HEALTH AND SAFETY GUIDELINES ON THE MANAGEMENT OF HAZARDS IN THE METAL CASTING INDUSTRY

A joint publication by:

Casting Technology NZ Inc and Occupational Safety and Health (OSH)

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Foreword

It is with great pleasure that I write this foreword to the Health and Safety Guidelines on the Management of Health Hazards in the Metal Casting Industry. This document replaces an earlier publication originally prepared by the then Department of Health in 1989, who recognised the particularly hazardous nature of the industry. Data contained in the OSH Notifiable Disease System (NODS) maintained by OSH confirms that there are a number of specific hazards in the metal casting industry which need to be carefully managed, including noise, dust, fumes, and manual handling.

Casting Technology New Zealand (Inc) are to be congratulated on their foresight and initiative in taking ownership for the preparation of this updated publication. Considerable effort has gone into the development and consultation process which is now presented as an industry best practice document. By using the information contained in this guideline industry members will be confident that they are taking all practicable steps to manage health and safety.

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SECTION 1

INTRODUCTION

1 Preface and Scope

Preface

This document has been prepared after consultation with the metal casting industry and other interested groups. The purpose of the guide is to provide general information to those in the industry and others about the hazards in the metal casting industry and suggestions for controlling or mitigating them.

Scope

This guideline applies to all industries involved in metal casting and similar operations. It helps to provide acceptable solutions to managing specific hazards found in the industry.

2 Introduction

These guidelines are aimed at safeguarding the health of those who visit or work in the metal casting industry, in particular to protect them against exposure to:

- dusts, including various forms of silica containing materials which can cause silicosis;
- gases, some given off in large quantities and some very toxic;
- excessive noise, sometimes of high intensity, causing hearing loss and interfering with communication between workers;
- heat, which is a common ingredient of foundry work and can cause severe burns especially from contact with hot metals or containers. Both radiant and ambient heat can also result in infra-red burns or heat exhaustion.

To protect workers against these and other hazards the following principles are applied:

1. Good plant design;
2. Ergonomics and manual handling;
3. Assessment of hazards;
4. Engineering controls;
5. Cleanliness and good housekeeping;
6. Safe work practices;
7. Adequate facilities properly cleaned and maintained;
8. Personal protective equipment, for use in high-risk areas or when engineering controls are temporarily inadequate;
9. Training in safety and health;
10. Response mechanisms to minimise the effect of an accident or emergency;
11. Provision of information on health and safety hazards at work;
12. Health assessments and medical monitoring.

3 Summary of the Health and Safety in Employment Act 1992

The principal object of the Health and Safety in Employment Act 1992 (HSE Act) is to prevent harm to employees at work. To do this, it imposes duties on employers, employees, principals, and others and promotes excellent health and safety management by employers. It also provides for the making of regulations and codes of practice and other best practice documents which may be used to assist in determining what constitutes "all practicable steps" when managing hazards.

Regulations

Regulations made under the Act may impose duties on employers, employees, designers, manufacturers, and others relating to health and safety. These regulations may apply with respect to places of work, plant, processes or substances and may have been made to deal with particular problems that have arisen.

Approved codes of practice

"Approved codes of Practice" are provided for in Section 20 of the HSE Act. They are statements of preferred work practices or arrangements, and may include procedures which could be taken into account when deciding on the practicable steps to be taken. Compliance with Codes of Practice is not mandatory, however they may be used as evidence in court of good practice. Industry guidelines or codes of practice may also provide an acceptable solution under the "All Practicable Steps" regime of the HSE Act. If an employer uses the advice given in an industry best practice document he can use this as a defence against any count of not taking all practicable steps.

Employer's duties

Employers have a responsibility to ensure the health and safety of employees at work.

Employers have a duty to take all practicable steps to ensure the safety of employees. In particular they are required to take all practicable steps to:

- Provide and maintain a safe working environment;
- Provide and maintain facilities for the health and safety of employees at work;
- Ensure that machinery and equipment is safe for employees;
- Ensure that working arrangements are not hazardous to employees; and
- Provide procedures to deal with emergencies that may arise while employees are at work.

Taking "all practicable steps" means, what is reasonably able to be done to achieve a result in the circumstances, taking into account:

- The severity of any injury or harm to health that may occur;
- The degree of risk or probability of that injury or harm occurring;
- How much is known about the hazard and the ways of eliminating, reducing or controlling it; and
- The availability, effectiveness and cost of the possible safeguards.

Hazard Management

Employers must have an effective method to identify and regularly review hazards in the place of work (existing, new and potential). They must determine whether the identified hazards are significant hazards and require further action.

If an accident occurs that requires particulars to be recorded, employers are required to investigate it to determine if it was caused by or arose from a significant hazard.

"Significant hazard" means a hazard that is a cause or potential cause or source of:

- Serious harm; or
- Harm (being more than trivial) where the severity of the effects on a person depends (entirely or among other things) on the extent or frequency of the person's exposure to the hazard; or
- 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 HSE Act sets out the steps employers 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, the employer must minimise the likelihood that employees will be harmed by the hazard.

Where the hazard has not been eliminated or isolated, employers must:

- Ensure that protective equipment is provided, accessible and used;
- Monitor employees' exposure to the hazard;
- Seek the consent of the employees to monitor their health; and
- With their consent, monitor employees' health.

Information for employees

Before employees begin work, they must be informed by their employer of:

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

Employees should be provided with the results of any health and safety monitoring. In doing so, the privacy of individual employees must be protected and their consent obtained prior to any release of personal information should this be necessary.

Employers should clearly indicate employees' responsibilities including:

- Adherence to standard work practices and procedures in the performance of their work;
- Adherence to safety policy and procedures and correct wearing of protective equipment and clothing;
- Complying with maintenance and replacement procedures and reporting of faulty or damaged plant and safety equipment;
- Maintaining a high standard of efficiency, order and cleanliness at the workplace; and
- Using the canteen, mess room, eating and drinking facilities in a responsible manner and keeping them clean.

Employers to involve employees in the development of health and safety procedures

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

Training of employees

Employers must ensure employees are either competent to do their work safely or are supervised by a competent person. In addition employees must be adequately trained in the safe use of all plant, objects, substances and protective clothing and equipment that the employee may be required to use or handle.

The employer's responsibilities includes training employees in:

- How to use hazard control measures correctly including the use of ventilation and other equipment;
- Safe working procedures;
- Emergency procedures;
- How to use personal protective clothing and equipment properly.

The employer's responsibilities should also include advice on:

- How to maintain personal hygiene;
- When to have medical examinations;
- When to report any defects that could undermine workers' health.

Provision of information

There is a specific requirement in section 12 of the HSE Act for employers to provide information about any process or substance used in a place of work. This should include details about what to do in an emergency, what the hazards are, how the effects can be minimised, and where all the necessary safety equipment is kept.

Safety of people who are not employees

Employers also have a duty towards persons who are not employees. This will involve having in place a procedure to ensure that contractors working on-site have systems in place to manage health and safety from their activities. Employers must take all practicable steps to ensure that employees do not harm any other person while at work, including members of the public or visitors to the place of work. Whether or not visitors or the public are permitted to enter a manufacturing plant while work is in progress is an issue which requires specific consideration and a clear policy communicated by the erection of signs or barriers.

Employees and self-employed persons' duties

Employees and self-employed persons have a responsibility for their own health and safety while at work. They must also ensure that their own actions do not harm anyone else.

Accidents and serious harm (recording and notification)

The HSE Act requires employers to keep a register of work-related accidents and serious harm. This includes every accident that harmed (or might have harmed)

- An employee at work;
- Any person in a place of work under the employer's control.

Employers are also required to investigate all accidents, or near misses, to determine if they were caused by, or arose from a significant hazard. Employers are required to notify serious harm (as defined in the HSE Act), that occurs to employees while at work, to the Secretary of Labour (in practice, the nearest Occupational Safety and Health (OSH) office), as soon as possible. In addition, the accident must also be notified on the prescribed form within 7 days. (Suitable forms for notification are available from OSH offices and selected stationers). If a person suffers serious harm, the scene of the accident must not be disturbed unless to:

- Save life or prevent suffering;
- Maintain public access for essential services, e.g. electricity, gas; and
- Prevent serious damage or loss of property

The OSH office will advise whether it wishes to investigate the accident and what action may be taken in the meantime.

Employers should also arrange for pre-employment and other medical examinations as considered necessary (see Health Surveillance, Section 3).

Health and safety advice by consultation

A workplace health and safety committee is one way of providing worker input into health and safety policies and operational problems. It is not a legal requirement in New Zealand to have such committees but experience has shown that consultation between workers and management can provide positive feedback on health and safety issues.

Where it has been decided that a health and safety committee is appropriate that committee should report to senior management who will be involved in decisions made.

Areas of responsibility should be set out at the start, particularly:

- Identification and assessment of safety and health hazards
- Information, instruction and clothing;
- Protective equipment and clothing;
- Personal hygiene;
- Eating, drinking and smoking;
- Cleaning;
- Maintenance; and
- Effective safety measures.

4 Other Legislation

Other legislation affecting the metal casting industry may include the following

a) Building Industry Act and Code:

This legislation sets down the minimum specification for buildings which are then administered by the local authority.

b) The Resource Management Act:

This Act is the main piece of legislation administered by Local Authorities and controls such issues as waste management, building consents, pollution, planning permission, and other aspects.

c) Environment Act:

This Act sets down minimum requirements for the administration of activities which may affect the environment.

d) Dangerous Goods Act 1964:

The Dangerous Goods legislation provides controls on the storage and certain uses of specified classes of chemicals. It provides for labelling, placarding, and licensing of those storing dangerous goods.

e) Regulations:

Abrasive Blasting Regulations 1958:

These regulate the abrasive blasting process and set down minimum requirements for booths, procedures for personal protection and other aspect of the process. The legislation also places controls on the use of silica sand.

f) Factories and Commercial Premises (First Aid) Regulations 1985:

These set down minimum requirements for first aid facilities, training and first aid requisites appropriate for the undertaking.

g) Asbestos Regulations 1983:

This legislation prescribes the minimum requirements that people working with asbestos must comply with. It provides for special situations and covers medical examination of employees, waste disposal, and special considerations when working with asbestos.

SECTION 2

PROCESSES AND HEALTH HAZARDS IN THE METAL CASTING INDUSTRY

1 Processes Used in Metal Casting

The main generic processes in foundries are:

1. Pattern/tool making
2. Mould preparation
3. Metal preparation
4. Metal melting
5. Casting
6. Removal of castings
7. Fettling and finishing
8. Heat treatment
9. Plant maintenance
10. Waste disposal
11. Material handling and packaging.

Most establishments will involve all or some of the above and many of these processes will involve significant hazards which will require effective management. What follows is a brief description of each process, a general statement about the process, and a list of possible hazards.

1 Pattern/tool making

Pattern making is the process of manufacturing the tooling for producing the final component from the metal casting process.

Pattern making involves a number of processes which may be hazardous. Woodworking machinery, wood dust, noise, and chemicals are all found in pattern making workshops. The use of epoxy resins and related chemicals is a particular hazard.

Potential hazards

- Woodworking machinery
- Metalworking machinery
- Noise
- Dust
- Chemicals and solvents
- Hand tools
- Material and manual handling
- Fumes.

2 Mould preparation

This is a process by which a mould is formed, by manual or mechanical means. It is a vessel which is the reverse image of the final component into which the molten metal is poured.

Moulds and cores are usually made of quartzose sand bonded with clay or other materials such as silicates, resins and isocyanates. The moulding sand is packed around the pattern within a moulding box to form a mould section. The complete mould may consist of an assembly of two or more sections or parts.

Potential hazards

- Moulding machines
- Dust
- Noise/vibration
- Chemicals /solvents
- Fumes
- Manual handling
- Heat/flames.

3 Metal preparation

This is the process of segregation and preparation of alloys and scrap prior to the melting process

Metal is prepared and weighed ready for the furnace. Depending on the type of foundry, the metal will include pig iron, metal ingots, and scrap. Sorting out undesirable or unsatisfactory metal will be an important process. Metal containing contaminants such as lead based paint should be excluded as well as items such as porcelain baths. For safety reasons metal being added to a hot furnace must be dry.

Potential hazards

- Sharp edges
- Hot material
- Dust/sparks
- Material/manual handling
- Toxic waste
- Heavy metal contamination
- Housekeeping.

4 Metal melting

This is the process by which metals are melted to a controlled temperature and composition.

Metal, which may be steel, stainless steel, iron, aluminium, bronze, brass and various alloys, may be melted by: electric arc, resistance or induction or resistance; a cupola furnace using coke; or in oil or gas burning furnaces. Molten metal may then be metallurgically processed before being transferred to the mould by a ladle or other means.

Potential hazards

- Moisture
- Extreme heat/temperature
- Fumes
- Explosions
- Equipment failure
- Materials/manual handling.

5 Casting

This is the process of transferring the molten metal into the prepared mould for solidification.

The molten metal is poured into moulds by any one of a number of methods depending on the process used but will usually involve a refractory lined steel lade. When molten metal is poured into sand moulds the sand is subjected to a high temperature (about 16000ºC in the case of steel). This temperature is sufficient to convert some of the quartz in the sand of the mould to cristobalite which is a significant respiratory hazard.

Potential hazards

- Molten metal
- Latent heat
- Fumes
- Dusts
- Materials/manual handling
- Equipment failure
- Moisture
- Explosions.

6 Removal of castings

This is the process of removing the casting from the moulding medium in preparation for fettling and finishing.

The process of removing the casting from the mould, is known as knockout or shakeout. The cool casting is removed by knocking it away from the mould by hand or using vibrators or pneumatic tools. Significant noise and dust hazards are created by these processes. Runners, risers and parts of the casting not forming part of the finished article, are removed by knocking or sawing from the casting, which is then ground on a grinding wheel to remove flashes, rough edges and runner remnants. Castings are usually dressed by fettling or abrasive blasting but small items may be rumbled in rotating drums.

Potential hazards

- Noise
- Dust
- Fumes
- Heat
- Sharp edges
- Waste
- Mechanical/manual handling.

7 Fettling and finishing

This is the process of removing excess material from the casting to meet specified dimensions.

Fettling and finishing involves a number of different processes depending on the type of foundry. This is an area in which many different types of hazards are found making it an important place to implement proper controls.

Potential hazards

- Noise/vibration
- Dusts
- Thermal cutting
- Fumes
- Sharp edges
- Housekeeping
- Grinding/cutting machines
- Abrasive cleaning
- Mechanical/manual handling
- Equipment failure
- Stress/mental fatigue
- Cutting oils
- X-rays
- Ultra violet light.

8 Heat treatment

This is the process of enhancing the metallic structure and physical properties of the component by the use of controlled temperatures.

Heat treatment will be used in specialist applications and because it involves heat the danger from burns and other effects of heat will need to be guarded against

Potential hazards

- Radiant heat
- Steam
- Mechanical/manual handling
- Chemicals
- Fire
- Explosions (gas mixtures)
- Dusts
- Waste
- Fume
- Equipment failure.

9 Plant maintenance

This is the process of maintaining all plant and machinery used for metal casting so as to keep it in a safe operable condition.

Furnaces used to melt the metals are often lined with refractory bricks which have a high quartz content. These are cemented into the furnace with grouting which may contain asbestos fibre. These types of furnaces require regular maintenance and this involves the replacement of refractory materials. Because of the health risks involved special precautions must be taken to protect people doing this work.

Potential hazards

- Electricity
- Dusts
- Gas
- Noise/vibration
- Compressed air
- Chemical/solvents
- Heights/confined space
- Mechanical/manual handling
- Housekeeping
- Hazardous waste.

10 Waste disposal

This is the process of removal, segregation. and safe storage and disposal of unusable materials and by-products.

Significant non-recoverable waste is produced in most metal casting processes mostly in the form of old sand and other debris. This waste is usually suitable for disposal at local authority refuse facilities but may need special approval. Enquiries should be made prior to dumping particularly if the waste has hazardous properties such as a high lead level.

Potential hazards

- Dusts
- Hazardous/toxic waste
- Manual/mechanical handling
- Storage of waste
- Sharp edges
- Heavy objects.

11 Material handling and packaging

This is the process of handling materials throughout the casting process and the presentation of components for dispatch to meet the customer specifications.

Potential hazards

- Manual/mechanical handling
- Sharp edges
- Lack of traceability
- Incorrect storage and staking.

2 Specific Health Hazards in Foundries

The following paragraphs provide some detailed information about specific health hazards found in many foundries.

Dust

Dust is one of the most common hazards likely to be found in foundries. The dust will be in the form of fine respirable particles, and depending on the type of foundry and the processes used, may contain significant amounts of silica, lead, or other contaminant. The following paragraphs contain information about the various forms of dust in a foundry.

i) Respirable siliceous dust

In some metal casting processes respirable siliceous dust is produced as a product of furnaces, moulding sand, knockout and shakeout of castings, fettling and abrasive blasting.

ii) Furnaces

Repeated heating converts the quartz of the firebricks and silica refractory lining furnaces to amorphous silicates of cristobalite and tridymite. Workers maintaining and replacing the refractory material may be exposed to dust containing significant amounts of cristobalite which is highly fibrogenic (causing the disease silicosis if inhaled into the lung). In the past grouting material used to retain the firebricks often contained asbestos but this has now been superseded. If in doubt about the safety of any product material safety data sheets should be referred to.

A high degree of respiratory protection therefore will usually be required for workers during this process (see *Respirators and Breathing Apparatus* (1992) available from OSH).

iii) Moulding

Heat from the molten metal in a sand mould produces two reactions. It reduces the sand-containing quartz in the mould to dangerously fine respirable particles and, it converts some into hazardous silicates, such as cristobalite. These forms of silica can cause the lung disease silicosis. This risk varies according to the efficiency of dust control, whether the sand is screened or not, and whether the mould is wet or dry.

Some "Parting powders", contain a high content of fine silica dust, and add to this hazard and should not be used if possible. The use of compressed air to clean dust from moulds is likely to produce airborne respirable dust and should be avoided.

iv) Sand handling

Sand will be handled in a variety of ways in the metal casting process, ranging from manual, pneumatic, or conveyors. Each method will produce significant amounts of dust some of which will contain airborne silica. Appropriate measures must be taken to control dust emissions, or the wearing of personal protection, whenever this occurs.

v) Knockout/shakeout of castings and their dressing - fettling and abrasive blasting

During the knockout process there are a wide variety of dusts produced of which alumino silicates and alumina are the most common.

These processes also liberate fine silica dust into the air and the environment of the foundry. If this dust is inhaled there is a risk of silicosis. Because fine dust is raised from the floor as airborne particles by draughts, people walking over the floor, and movement of vehicles such as forklifts, total dust control is an important item in plant housekeeping and hazard management.

vi) Pattern shop

The increased use of particleboard in pattern making causes increased levels of wood dust and formaldehyde binders which are both recognised health hazards.

vii) Core making

There are a variety of mineral sands used in core making. These can include zircon, chromate, magnesite, alumina silicates. In keeping with good work practices exposure to these dusts should be avoided by the use of appropriate control measures.

viii) Metal melting

In this process, dust is generated, which will contain a wide variety of chemicals. These will be carried into the ventilation system where this is installed. If ventilation extraction is not installed appropriate protective measures must be taken for workers in the area.

ix) Scrap handling

During this process significant dust will be produced. Good work practices will need to be employed. Special attention must be given to the use of gas cutting where lead based paint is present on scrap metal.

x) Lead dust or fumes

Lead dust or fumes are a real health hazard. Lead is used to improve the characteristics of bronze, brass, steel and lead alloy castings. Lead is also evolved from melting scrap iron that may have been previously coated with lead based paint porcelain or lead based petroleum products. Foundries melting leaded copper base alloys are at greatest risk form the evolution of lead fume and dust. The dust collected in bag filters attached to the ventilation system will contain high levels of lead. The handing and disposal of this dust will require special consideration. The fettling and finishing process of lead alloy castings will present a significant hazard to operators and must be controlled.

Further information on the health aspects of lead can be found in the booklet Occupational Safety and Health Information series *Guidelines for the Medical Surveillance of Lead Workers;* available from OSH.

Chemicals

i) Toxic chemicals

All chemicals can be used safely if sensible precautions are employed. Information about the safe handling and use of chemicals is available in the Material Safety Data Sheets supplied by the supplier/manufacturer/importer. Labels provide simple instructions on how to use a chemical safely and they may also provide emergency first aid treatment. MSDS will also provide details on correct storage.

Vegetable oils and clay were traditionally used as binders for moulds and cores. Modem technology has moved to the use of potentially more dangerous substances such as:

- Silicates;
- Furanes;
- Phenolic or alkyl isocyanates, and synthetic resins involving various curing procedures;
- Mould release agents.
- Degassing agents i.e. hexachloroethane
- Cutting and quenching oils.

The following is a list of chemicals which may be found in a foundry operation:

Phenolic furan
Toluene suphonic acid
Xylene sulphonic acid/sulphuric acid blend
Phosphoric acid
Phenol formaldehyde
Triethylamine
Aqueuos phenolic resin
Ester Catalyst
Latent catalysts
Polymeric isocyanate solution
Isocyanate solution

Gases

i) Carbon monoxide

Carbon monoxide (CO) is a colourless, odourless gas usually formed during the combustion process. Potentially significant amounts of carbon monoxide (CO) will be generated in a number of processes in metal casting. Anywhere there is a heated process leading to the formation of smoke such as moulds and cupola furnaces CO will be present. Workers on charging platforms or catwalks can unknowingly breathe high concentrations of this colourless, odourless gas. This can block oxygen being transported, from the lungs, causing the worker to suddenly lose consciousness and this could lead to a fall onto dangerous or hot materials.

Warning signs are headache, nausea and breathlessness on exertion, such as climbing steps. High concentrations may prove rapidly fatal without any warning symptoms. The current workplace exposure standard (WES) in New Zealand is 25 parts per million (ppm). Monitoring for the presence of CO is a method of controlling the hazard by identifying the processes and places where there is CO build-up.

ii) Formaldehyde

Formaldehyde may arise from a number of resins during the moulding and casting processes. The current WES is 1 ppm TWA and a STEL of 2 ppm. For further information, see Occupational Health guidelines series, 6: *Guidelines on the Use of Formaldehyde and Similar Products at Work* (May 1985) available from OSH

iii) Furfuryl Alcohol

Furfuryl alcohol is used in the various types of furane resins, and exposure in foundries is likely to be only to the vapour. Exposure causes mild irritation to the eyes, skin and mucous membranes.

iv) Sulphur Dioxide

Sulphur dioxide is produced from the decomposition, during casting, of the sulphonic acid catalyst used in the furane process. It is a gas with a characteristic pungent odour and in high concentrations is intensely irritating to both the eyes and the respiratory tract. The workplace exposure standard (WES) is 2 ppm.

Vapours

i) Methylene Biphenyl Di-isocyanate

(Synonyms: Diphenyl-methane-di-isocyanate, MDI)

Isocyanate based resins such as those used in the phenolic urethane cold box processes, contain MDI, which has a WES of 0:02 ppm (ceiling level). Compared with other isocyanates, the resin does not evaporate rapidly.

Short-term exposure produces wheezing, breathlessness, coughing, irritation of the eyes and lungs and various other symptoms, which may appear up to eight hours after exposure. Long-term exposure may lead to permanent breathing or chest problems, while repeated or prolonged exposure of the skin may produce a rash. Isocyanate sensitisation is well known and affected workers must be deployed to alternative duties once sensitised.

For further information see *Approved Code of Practice for the Safe Use of Isocyanates* available from any OSH office.

ii) Phenol

Various resins, during the moulding and casting processes in some foundries, produce phenol but this is unlikely to be found in any form other than as the vapour in normal foundry operations. In this form it irritates the eyes, mucous membranes and skin.

The odour threshold has been reported as being as low as 0.06 ppm. This is below the WES so phenol is regarded as a substance with good warning properties. The WES is 5 ppm.

iii) Triethylamine

Triethylamine is used as a catalyst in the cold box process. It is a liquid with a distinctive smell. The vapour causes irritation of the eyes, nose and throat, while the liquid causes severe eye damage. Repeated or prolonged exposure causes skin and lung irritation.

Noise

Excessive noise is a common hazard in foundries and causes permanent occupational deafness to those exposed. Sources of noise include:

- Metal impacting upon metal (shakeout, core, knockout tumbling, chipping, handling and transport of castings);
- Exhaust from compressed air operated machines and tools (moulding machines, chipping hammers, grinders, hoists);
- Electric furnaces, ladle heaters;
- Conveyors;
- Wood saws and other machinery in the pattern shop;
- Electric arc cutting;
- Core blowers, sand slingers and high pressure moulding machines; and
- Shot blasting.

For information on noise in the workplace and information about the effects of noise and how to carry out health surveillance see the *Approved Code of Practice for the Management of Noise in the Workplace* 1996 from OSH offices.

Vibration

Grinders, pneumatic chipping hammers, chisels and electrically operated rotary grinders can produce "dead hand" or vibration white finger if used extensively. Where people are exposed to whole or part body vibration the exposure must be controlled within limits that protect them from adverse health effects. Guidance on the limits can be found in the international standards ISO 2631 and ISO 5349.

The condition usually affects both hands, with the index, ring and middle fingers suffering the most. As the attacks occur mostly in cold weather, thick winter gloves may help in preventing this.

Manual handling

Moulding and core making may involve the lifting, carrying and stacking of heavy objects. Proper workplace design, using ergonomic principles, will prevent long-term serious injury to workers. The economical benefits of are well recognised by increased production and less downtime or lost time through absenteeism. For more information refer to the publication *Manual Handling* from OSH.

Heat and molten metal

Hazards from molten metal processes include the potential for serious and even fatal burns. The risk of injury depends on many factors including the type of operation, the degree of exposure, and the extent to which protective clothing is worn. Protective clothing is just one preventative factor and although it is known to reduce or prevent injury it must be regarded as the last line of defence after all other reasonably practicable measures have been taken.

Prolonged exposure to heat may also cause heat stress and fatigue and even collapse. Recognition of these hazards must be incorporated in training of workers in foundries. Further information on the effects of heat can be found in the OSH publications *Guidelines for the Management of Heat and Cold*, and *Guidelines for the Management of Work in Extremes of Temperature.*

Other physical hazards

As is the case with many industries of this nature there are a number of physical hazards which have to be managed. Handling heavy objects can lead to crushing injuries, moisture in molten metal can cause explosions, rapid evolution of hot gases can cause lung damage and burns, and in the fettling shop flying objects can cause eye injury. In the finishing department of specialised shops ionising radiation from radiography may be a hazard. The hazard management process must be systematic in order to identify all hazards.

3 Potential Health Risks in Foundries

This chapter provides general information about a number of potential health risks associated with the metal casting industry. It may not be a complete list for all foundries so readers will need to be aware of this.

1 Occupational Overuse syndrome (OOS)
2 Cancer
3 Dermatitis
4 Stress
5 Fatigue
6 0200 - 0500 (Night shift workers)
7 Metal fume fever
8 Vibration white finger
9 Burns
10 Soft tissue injuries
11 Lead poisoning
12 Respiratory disease
13 Sprains and strains
14 Eye injuries
15 Silicosis
16 Noise-induced hearing loss
17 Severe injury
18 Carbon monoxide poisoning

1 Occupational overuse syndrome (OOS)

Occupational overuse syndrome (OOS) is an umbrella term covering a range of disorders characterised by pain and other sensations in muscles, tendons, nerves, soft tissues and joints with evidence of clinical signs. These disorders can be caused by occupational factors including prolonged muscle tension, repetitive actions, forceful movements, and sustained or constrained postures which exceed the usual ability of the body to rapidly recover. OOS is a complex problem that invariably has multifactorial causes. Organisational factors such as excessive workload, psychosocial factors, and individual characteristics are known to increase the risk of developing QOS. Providing all of these factors are identified as possible causes and work processes are designed to take account of them OOS should be able to be controlled in the metal casting industry. Workplace design and work schedules including breaks must be given a high priority in any preventative programme. Further information is available in the OSH publications; *Guidelines for the Prevention and Management of OOS*, *Checklist for the Evaluation of Work*, and *Treatment and Rehabilitation: a Practitioner's Guide*.

2 Cancer

Overseas studies suggest that there may be an increased risk of lung cancer in foundry workers. New evidence (April 1997) has meant that the International Agency for Research into Cancer ([ARC) has placed crystalline silica into group 1 Carcinogen to Humans. Every effort should be made therefore to reduce exposures to dusts containing free silica, and to other fumes and tobacco smoke in the workplace.

3 Dermatitis

Some chemicals and substances used in the metal casting industry may cause adverse skin reactions in susceptible people. MSDS and label information will identify this and make suggestions on the appropriate action to take to prevent it. If substitution with a safer alternative is not practicable then protective clothing may need to be resorted to. In some cases the use of moisturising creams may assist but hand creams are not considered as a substitute for hand protection.

7 Metal fume fever

Breathing in metal fumes or oxides, particularly from zinc in brass casting, can cause metal fume fever. The flu-like illness comes on suddenly a few hours after breathing the fumes. Symptoms may include shivering and sweating and usually last up to 36 hours. Fumes may be from welding, thermal cutting or melted metal. Victims usually recover completely after a break from work.

SECTION 3

ASSESSMENT AND CONTROL OF HEALTH HAZARDS

1 Assessment of Hazards

All sections of the foundry should be assessed to determine the presence and degree of health hazards.

The Assessment

All processes used in a particular metal casting workshop, as well as the major processes listed in Chapter 6 of these guidelines should be itemised and assessed.

Everyone who could be exposed to the hazards should be identified, and the workers needing health surveillance should be selected.

The specific hazards are outlined in these guidelines. For a foundry's own assessment, the types of hazards may be further broken down into direct and indirect hazards.

It is the responsibility of the employer to assess and to measure if necessary, the frequency, duration and intensity of exposure to these hazards, and to advise on the measures to be taken to reduce them to within acceptable levels with suitable control and monitoring measures.

Re-assessment

A re-assessment will be necessary, if there is any change of work which could affect employees' health; for example, any change to engineering controls, the processes and materials used, or the site of a process.

Assessment sheet

Appendix 1 shows a typical assessment sheet. This is a guide only, as in some processes different areas may need more emphasis.

2 Measures for Controlling Hazards

Building specifications

Building and plant design must enhance the working environment and occupational health and safety in the foundry.

A good work environment needs the following:

- Adequate room height to give enough air space and to allow for the natural convection of gases of fumes that escape the collection system;
- Efficient ventilation to ensure an adequate rate of air change;
- Good lighting, both natural and artificial;
- An easily cleaned building with a minimum amount of ledges or exposed beams that can collect dust.

Good plant layout includes using the correct machinery, properly installed according to ergonomic principals as to height and layout for the job. Allowance should be made for a good work flow, adequate space between and around machines and furnaces, and clearly defined lanes (preferably of easily cleaned concrete) for movement of people and vehicles.

Fumes collection and dust control

Dust and fumes removal from the work environment (as required by the Health and Safety in Employment Regulations 1995) requires that all practicable measures shall be taken to ensure that smoke fumes and air contaminants be carried off and rendered harmless. This will require some furnaces to be well-hooded, with fumes being ducted into a collection system., Dust from dry sand operations such as elevators, shake-outs, shot-blasters, fettling work, should also be collected and ducted into bag-houses or similar systems.

Mould pouring should be done under a hooded area, or roof extractors used to help dissipate the fumes. Each situation has to be treated on its merits because the size and complexity of the operation will dictate what is practicable and possible.

Process controls

If air contaminants from processes are excessive then engineering or administrative controls should be established wherever possible. If this can not be done, then personal protective equipment must be used.

The main method of engineering control is extraction ventilation. Local exhaust ventilation systems are designed to catch and remove excessive dust and fumes before they escape into the workplace air.

General exhaust ventilation will also remove contaminants from the air, but not as efficiently as local exhaust.

Local exhaust ventilation systems for fixed equipment such as sand-mullers, furnaces, abrasive-blasting equipment, grinders or shake-out tables are highly efficient in controlling contaminants when properly designed.

Pouring or shake-out operations cover a wide area, and gases, dusts, and fumes are more difficult to control. A suitably experienced ventilation engineer should be consulted for advice on such problems.

(A useful reference is: *Industrial Ventilation: A Manual of Recommended Practice*, published by the American Conference of Governmental Industrial Hygienists (ACGIH).)

Grinding wheels (floor stand, pedestal or bench) and abrasive cut-off wheels should have hoods or enclosures connected to exhaust systems to stop dust getting into the breathing zone. The wheel size and grinder type decide the exhaust volume needed to meet ventilation requirements. Work methods should be examined and modified so that the least dust is created during daily work.

Fettling areas are one of the most difficult areas to ventilate but judicious use of local ventilation systems close to the process and complimented by general workplace ventilation workers should be adequately protected.

Concrete walkways which are easily cleaned should be used wherever possible to reduce dust in the air and vacuum cleaning used as the preferred method of cleaning.

Abrasive blasting

The Abrasive Blasting Regulations, 1958, contain requirements for this operation. An OSH policy on the use of silica as an abrasive blasting medium has been issued which restricts the use of sand containing free silica to those sands under 5% free crystalline silica. In general terms blasting medium other than sand will have to be used for abrasive blasting.

Occupational noise exposure

It is management's responsibility to make sure workers are not exposed to noise levels exceeding the standard for safety, hence noise levels should not exceed the equivalent of 85 dBA for eight hours. This is the same as being exposed to 91 dBA for two hours. Both engineering and administration controls must be used to reduce noise levels or exposure time to comply with the standard.

Methods for ensuring safe noise levels include:

- Separation and isolation of noisy jobs;
- Impact reduction and vibration dampening, by lamination or lining with acoustic materials;
- Mufflers on compressed air equipment exhausts, if possible;
- Properly lubricated and maintained machinery;
- Specifying the lowest noise production available when purchasing new equipment.

If it is not possible to lower noise to acceptable levels, personal protective equipment must be provided, and a continuing effective hearing conservation programme provided.

Adequately equipped and trained personnel should undertake a noise survey. They should then properly define the noise levels and problem areas before beginning engineering and administrative controls and/or starting hearing conservation programmes. Full details of how to identify and manage noise in the workplace can be found in the OSH publication *Approved Code of Practice for the Management of Noise in the Workplace*, available from OSH offices.

Personal protective equipment

Personal protective equipment is not a substitute for good administrative and practical engineering controls. However, if control methods are not possible, then personal protective equipment is needed wherever harmful substances can be contacted, absorbed, or inhaled. Special protective equipment is also needed against the hazards of molten metal, heat, or sparks in pouring or welding. Personal protective equipment includes respiratory and hearing protective devices, protective clothing and protection for the eyes, face, head and feet. All personal protective clothing equipment must be safety designed and must be carefully maintained. There are a range of joint Australian/New Zealand Standards on personal protective equipment. In general terms all equipment should comply with these standards however it is acceptable to have equipment comply with standards produced in the major European or American markets.

Eye and face protection: Goggles, safety glasses or face-shields to suit the appropriate heat range should be worn if there is a chance of eye injury from flying particles, chips and sparks during grinding, cutting, welding and pouring.

Proper eye protection filters are needed for the intense light given off during such operations as welding, cutting or the treatment of molten iron with magnesium.

Some mould-release agents are highly corrosive and eye or face protection must be worn while using these and other corrosives.

Gloves: Properly selected safety gloves specific for the process should be used. Good hand protection in the metal casting process is vital to protect against burns, cuts and abrasions and chemicals. A thorough risk assessment of the requirements must be done for each task. Selection will be based on such factors as comfort, sensitivity, and impermeability.

Aprons, coveralls and leggings: Welders and metal pourers need adequate protection for the legs and bodies from flames, sparks and metal splashes. The selection of appropriate clothing to protect against molten metal is not straightforward. Different materials react differently when in contact with different molten metals and slag. It is essential that a full risk assessment be carried out before making a decision. The design, style and fit of a garment is one aspect to consider and needs to take into account ease of removal, lack of pockets, and flammability. The type of material will vary according to each particular circumstance but the usual choice of material will be leather, wool, or treated cotton. The type of fasteners will also need to be considered. Metal zips and domes get very hot in some applications while plastic ones will distort with heat.

Foot protection: Foot protection with steel toecaps and other special features should be worn when manually handling heavy parts or where there is danger from falling objects or spilt metal. Leather has been found to be the best material for footwear in many occupations. Sole material should be appropriate for foundry workers. In the foundry workers handling molten metal must ensure that trousers or leggings are worn outside the boot to prevent molten metal entering the top of the boot.

Hearing protection: Noise levels exceeding 85 dBA require the wearing of the appropriate hearing protection. Other factors may influence the type of hearing protection which can be used such as the need to wear other protective gear.

Head protection: Hard hats must be worn where there may be danger from falling or flying objects. In the metal casting industry PVC helmets may not be suitable due to distortion through heat. Fibreglass helmets will not distort so easily.

Aluminised reflective clothing: Reflective clothing should be worn if there is a danger from radiant heat, such as around furnaces or during pouring.

Washing and storage facilities for protective clothing and equipment

To work efficiently, all protective equipment must be constantly looked after. This includes storage in a clean, dust-free area. Wash, clean and disinfect respiratory equipment after use. If possible, have separate clothing storage areas for men and women. Lockers should comply with New Zealand Standard NZS 1187:1969 - *Clothes lockers* and have louvred or open mesh doors for ventilation.

Respiratory Protection: Employers must provide respirators when the air is contaminated with excessive amounts of harmful dust, fumes, mists, gases and vapours. Respirators should only be used when engineering and administrative controls are not feasible or while they are being established or in emergency situations.

When respirators are specified, a respiratory protection programme must be established:

- To provide written instructions on the selection and use of respirators;
- To choose the right respirator for the job;
- To train employees to use and maintain respirators properly;
- To train employees to replace filters when the respirator has been used for the cartridge's specified lifetime, or if an employee can smell vapours in the mask, or if breathing becomes difficult;
- To ensure personal issue and use of a respirator by one person;
- To discuss and arrange with workers the close fitting of respirators and resolve problems of poor fit due to glasses and beards.

Guidelines for respirator cleaning

- Remove any filters, cartridges or canisters.
- Wash face-piece and breathing tube in cleaner-disinfectant solution (see following
- paragraph). Use a hand brush for removing dirt.
- Rinse completely in clean, warm water.
- Air dry in a clean area.
- Clean other respirator parts as recommended by the manufacturer.
- Inspect valves, head straps etc, and replace with new parts if defective.
    Insert new filters, cartridges or canisters; make sure the seal is tight.
    - Store in a plastic bag or some other container.
    - Store respiratory protective clothing and equipment safely.

Further information on respirators can be obtained from the safety equipment suppliers or the OSH publication *A Guide to Respirators and Breathing Apparatus*.

Eating, drinking and smoking

For health reasons, workers should not eat, drink or smoke in the work area. A suitable room or area for eating and drinking must be available if seven or more people are employed. There must be enough seats and tables and the room should not be used for storage. It should have smooth, easy to clean walls and floor, and there should be at least one square metre of room per person.

Work practices

Ergonomic principles should be employed in critically appraising the work practices of all workplaces, and these re-organised to eliminate unnecessary and faulty handling by providing mechanical handling aids, with proper training and supervision in lifting and handling materials.

Personal hygiene

Employers must insist on workers maintaining high standards of personal hygiene, minimising the risk of ingesting or otherwise absorbing metals, such as lead, used in foundry processes.

Walls, ceilings, floors, washbasins and showers should be kept clean.

Housekeeping

In addition to cleaning it is important to also ensure that the workplace is kept tidy and clear of obstacles and tripping hazards.

The following points can be used as a checklist:

- **Area**: State name of area: facilities and class of object to be cleaned.
- **Responsibility**: State name of area: facilities and class of object to be cleaned, and organised and by which worker.
- **Method**: Define the method of cleaning and tidying in particular areas. Suitable methods may include wet cleaning or using a vacuum cleaner. To reduce dust hazards, do the sweeping last.
- **Frequency**: State the minimum frequency for cleaning particular areas. Cleaning should be done frequently so as to remove deposits which could be inhaled, ingested or absorbed.

The following should be noted:

- Floor and work areas;
- External plant surfaces that are readily accessible;
- Respiratory protective equipment and clothing; hygiene facilities;
- Do not let deposits accumulate on overhead fixtures, where dust can be dislodged and become airborne.

Further information on the minimum facilities and requirements for workplaces can be found in the OSH publication *Guidelines for the Provision of Facilities and General Safety and Health in Commercial and Industrial Premises*.

3 Maintenance

Normal procedures

Maintenance procedures should suit each work situation. They should be clearly defined.

1. Hazard control measures that need to be maintained

These should include:

- Foundry process control measures;
- Protective clothing and respiratory protective equipment;
- Personal hygiene;
- Drinking and eating facilities;
- Cleanliness controls.

2. How to do the maintenance

Maintenance should include visual inspections to find obvious defects in the safety control measures and more thorough assessments, using instruments where necessary, to test the efficiency of such technical controls as exhaust ventilation systems.

3. When to do the maintenance

The intervals between visual inspections and thorough assessments will vary, but generally there should be:

- a weekly general visual inspection;
- a check of respiratory protective equipment each day before use. Carefully check face-pieces, harnesses, inlets and exhaust valves, filters, canisters, cartridges, and hoses. This equipment should be thoroughly examined and tested monthly;
- a yearly examination and testing of exhaust ventilation equipment.

4. Correcting defects

There should be procedures for replacement, repair and remedial action. Time limits will probably range from immediate action to action within a few weeks or months, depending on the equipment concerned.

5. Who is responsible for maintenance

Visual inspections should be carried out by workers and supervisors as part of their daily work routines. This process should find obvious defects such as damaged protective clothing and leakages from enclosures. Some employers might delegate maintenance to supervisors, while giving overall maintenance supervision to one person. Workers with special skills should be responsible for the thorough examination and testing of breathing apparatus and exhaust ventilation.

The Exhaust Ventilation System (Where an air quality discharge permit is in force it will set down the frequency and detail of quality checks required.)

The yearly examination should include:

1. A thorough examination, both internally and externally, where necessary. Exhaust openings, collection hoods or suction points, duct-work, dust collection and filtration units, fans or air movers should all be check-listed.
2. Measurements of static pressure in the duct immediately behind each exhaust opening, collection hood or suction point. This should be done when the equipment is simultaneously extracting from each place served.
3. Measurement of air velocities at the opening s to enclosures, collection hoods or suction points for which standard velocities have been specified.
4. An assessment of whether the dust, fumes or vapour are being effectively safety controlled at each exhaust opening, collection hod or suction point. Dust-lamps or smoke tubes should be used.
5. Dust-in-air concentrations, appropriately measured to make sure the system is keeping the level below the hazard control limit.

The filtration plant

The efficient running of any filtration plant should be similarly assessed. Care must be taken when handling the dust from the filters as it may contain toxic compounds.

4 Health Surveillance

The aim

The aim of health surveillance is to protect the health of all workers in the foundry.

Scope

After the assessment it should be decided as to who needs health surveillance. A model questionnaire suitable for recording health examination results is available in Appendix 2. Firms may reproduce these to use in their occupational health programmes. An audiometry assessment form can be found in the OSH *Approved Code of Practice for the Management of Noise in the Workplace*.

Communication

Whoever does the health examination should discuss the results with the worker concerned.

Pre-placement health examination

This should be done for all prospective foundry workers to ensure that:

- The worker has no relevant disability that will stop him or her doing the job;
- The proposed work will not adversely affect health;
- Adequate health education and information relative to the job is given;
- Baseline health information is recorded. Later health information can then be compared with this.

An example of issues to be clarified could include:

- Any sign of serious back injury;
- Pre-existing asthma or respiratory disease;
- Pre-existing skin disease.

Measurements which can be done may include:

- Audiograms;
- Lung function test (pre and post ventolin);
- Chest x-ray.

Routine health examinations

The type of work done should decide the frequency and scope of routine health examinations. Those exposed to lead for instance will require regular surveillance as will those exposed to high noise levels. Administration staff on the other hand will not require the same intensity of surveillance.

5 Monitoring Hazards in the Environment

The purpose of environmental monitoring is twofold:

1. To measure the potential health hazards to employees.

2. To decide whether existing plant and process control measures are working efficiently.

Environmental monitoring is usually done by sampling. This is a measurement technique using instruments to give an indication of exposure to a hazard or contaminant.

A sample may be a personal sample, e.g. a measurement of respirable dust in the breathing zone of a person, or an area sample, e.g. a measurement of the total dust-in-air in work environment.

The results of an initial assessment (see Section 8) will indicate the potential hazards that require periodic monitoring (as shown in Appendix 1).

The following need to be considered when environmental monitoring is undertaken:

- The type of hazard
- Whom and where to sample
- When to sample
- How long to sample for
- The number of samples
- The sampling period.

The correct sampling instruments, methods and correct analytical procedures need to be identified. Advice on this is available from the equipment suppliers or consultants experienced in occupational hygiene measurements.

The following table gives a rough indication of the frequency of monitoring for certain hazards.

Hazard	**Frequency for Monitoring the Hazard**
Noise	Initial assessment, and as required
Heat	Initial assessment, and as required.

Dusts:

- Respirable Quartz Initial assessment, and as frequently as considered necessary to build up a data base-line for action and future comparison after this level has been reduced, if levels are greater than the workplace exposures standards (WES).

  Once every 12 months if levels are greater than half the WES.

- Lead Initial assessment and at least once every three months if levels are greater than half the WES.

Carbon Monoxide Initial assessment. Regular monitoring to establish baselines for immediate action to protect workers and for future comparison. Continue until ventilation controls have reduced the level below the WES.

Once every 12 months if levels are greater than half the WES.

Other hazards Initial assessment, and as required contaminants

A new monitoring programme should be conducted if there is a change in materials, plant or process controls, or major changes in operator staff.

An initial assessment must be undertaken, as this will give valuable information as a basis for comparison when re-assessments are carried out.

6 First Aid Treatment

Provision of first aid

Consideration of the most appropriate first aid treatment needs to reflect the hazards associated with the industry or the particular processes in the establishment. The Factories and Commercial Premises (First Aid) Regulations 1985, which are still in force, set out the requirements for first aid in industries such as metal casting workshops. The number of trained first aiders is included along with the minimum requisites for first aid cabinets. First aid training must be conducted by trainers approved by OSH, who will use unit standards set by NZQA. A guidance note on Providing First Aid Training is available from the nearest OSH office. A further guidance note on first aid supplies is in preparation and should be available late in 1997.

7 Information, Instruction and Training

General Information on metal casting work

All foundry workers and supervisors should know:

- How dust and fumes are absorbed and how they may cause ill-health;
- Why and how respirable dust levels are monitored;
- How to keep dust and fumes to a minimum in the work area;
- The importance of installing and correctly maintaining ventilation equipment;
- The results of any assessments and where potential hazard areas are;
- All the relevant information an employer has about fumes, dust and the health and safety of workers in that process;
- The reasons for high standards of personal hygiene;
- The risk of noise induced hearing loss from excessive noise exposure in the work area.
- How to handle chemicals safely and know what to do in an emergency

Training

This should include:

- Instruction in the need for ventilation equipment to limit dust-in-air levels and training in its proper operation;
- Instruction in the use, care and maintenance of personal protective clothing and equipment, such as respirators or hearing protection;
- Regular emergency drills where an assessment has shown this to be necessary.

It is important that workers understand all information and training and that there is regular refresher training, especially in emergency procedures.

Instruction and training should be given by supervisors, helped by the firm's safety officer or occupational health nurse if employed or other health and safety professionals. The nurse would be the best person to discuss personal hygiene, protective clothing and to explain the results of any monitoring done. The nurse could also discuss the information and training resources available.

8 Keeping Records

Records should be kept of all health surveillance and environmental safety monitoring carried out. These records should be available, with the exception of confidential personal medical data.

Individual medical records

This information should be recorded for each worker:

- Job classification (e.g. fettler, moulder, etc.);
- Health problems, especially those which may be work-related;
- Biological monitoring results.

These records should be kept for at least 10 years. The records should be available only to a doctor or occupational health nurse and the worker concerned, unless the worker gives written consent that someone else can see his or her records. The security and confidentiality of these records should be guaranteed.

Environmental safety monitoring records

These should clearly show:

- The precise identification of the work being monitored;
- The results of initial and progressive checks on the contaminants;
- Where results above the WES are found, details of corrective action taken should be noted;
- Any significant changes to:

  (1) Processes;
  (2) Materials used;
  (3) Operating staff;
  (4) Environmental control equipment;
  (5) Name, status and dated signature of person doing this monitoring.

Records should be made available to health and safety inspectors, and employee representatives subject to normal privacy requirements such as consent procedures. Results of any environmental measurements should be readily available.

9 Glossary of Terms

This glossary of terms contains those commonly used in the metal casting industry.

Metal casting

Mould

Core

Ferrous

Non-ferrous alloys

Gravity die-casting

Pressure die-casting

Fettling

Refractory material

Silicosis: is a fibrosis of the lung caused by exposure to dust containing respirable sized particles of crystalline silica. This disease is caused by long-term exposure to moderate levels of dust or short-term exposure to extremely high levels.

Pattern

Investment casting

10 Acronyms Used In This Document

WES	Workplace Exposure Standards 1992 OSH NZ
STEL	Short-Term Exposure Limit applies to any 15 minute period in the working day. (See WES booklet for full description)
WES-TWA	Is the 8-hour Time Weighted Average exposure standard designed to protect the worker from the effects of long term exposure.
OSH	The Occupational Safety and Health Service of the Department of Labour
HSE Act	Health and Safety in Employment Act 1992
OOS	Occupational Overuse Syndrome; an umbrella term used to describe a range of disorders characterised by pain and/or sensations in muscles, tendons, nerves, soft tissues and joints with evidence of clinical symptoms.
dB	The abbreviation for decibel, a measurement of sound pressure levels
dBA	The abbreviation for A weighted decibel readings. The A frequency weighting is used because it approximates the response of the human ear.
CTI	Casting Technology NZ Inc
H & S Committee	Health and Safety Committee
MSDS	Material Safety Data Sheet
CO	Carbon monoxide
MDI	Diphenyl - methane - di-isocyanate
ISO	International Standards Organisation
IARC	International Agency for Research into Cancer
ACGIH	American Conference of Governmental Industrial Hygienists
PVC	Polyvinyl chloride
NZS	New Zealand Standards

Appendix 1: Assessment Check List

Determine the Types of Hazard

Some of the potential hazards that are present in the metal casting plant are:

Pattern Shop

Dust
Noise
Electrical Hazards
Manual Lifting
Moving Machine Parts
Toxic Vapours

Core Shop

Dust
Noise
Explosion
Heat
Moving Machine Parts

Foundry

Lifting
Toxic Vapours
Metal Fumes
Moving Machine Parts
Falling and Flying Objects
Non-ionising Radiation
Silica Dust
Talc Dust
Heat
Noise
Fire
Explosion
Poor Housekeeping
Foundry Structure, e.g. roof, walls etc.

Sand Preparation

Noise
Dust
Moving Machine Parts
Chemicals

Furnace

Noise
Heat
Non-ionising Radiation (ultraviolet and infra red)
Explosion
Fire
Molten Metal
Gases
Metal Fumes
Furnace

Finishing Shop

Silica Dust
Noise
Flying and Falling Objects
Lifting
Metal Fumes
Gases
Non-ionising Radiation (ultraviolet and infra red)
Electrical Hazards
Shop Structure

Collate Previous Tests

Information from previous tests of the workplace should be collated. These would include any tests of air level of hazardous substances, noise level measurements, temperature measurement etc. If these tests are out of date and new tests are required to assess the levels of hazard in the plant, then further testing should be done.

Recommendations

Recommendations as to how to reduce the potential hazard need to be made for each hazard.

The format of a typical assessment sheet follows.

Appendix 2: Sample Assessment Sheet

Assessment of _____		
This assessment was carried out on ___ / ___ / ___ It included all areas of the plant.		
It was carried out by: _____ and: _____		
AREA OF PLANT	POTENTIAL HAZARD	RECOMMENDATION
1. Pattern Shop	1. Sawdust of shop	1. Extra cleaning.
	2. Noise - noise level measurements taken 26/02/76 showed noise excess of 90 dBA.	2. Further noise level measurements to be taken.
	3. Electrical hazards - wiring is currently checked once a year.	3. No recommendation
4. Manual lifting -	4. None of the workers have had training in lifting techniques. There have been two back injuries in the last year.	Accident Compensation Corporation be asked to run a training course on manual lifting techniques.
5. Moving Machine Parts	5. Operators to be shown a film on the importance of machine guards.	All machines are guarded.
(This process should be repeated for each area of the plant).		
Signed: _____ Designation: _____ Date: ___ / ___ / ___		