done.

CONTROLLING EXPOSURE

Monitoring risks associated withhazardous substances

Regulation 5.22 states

If an assessment under regulation 5.15 indicates that monitoring should be done at the workplace then a person who, at the workplace, is an employer, the main contractor or a selfemployed person must ensure that –

(a) appropriate monitoring is done;

(b) a record is kept of the results of monitoring;

(c) each person who is likely to be exposed to a hazardous substance at the workplace is given the results of the monitoring of the hazardous substance as soon as the results are available; and

(d) the results of monitoring are accessible to all persons referred to in paragraph (c) at all reasonable times.

7.7.1 Atmospheric monitoring

Atmospheric monitoring should be carried out initially to determine workers' exposure and subsequently if changes are introduced in the workplace likely to affect the level of styrene vapour.

Any measurements taken need to be representative of environmental conditions (especially ambient temperature) and changes in these conditions may require further monitoring to be carried out.

Atmospheric monitoring involves measuring the concentration of styrene vapour either in workers' breathing zones (personal samples) or at selected points in the factory (positional samples). Atmospheric monitoring can be used to determine:

- the extent of worker exposure;
- control measures needed;
- the effectiveness of control measures; and
- the effect of any changes made in the workplace.

There is a range of atmospheric monitoring devices available.

- **Absorbent tubes**
  Absorbent tubes are glass tubes filled with a suitable absorbing medium. Air is drawn through at a set rate using a small pump. Contaminants are collected on the absorbing medium and are analysed in a laboratory to measure the concentration in the air sampled.

- **Passive devices**
  Passive devices are small tubes or badges that contain an absorbing medium. Contaminants diffuse into these devices and are collected for subsequent analysis in a laboratory.

- **Detector tubes**
  Detector tubes are filled with a reacting material that is designed to give a colour change when exposed to a specific chemical. Air is drawn through the tube using a hand pump. The length of the coloured stain is most commonly measured against a calibrated scale to give the concentration.

Monitoring should be carried out by a person with appropriate training. Occupational hygiene services able to carry out monitoring are provided by a number of Western Australian companies.

7.7.2 Biological monitoring

Biological monitoring can be used to provide information on the amount of styrene absorbed into the body. It can demonstrate routes of exposure other than air inhalation and the efficiency of personal protective equipment.

Biological monitoring should be used only to supplement, rather than replace, atmospheric monitoring. Atmospheric monitoring is covered in the section above.

Biological monitoring should only be carried out by a person with appropriate training. Occupational health and occupational hygiene services are required to ensure proper planning and implementation of a biological monitoring program and correct interpretation of the monitoring results.

The Chamber of Commerce and Industry of Western Australia (Tel. 365 7577), the Trades and Labor Council of Western Australia (Tel. 328 7877) and WorkSafe Western Australia (Tel. 9327 8777) can provide information on the availability of occupational health and hygiene providers.

APPENDIX 1 – THE MEASUREMENT OF STYRENE EVAPORATION FROM UNSATURATED POLYESTER RESINS

Object

The purpose of this test method is to give an indication of the rate of styrene loss from a typical Chopped Strand Mat (CSM) contract moulded laminate, with a surface open to the atmosphere.

Principle

A single layer of CSM is impregnated with the uncatalysed resin and supported on an accurate direct reading top pan balance in a temperature controlled draught free room. The loss in weight in grams is recorded against time.

Apparatus and materials

- Top pan direct reading balance accurate to 0.01 grams.
- Polyethylene terephthalate film (eg. Melinex).
- Glass fibre CSM – emulsion bound – 450 grams.
- Draught free room. 50 cubic metres minimum controlled at 23°C.
- Optional shielding (see Figure 1).
- Suitable support platen 300 millimetres x 300 millimetres.
- Glass beaker.

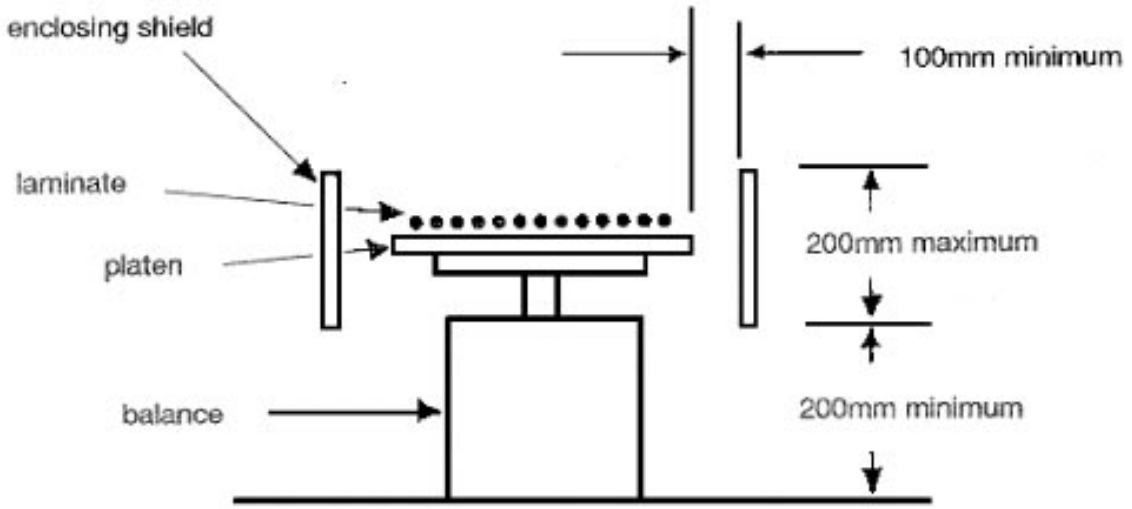
Method of test

1. Set up the apparatus in a draught free room.
2. Cut and weigh a 250 millimetre x 250 millimetre section of CSM.
3. Cut a 300 millimetre x 300 millimetre square of Melinex film and mark an area of 250 millimetre x 250 millimetre on the back of the film with a marker pen.
4. Adjust the resin temperature to 23°C.
5. Place the Melinex film on the support platen. Pour a quantity of resin from the glass beaker onto the film equal to 2 times the weight of the CSM and spread evenly over the marked area.
6. Place the CSM sample into the resin and quickly ensure complete impregnation of the mat by gently pressing with the edge of a spatula. Within one minute, place the lay-up and the support platen on the balance and note the reading.
7. Record the weight at 2 minutes, 5 minutes, 10 minutes and thereafter at 10 minute intervals for one hour, or long as required.
8. Repeat the procedure from points 2. to 7. twice.
9. From the results, plot a graph of mean cumulative loss in weight against time.

APPENDIX 1 – THE MEASUREMENT OF STYRENE EVAPORATION FROM UNSATURATED POLYESTER RESIN

Items to be reported

- Resin identification.
- CSM identification.
- Actual atmospheric temperature.
- Relative humidity.
- The amount of styrene (grams) emitted after 60 minutes, or at other time intervals as agreed between the resin manufacturer and purchaser.



Optional Shielding

In the likelihood that draughts may be encountered, it is recommended that this shielding should be used.

The shielding is to be positioned so that there is a minimum clearance of 100 millimetres between the platen and shield.