

APPENDIX 12 - ABRASIVE BLASTING

Code of Practice

TABLE OF CONTENTS

FOREWORD	2
SCOPE AND APPLICATION	2
1. INTRODUCTION	4
1.1 What is abrasive blasting?	4
1.2 Who has health and safety duties in relation to abrasive blasting?	4
1.3 What is required to manage risks associated with abrasive blasting? 5	
2. THE RISK MANAGEMENT PROCESS	8
2.1 Identifying the hazards	8
2.2 Assessing the risks	9
2.3 Controlling the risks.....	11
2.4 Reviewing control measures	11
3. SPECIFIC HAZARDS AND CONTROL MEASURES	16
3.1 Prohibited and restricted chemicals.....	16
3.2 Dust	18
3.3 Particulate matter.....	30
3.4 Abrasive blasting plant and equipment.....	32
3.5 Recycling of blast material.....	37
3.6 Disposal of waste	38
4. OTHER HAZARDS AND CONTROL MEASURES	39
4.1 Noise	39
4.2 Heat	41
4.3 Vibration	42
4.4 Manual tasks	43
4.5 Confined spaces	43
APPENDIX A – SELECTING AN ABRASIVE BLASTING MEDIUM	45

FOREWORD

This Code of Practice on abrasive blasting is an approved code of practice under section 274 of the *Work Health and Safety (WHS) Act*.

An approved code of practice is a practical guide to achieving the standards of health, safety and welfare required under the WHS Act and the Work Health and Safety Regulations (the WHS Regulations).

A code of practice applies to anyone who has a duty of care in the circumstances described in the code. In most cases, following an approved code of practice would achieve compliance with the health and safety duties in the WHS Act, in relation to the subject matter of the code. Like regulations, codes of practice deal with particular issues and do not cover all hazards or risks which may arise. The health and safety duties require duty holders to consider all risks associated with work, not only those for which regulations and codes of practice exist.

Codes of practice are admissible in court proceedings under the WHS Act and Regulations. Courts may regard a code of practice as evidence of what is known about a hazard, risk or control and may rely on the code in determining what is reasonably practicable in the circumstances to which the code relates.

Compliance with the WHS Act and Regulations may be achieved by following another method, such as a technical or an industry standard, if it provides an equivalent or higher standard of work health and safety than the code.

An inspector may refer to an approved code of practice when issuing an improvement or prohibition notice.

This Code of Practice is based on the draft developed as a model code of practice under the Council of Australian Governments' *Inter-Governmental Agreement for Regulatory and Operational Reform in Occupational Health and Safety* for adoption by the Commonwealth, state and territory governments.

SCOPE AND APPLICATION

This Code provides practical guidance for persons conducting a business or undertaking on how to manage health and safety risks associated with abrasive blasting. This Code applies to all workplaces covered by the WHS Act where abrasive blasting processes are carried out and where abrasive blasting products and equipment are used and stored.

How to use this code of practice

In providing guidance, the word 'should' is used in this Code to indicate a recommended course of action, while 'may' is used to indicate an optional course of action.

This Code also includes various references to provisions of the WHS Act and Regulations which set out the legal requirements. These references are not exhaustive. The words 'must', 'requires' or 'mandatory' indicate that a legal requirement exists and must be complied with.

1. INTRODUCTION

1.1 WHAT IS ABRASIVE BLASTING?

Abrasive blasting means propelling a stream of abrasive material at high speed against a surface using compressed air, liquid, steam, centrifugal wheels or paddles to clean, abrade, etch or otherwise change the original appearance or condition of the surface.

It is used in a wide range of industries for many different purposes, including cleaning surfaces such as steel, bricks, cement and concrete. The most common method uses compressed air to propel abrasive material from a blast pot, through a blasting hose to a nozzle that is manually controlled by the operator. Automated abrasive blasting machines such as centrifugal wheel systems and tumblers are also used. Blasting is generally performed in enclosed environments like blasting chambers or cabinets, or on open sites, for example on buildings, bridges, tanks, boats or mobile plant.

Common hazards include dusts, hazardous chemicals and risks associated with the use of plant and equipment.

1.2 WHO HAS HEALTH AND SAFETY DUTIES IN RELATION TO ABRASIVE BLASTING?

A **person conducting a business or undertaking** has the primary duty to ensure, so far as is reasonably practicable, that workers and other persons are not exposed to health and safety risks arising from the business or undertaking.

A person conducting a business or undertaking that carries out abrasive blasting must eliminate risks arising from abrasive blasting, or if that is not reasonably practicable, minimise the risks so far as is reasonably practicable.

The WHS Regulations include more specific requirements to manage the risks of hazardous chemicals, airborne contaminants and plant, as well as other hazards associated with the abrasive blasting activities such as noise and manual tasks.

Designers, manufacturers, importers and suppliers of plant or substances used in abrasive blasting must ensure, so far as is reasonably practicable, that the plant or substance is without risks to health and safety. This duty includes carrying out testing and analysis as well as providing specific information about the plant or substance.

Officers, such as company directors, have a duty to exercise due diligence to ensure that the business or undertaking complies with the WHS Act and Regulations. This includes taking

reasonable steps to ensure that the business or undertaking has and uses appropriate resources and processes to eliminate or minimise risks that arise from abrasive blasting.

Workers have a duty to take reasonable care for their own health and safety and that they do not adversely affect the health and safety of other persons. Workers must comply with any reasonable instruction and cooperate with any reasonable policy or procedure relating to health and safety at the workplace. If personal protective equipment is provided by the person conducting the business or undertaking, the worker must use it in accordance with the information, instruction and training provided.

1.3 WHAT IS REQUIRED TO MANAGE RISKS ASSOCIATED WITH ABRASIVE BLASTING?

The WHS Regulations require a person conducting a business or undertaking to 'manage risks' associated with specific hazards, including noise, hazardous chemicals, plant and electricity.

Regulation 32-38: In order to manage risk under the WHS Regulations, a duty holder must:

- a) identify reasonably foreseeable hazards that could give rise to the risk
- b) eliminate the risk so far as is reasonably practicable
- c) if it is not reasonably practicable to eliminate the risk, minimise the risk so far as is reasonably practicable by implementing control measures in accordance with the hierarchy of risk control
- d) maintain the implemented control measure so that it remains effective
- e) review, and if necessary revise all risk control measures so as to maintain, so far as is reasonably practicable, a work environment that is without risks to health and safety.

This Code provides guidance on managing the risks of abrasive blasting by following a systematic process that involves:

- identifying hazards
- if necessary, assessing the risks associated with these hazards
- implementing control measures, and
- reviewing control measures.

Guidance on the general risk management process is available in the *Code of Practice: How to Manage Work Health and Safety Risks*.

Consulting your workers

Consultation involves sharing of information, giving workers a reasonable opportunity to express views and taking those views into account before making decisions on health and safety matters.

Section 47: A person conducting a business or undertaking must consult, so far as is reasonably practicable, with workers who carry out work for them who are (or are likely to be) directly affected by a work health and safety matter.

Section 48: If the workers are represented by a health and safety representative, the consultation must involve that representative.

Consultation with workers and their health and safety representatives is required at each step of the risk management process. By drawing on the experience, knowledge and ideas of your workers you are more likely to identify all hazards and choose effective control measures.

Consultation with workers can help you select appropriate control measures, including any personal protective equipment they may require.

Consulting, co-operating and coordinating activities with other duty holders

Section 46: A person conducting a business or undertaking must consult, cooperate and coordinate activities with all other persons who have a work health or safety duty in relation to the same matter, so far as is reasonably practicable.

Sometimes you may share responsibility for a health and safety matter with other business operators who are involved in the same activities or who share the same workplace. In these situations, you should exchange information to find out who is doing what and work together in a cooperative and coordinated way so that all risks are eliminated or minimised so far as is reasonably practicable.

For example, if you engage a contractor to carry out abrasive blasting activities at your workplace, then you should find out what blasting medium and what work processes are being used, any associated hazards and how the risks will be controlled. This may include jointly conducting a risk assessment for the work and determining the control measures to implement. After the

risk assessment has been conducted, it is important for all duty holders to cooperate and coordinate activities with each other to implement the control measures.

Further guidance on consultation is available in the *Code of Practice: Work Health and Safety Consultation, Co-operation and Co-ordination*.

2. THE RISK MANAGEMENT PROCESS

2.1 IDENTIFYING THE HAZARDS

The first step in managing risks associated with abrasive blasting activities is to identify all the hazards that have the potential to cause harm.

Potential hazards may be identified in a number of different ways including:

- conducting a walk through assessment of the workplace
- observing the work and talking to workers about how work is carried out
- inspecting the plant and equipment that will be used during the abrasive blasting activity
- reading product labels, safety data sheets and manufacturer's instruction manuals
- talking to manufacturers, suppliers, industry associations and health and safety specialists
- reviewing incident reports.

Examples of abrasive blasting hazards include:

- airborne contaminants such as dust
- hazardous chemicals, particulate matter, for example small particles or pieces of the substrate or blasting medium
- noise
- abrasive blasting plant and equipment.

Exposure standards

Regulation 49: A person conducting a business or undertaking must ensure that no person at the workplace is exposed to a substance or mixture in an airborne concentration that exceeds the exposure standard for the substance or mixture.

Exposure standards represent airborne concentrations of a particular substance or mixture that must not be exceeded. There are three types of exposure standard:

- 8-hour time-weighted average
- peak limitation
- short term exposure limit.

Exposure standards are based on the airborne concentrations of individual substances that, according to current knowledge, should not cause adverse health effects nor cause undue discomfort to nearly all workers.

Chemicals with workplace exposure standards are listed in the *Workplace Exposure Standards for Airborne Contaminants*. These exposure standards are also available from the Hazardous Substances Information System (HSIS) on the Safe Work Australia website. The HSIS database contains additional information and guidance for many substances. Although exposure standards may also be listed in Section 8 of the Safety Data Sheet (SDS), you should always check the *Workplace Exposure Standards for Airborne Contaminants* or HSIS to be certain.

If the blasting medium or the surface being blasted contains any crystalline silica, lead or any other substance with an exposure standard, you must ensure that workers are not exposed to levels that exceed the relevant exposure standard.

To comply with the WHS Regulations, monitoring of workplace contaminant levels for chemicals with exposure standards may need to be carried out.

Guidance on interpreting exposure standards is available in the *Guidance on the Interpretation of Workplace Exposure Standards for Airborne Contaminants*.

2.2 ASSESSING THE RISKS

Under the WHS Regulations, a risk assessment is not mandatory for abrasive blasting activities however it is required for specific situations, for example when working in a confined space. In many circumstances a risk assessment will assist in determining the control measures that should be implemented. It will help to:

- identify which workers are at risk of exposure
- determine what sources and processes are causing that risk
- identify if and what kind of control measures should be implemented
- check the effectiveness of existing control measures.

The following questions may help to assess the risk:

- How often, and for how long, will exposure to the hazard occur?
- In the event of exposure to the hazard, will the outcome be severe, moderate or mild?
- What are the properties of the blasting medium being used?
- What is the substrate being blasted?

- What are the surface coatings of the items being blasted? For example do they contain lead or other toxic metals
- What are the conditions under which abrasive blasting is carried out (for example, confined spaces)?
- What are the skills, competence and experience of the operator?

Monitoring airborne contaminant levels

Regulation 50 A person conducting a business or undertaking at a workplace must ensure that air monitoring is carried out to determine the airborne concentration of a substance or mixture at the workplace to which an exposure standard applies if:

- the person is not certain on reasonable grounds whether or not the airborne concentration of the substance or mixture at the workplace exceeds the relevant exposure standard; or
- monitoring is necessary to determine whether there is a risk to health.

The results of air monitoring must be recorded and kept for 30 years after the date the record is made.

Air monitoring is the sampling of workplace atmospheres to obtain an estimate of workers' potential inhalation exposure to hazardous chemicals.

Air monitoring can be used:

- when there is uncertainty about the level of exposure
- to indicate whether the exposure standards are being exceeded or approached
- to test the effectiveness of the control measures.

Air monitoring should be carried out by a person such as an occupational hygienist with skills to carry out the monitoring according to standards and to interpret the results.

Where monitoring of airborne contaminants is used to determine a person's exposure, the monitoring must be undertaken in the breathing zone of the worker (i.e. inside the abrasive blasting helmet) to ensure the effectiveness of the abrasive blasting helmet.

Monitoring should also be conducted in the breathing zones of other workers in the vicinity, to ensure that they are not exposed to hazardous levels of dust.

Results from air monitoring indicate how effective your control measures are, for example whether ventilation systems are operating as intended. If monitoring identifies that the exposure

standard is being exceeded, the control measures must be reviewed and any necessary changes made.

In dense clouds of dust it is often necessary to take a measurement more than once to ensure an accurate reading. Air monitoring is particularly important in measuring exposure when a toxic material is introduced into the blasting process.

Air monitoring cannot be used to determine a risk to health via skin contact of airborne chemicals.

2.3 CONTROLLING THE RISKS

The hierarchy of control measures

Some control measures are more effective than others. Control measures can be ranked from the highest level of protection and reliability to the lowest. This ranking is known as the *hierarchy of control*.

You must always aim to eliminate a hazard and associated risk first. If this is not reasonably practicable, the risk must be minimised by using one or more of the following approaches:

- *Substitution* – for example, use a less hazardous abrasive material
- *Isolation* – for example, carry out blasting in a blasting cabinet or enclosure
- *Implementing engineering controls* – for example, use automatic cut-off devices on abrasive blasting equipment.

If risk remains, it must be minimised by implementing administrative controls, so far as is reasonably practicable, for example by establishing exclusion zones around open air blasting activities. Any remaining risk must be minimised with suitable personal protective equipment (PPE).

Administrative control measures and PPE rely on human behaviour and supervision, and used on their own, tend to be least effective in minimising risks.

A combination of these control measures may be required in order to adequately manage the risks with abrasive blasting. You should check that your chosen control measure does not introduce new hazards.

Chapters 3 and 4 of this Code provide information on control measures for abrasive blasting activities.

2.4 REVIEWING CONTROL MEASURES

The control measures that are put in place to protect health and safety should be regularly reviewed to make sure they are effective. This may involve, for example, air monitoring to measure the concentration of crystalline silica in the worker's

breathing zone during the abrasive blasting process. If the control measure is not working effectively it must be revised to ensure it is effective in controlling the risk.

Common review methods include workplace inspection, consultation, testing and analysing records and data.

You can use the same methods as in the initial hazard identification step to check control measures. You should also consult your workers and their health and safety representatives and consider the following questions:

- Are the control measures working effectively in both their design and operation?
- Have the control measures introduced new problems?
- Have all hazards been identified?
- Have new work methods, new equipment or chemicals made the job safer?
- Are safety procedures being followed?
- Has the training and instruction provided to workers on how to work safely been successful?
- Are workers actively involved in identifying hazards and possible control measures?
- Are they openly raising health and safety concerns and reporting problems promptly?
- Are the frequency and severity of health and safety incidents reducing over time?
- If new legislation or new information becomes available, does it indicate current control measures may no longer be the most effective?

If problems are found, go back through the risk management steps, review your information and make further decisions about risk control.

Health monitoring

Regulation 368: A person conducting a business or undertaking must ensure health monitoring is provided to a worker carrying out work for the business or undertaking if:

- the worker is carrying out ongoing work at a workplace using, handling, generating or storing hazardous chemicals and there is a significant risk to the worker's health because of exposure to a hazardous chemical referred to in Schedule 14, table 14.1, column 2; or

- the person identifies that because of ongoing work carried out by a worker using, handling, generating or storing hazardous chemicals there is a significant risk that the worker will be exposed to a hazardous chemical (other than a hazardous chemical referred to in Schedule 14, table 14.1) and either:
 - valid techniques are available to detect the effect on the worker's health; or
 - a valid way of determining biological exposure to the hazardous chemical is available and it is uncertain, on reasonable grounds, whether the exposure to the hazardous chemical has resulted in the biological exposure standard being exceeded.

Health monitoring of a person means monitoring the person to identify changes in the person's health status because of exposure to certain substances. It involves the collection of data in order to evaluate the effects of exposure to determine whether or not the absorbed dose is within safe levels. This allows decisions to be made about implementing ways to eliminate or minimise the worker's risk of exposure, for example, reassigning a worker to other duties that involve less exposure or improving control measures.

Substances commonly encountered during abrasive blasting (either in the blasting medium or the surface being blasted) that may require health monitoring to be carried out include:

- asbestos
- crystalline silica
- cadmium
- inorganic arsenic
- inorganic chromium, and
- inorganic lead.

Health monitoring, which may include biological monitoring, can assist in:

- establishing whether an identifiable disease or health effect known to be linked to exposure to dust, chemicals or noise has occurred
- determining levels of toxic substances in the body so that informed decisions can be made about the effectiveness of control measures and whether any further action needs to be taken (e.g. a reduction in or cessation of exposure).

Biological monitoring is a way of assessing exposure to hazardous chemicals that may have been absorbed through the skin, ingested or inhaled, therefore, biological monitoring techniques should also be used. For example, workers exposed to lead may require biological monitoring to measure the level of lead in their blood.

Biological monitoring has the specific advantage of being able to take into account individual responses to particular hazardous chemicals. Individual responses are influenced by factors including size, fitness, personal hygiene, work practices, smoking and nutritional status.

A person conducting a business or undertaking must ensure that where health monitoring must be provided to a worker, the type of health monitoring referred to in the WHS Regulations is provided unless:

- an equal or better type of health monitoring is available, and
- the use of that other type of monitoring is recommended by a registered medical practitioner with experience in health monitoring.

Health monitoring is not an alternative to implementing control measures. If the results indicate that a worker is experiencing adverse health effects or signs of exposure to a hazardous chemical, the control measure must be reviewed and if necessary revised.

A person conducting a business or undertaking must:

- inform workers and prospective workers about health monitoring requirements
- ensure health monitoring is carried out by or under the supervision of a registered medical practitioner with experience in health monitoring
- consult workers in relation to the selection of the registered medical practitioner
- pay all expenses relating to health monitoring
- provide certain information about a worker to the registered medical practitioner
- take all reasonable steps to obtain a report from the registered medical practitioner as soon as practicable after the monitoring has been carried out
- provide a copy of the report to the worker and Comcare if the report contains adverse test results or recommendations that remedial measures should be taken.

Also provide the report to all other persons conducting a business or undertaking who have a duty to provide health monitoring for the worker

- keep reports as confidential records for at least 30 years after the record is made (40 years for reports relating to asbestos exposure), and
- not disclose the report to anyone without the worker's written consent unless required to under the WHS Regulations.

The WHS Regulations also contain specific requirements relating to health monitoring for lead. If a worker is carrying out lead risk work, health monitoring must be provided to a worker before the worker first commences lead risk work and one month after the worker first commences lead risk work.

Further information on health monitoring can be found in the *Health Monitoring for Exposure to Hazardous Chemicals – Guide for Workers* and *Health Monitoring for Exposure to Hazardous Chemicals – Guide for Persons Conducting a Business or Undertaking*.

3. SPECIFIC HAZARDS AND CONTROL MEASURES

3.1 PROHIBITED AND RESTRICTED CHEMICALS

The WHS Regulations prohibit and restrict the use of some hazardous chemicals as abrasive material in an abrasive blasting process.

Regulation 381: A person conducting a business or undertaking must not use, handle or store, or direct a worker to use, handle or store the hazardous chemicals listed in table 1 for abrasive blasting.

Table 1 – Restricted hazardous chemicals

Any substance that contains greater than: <ul style="list-style-type: none">• 1 % free silica (crystalline silicon dioxide)• 0.1 % antimony• 0.1 % arsenic• 0.1 % beryllium• 0.1 % cadmium• 0.5 % chromium (except as specified for wet abrasive blasting)• 0.1 % cobalt• 0.1 % lead (or which would expose the operator to levels in excess of those set in the WHS Regulations covering lead)• 0.1 % nickel• 0.1 % tin
For wet abrasive blasting, any substance than contains chromate, nitrate or nitrite
Polychlorinated biphenyls (PCBs)

There are also other carcinogenic chemicals that are prohibited or their use is restricted under the WHS Regulations and therefore cannot be used in abrasive blasting, for example acrylonitrile (CAS number 107-13-1) must not be used, handled or stored for *any purpose*, including abrasive blasting, unless Comcare has properly authorised it. Restricted and prohibited carcinogenic chemicals and restricted hazardous chemicals are listed in Schedule 10 of the WHS Regulations.

Asbestos

Regulation 446 A person conducting a business or undertaking must not use, direct or allow a worker to use high pressure water spray or compressed air on asbestos or asbestos containing materials.

The use of high pressure water spray or compressed air on asbestos or asbestos containing materials is prohibited. Asbestos can release airborne fibres whenever it is disturbed, and the inhalation of these fibres into the lungs is a significant health risk.

Asbestos has been used in products including:

- certain textured coatings and paints
- roofing materials
- vinyl or thermoplastic floor tiles, profiled sheets used on roofs and walls and flat sheets in flashings
- imitation brick cladding, and
- plaster patching compounds.

The WHS Regulations contain specific requirements on asbestos and asbestos-containing material.

It can be difficult to identify the presence of asbestos by sight so having a sample of the suspected material analysed will confirm whether it is asbestos or not. Sampling can be hazardous and should only be undertaken by a competent person and samples should only be analysed by a National Association of Testing Authorities (NATA) accredited laboratory or a laboratory approved by Comcare or operated by Comcare.

Further guidance is available in the *Code of Practice: How to Safely Remove Asbestos* and the *Code of Practice: How to Manage and Control Asbestos in the Workplace*.

Lead

Lead may be present in surface coatings or the object being blasted. The WHS Regulations contain specific requirements for working with lead in addition to the hazardous chemicals requirements. These include the identification of lead risk work and removing a worker from lead risk work in certain circumstances.

Naturally occurring radioactive material

Some abrasive blasting mediums such as garnet and staurolite may contain trace levels of thorium. Thorium is a naturally

occurring radioactive material. While the concentration of thorium or other radioactive materials is low, mineral extraction may concentrate naturally occurring radioactive material. Exposure to naturally occurring radioactive material is through inhaled dust. Exposure to radioactive materials may increase the risk of cancer.

The use of abrasives containing any radioactive substance where the level of radiation exceeds 1 becquerels per gram (Bq/g) is prohibited, so far as reasonably practicable. You should actively source material with lower radioactive content levels to minimise the risks from radiation.

Further information on selecting an abrasive blasting medium is at Appendix A.

3.2 DUST

One of the main hazards in abrasive blasting is dust which in many cases can be toxic. Crystalline silica and lead are typical examples of toxic dusts that can be generated during abrasive blasting activities.

Identifying dust hazards

Abrasive blasting can generate large quantities of respirable and inhalable dust from the abrasive blasting medium and the surface of the object being blasted.

'Inhalable' dust means the dust present in the air which a worker can inhale through the nose or mouth during breathing. 'Respirable' dust is that portion of inhalable dust that is small enough to enter the lungs down to the lower bronchioles and alveolar regions.

Respirable dusts may be more hazardous than inhalable dusts for some materials, such as crystalline silica which can result in permanent scarring of the lung tissue.

Labels and SDSs should be checked to identify dust hazards in the blasting medium. Manufacturers, importers and suppliers of hazardous chemicals have a duty under the WHS Regulations to ensure that the current SDS is provided to a person at the workplace if the person asks for it. The SDS provides information about the chemical, possible health effects, control measures that may be used to minimise exposure and first aid requirements.

You should also consider dust hazards presented by the surface being blasted, which could discharge particles of hazardous chemicals. Hazards include any paint or coating on the surface (which, for example, could contain lead) and the composition of

the object or structure being blasted (which could contain asbestos or other hazardous chemicals).

Crystalline silica dust

Crystalline silica dust can be generated by:

- using abrasive materials that contain traces of crystalline silica, (e.g. staurolite or garnet), or
- abrasive blasting surfaces that contain crystalline silica (e.g. concrete, sandstone masonry, calcium silicate bricks, foundry castings).

Exposure to respirable crystalline silica can result in silicosis, which is stiffening and scarring of the lungs. It results in shortness of breath, coughing, and chest pain. The effects are irreversible and lead to a degeneration in the person's health, invariably resulting in death. Exposure to respirable crystalline silica is also associated with chronic lung diseases and cancer.

Silicosis can result from short-term exposure to high concentrations of crystalline silica dust (acute silicosis) or it can develop after long-term exposure over a number of years.

Lead dust

Lead dust can be generated by:

- using an abrasive material that contains lead (prohibited under the WHS Regulations)
- the abrasive blasting of surfaces containing lead, or
- abrasive blasting surfaces covered by paint that contains lead.

These surfaces commonly occur on bridges, ships, machinery, vehicles and recycled old housing timber.

Lead is easily absorbed or taken into the body by:

- inhaling dust or fumes
- eating contaminated food, or
- eating, drinking or smoking using contaminated fingers.

The major risk associated with lead is lead poisoning (plumbism). This affects the blood system and can cause anemia. Other symptoms include abdominal pain, convulsions, hallucinations, coma, weakness, tremors and the possible increased risk of cancer. Lead exposure can also affect both male and female reproductive systems. A developing foetus is particularly at risk, especially in the early weeks before a pregnancy becomes known.

The rate of absorption of lead depends on the size of the particles and the route of entry. Abrasive blasting produces particles small enough to be absorbed rapidly, leading to more acute and severe toxic effects.

Regulation 392: Under the WHS Regulations using a power tool, including abrasive blasting and high pressure water jets to remove a surface coated with paint containing more than 1 percent by dry weight of lead metal and handling waste containing lead is a *lead process*.

This means certain requirements in the WHS Regulations apply including:

- giving information to a person likely to be engaged to carry out a lead process, before the person is so engaged, on the health risks and toxic effects associated with lead, and the need for medical examinations and biological monitoring of workers carrying out a lead process, and
- assessing each lead process to determine if the lead process is lead risk work, i.e. if the work is likely to cause a worker's blood lead level to be more than 10 micrograms per decilitre (for a female of reproductive capacity) or 30 micrograms per decilitre (for all other cases).

Assessing the risks from dust exposure

There are a number of factors that affect the degree of risk associated with dust produced in abrasive blasting activities. These factors include:

- the concentration of airborne dust in the breathing zone of the worker
- the size of the dust particles generated (whether dust particles are inhalable or respirable)
- the duration of exposure, and
- the type of dust and its biological effect

You should also identify situations where dust could spread to other workplaces or the environment.

Control of dust

Using a less hazardous abrasive material

Before purchasing any abrasive blasting mediums, you should look at the label and SDS to check the concentration of impurities and whether its use is prohibited or restricted under the WHS Regulations. Where a material is prohibited from use, your supplier may be able to advise alternative abrasive blasting medium (see Appendix A).

It is important to select an abrasive blasting medium with qualities that will generate minimum dust levels. Metallic abrasives have proven characteristics that resist shattering on impact, which is the major cause of the dust produced during blasting. Environmentally clean and recyclable abrasives, such as chilled iron grit or cast steel grit, should be used where reasonably practicable.

Using a less hazardous surface preparation method

The selection of methods of surface preparation can also affect the amount of dust in the air.

Wet abrasive blasting

A standard blast machine and compressed air are used to propel the abrasive with just enough water added to suppress the dust. Inhibitors are sometimes added to the water to minimise flash rusting. For effective dust suppression, the water should be added before the abrasive leaves the nozzle. The use of inhibitors such as chromate, nitrate or nitrite must comply with the restrictions on use in Table 10.3 of Schedule 10 of the WHS Regulations.

Water jetting (high and ultra high pressure)

High pressure water jetting is an alternative method to abrasive blasting. For further information on high pressure water jetting you should refer to AS/NZS 4233.1 *High pressure water (hydro) jetting systems Part 1:– Guidelines for safe operation and maintenance* and AS/NZS 4233.2: *High pressure water (hydro) jetting systems Part 2:- Construction and performance*.

Centrifugal wheel blasting

Centrifugal wheel blasting involves a rotating wheel assembly, either air or electrically driven, inside an enclosure fitted with a dust collector. Abrasive is propelled outwards from the spinning wheel by centrifugal force, striking the surface to be cleaned and removing rust, paint and mill scale.

Abrasives used include steel shot, steel grit, cut wire and chilled iron grit. They are recyclable and are continuously recovered, cleaned and returned for re-use.

Centrifugal wheel blasting is normally used where the work is of a consistent size, (e.g. pipes, valves, or steel sections). Normally, the rotating wheel assembly remains fixed and the surface to be cleaned is passed through the enclosure, but centrifugal wheel blasting can also be used on-site, (e.g. on a tank), with special adaptors where the wheel assembly moves across a stationary work surface.

Because all blasting takes place within an enclosure, there is no contact with airborne dust or high velocity particles. This minimises the risk to operators. However, attention should be paid to seals on wheel abrading equipment to ensure that toxic dusts cannot escape into the workplace during operation and that sufficient extraction clearance time is allowed before access doors are opened.

Vacuum blasting

Vacuum blast cleaning uses a standard abrasive blast nozzle, operating inside a shroud which is in close contact with the work surface, forming a tight seal. As the abrasive impinges on the surface, a vacuum is applied inside the shroud, removing the debris. The abrasive material, which typically can be steel shot, steel grit, chilled iron grit, aluminium oxide or garnet, is separated, and returned for re-use.

A variety of heads may be used to achieve a tight seal for inside corners, outside corners, and flat surfaces. In practice, however, operators tend not to change heads, lifting the assembly from the surface to clean odd shapes and inaccessible surfaces. While this may save time, it breaks the seal, defeating the purpose of the vacuum and exposing workers and the environment to hazards. This practice should be avoided where possible.

When used properly, vacuum blast cleaning can clean effectively with minimal dust generation.

Other removal methods

There are many emerging techniques and equipment that may minimise airborne dust levels. These include:

- sodium bicarbonate blasting
- blast cleaning with reusable sponge abrasives
- carbon dioxide (dry ice) blast cleaning.

You should also consider cleaning techniques that do not involve blasting, particularly for smaller jobs. These include:

- chemical strippers
- heat guns
- power tools with dust collection systems
- manual sanding
- scraping.

Although these techniques should generate low levels of dust, and therefore generally present lower risks to workers than

abrasive blasting, other risks involved in using such techniques still need to be assessed and controlled.

Isolation and engineering controls

Abrasive blasting should be carried out in a blasting cabinet or blasting chamber where practicable.

Blasting cabinets

These are suitable for blasting small objects. The cabinet (see Figure 1) is fully sealed and the operator manipulates the work piece and the blasting hose from outside, viewing the object through a sealed window.

When using a properly designed and maintained cabinet, there is no need to wear a respiratory device. However, a low toxicity abrasive should still be used as poor maintenance of the cabinet may expose workers to dust.

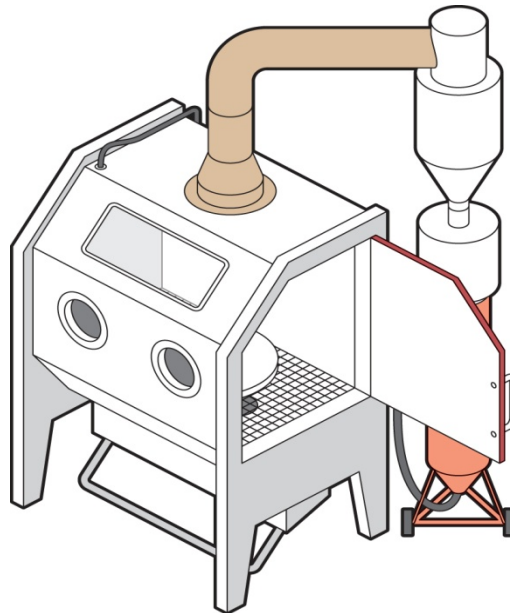


Figure 1: Blasting cabinet

Blasting chambers

Blasting chambers (also known as blast rooms – see Figure 2) should be used for cleaning transportable objects that are too large to be treated inside a blasting cabinet.

Blasting is done manually by operators working inside the chamber. Operators working inside blasting chambers must wear a hood or helmet type airline respirator which should be fitted with an inner bib and a high visibility shoulder cape, jacket or protective suit. Further information on hood or helmet type airline respirators can be found in *AS/NZS 1716: Respiratory protective devices*. The necessary capacity of any air service for

respiratory protection should be calculated on a minimum requirement of 170 litres per minute continuous flow for each person, measured at the regulator. Where air cooling or encapsulated suits are used additional air will be required and advice should be sought from a competent person. Further information on quality of breathing air can be found in AS/NZS 1715: *Selection, use and maintenance of respiratory protective equipment*.

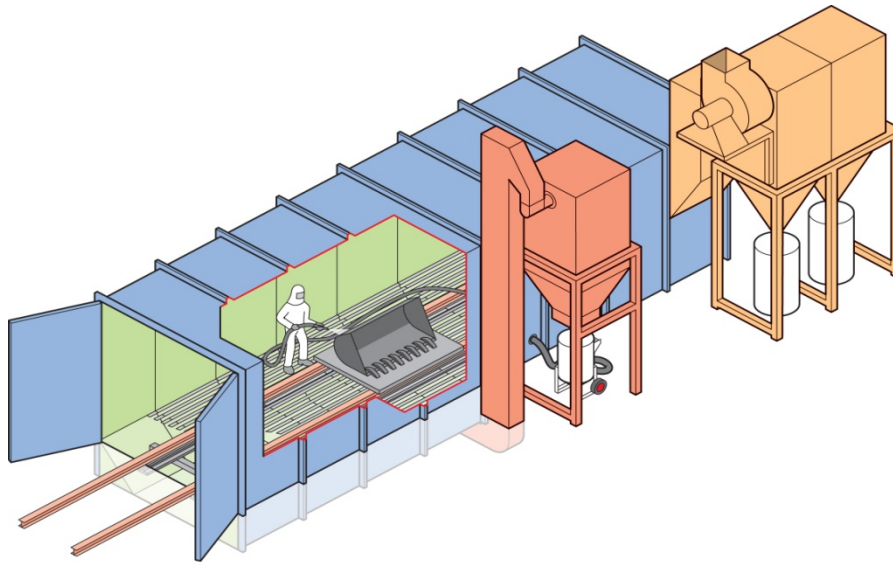


Figure 2: Blasting chamber

Temporary enclosures

Temporary enclosures should be used when the object or structure to be blasted is unable to be transported or too large for a blasting chamber. Temporary enclosure should also be used for fixed structures such as bridges or water tanks.

Where monitoring indicates that persons in surrounding areas may be exposed to dust levels in excess of the exposure standards, they should be excluded from the area where possible by warning signs and barricading, or provided with PPE.

Regardless of the control measures chosen, you must ensure that no-one at the workplace is exposed to dust levels in an airborne concentration that exceeds the relevant exposure standard.

Further information on blasting cabinets, blasting chambers and temporary enclosures can be found in Section 3.4 of this Code.

Administrative controls

Exclusion zones

Although open air blasting activities are not recommended, there may be occasions when there is no alternative. In these

circumstances, exclusion zones (also known as buffer zones) should be used to protect workers and other persons in the vicinity from exposure to hazardous dust (see Figure 3). Exclusion zones may also be used in conjunction with blasting chambers and temporary enclosures.

The size of the exclusion zone should be determined after assessing the risk to all unprotected people. The prevailing conditions at the time of blasting should be taken into account, for example, the exclusion zone may need to be extended downwind.

An exclusion zone should be established and maintained to exclude workers and other persons who are not wearing respiratory protective equipment (RPE). Warning signs should be located

so that they are clearly visible before entering the area.

Signs should warn that:

- abrasive blasting is in progress and that there is a dust hazard
- access to the area is restricted to authorised persons
- RPE should be worn in the exclusion zone.

Where an exclusion zone interferes with other activities at a workplace, other workers should only work within the exclusion zone after being provided with RPE.

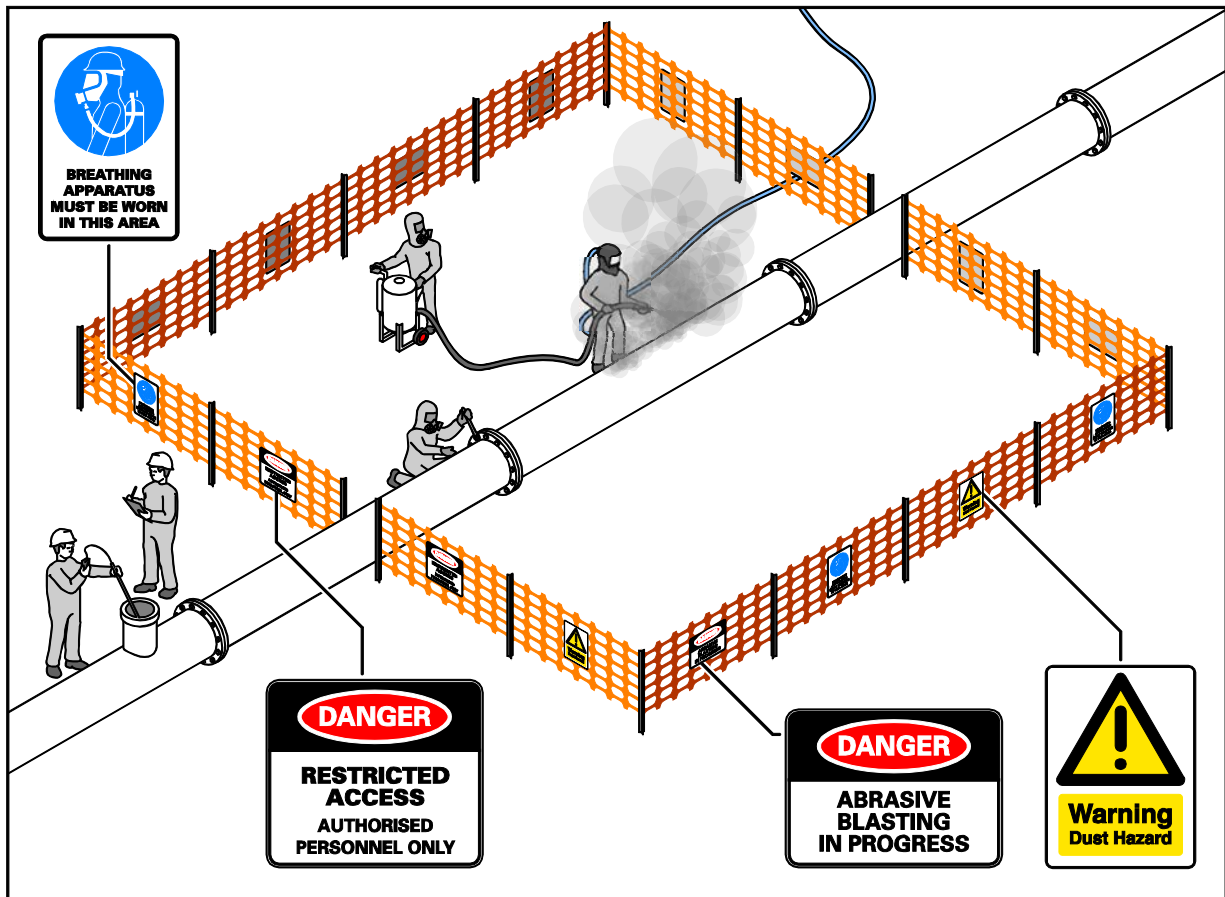


Figure 3: Exclusion Zone

Scheduling abrasive blasting activities

The number of people who will be exposed to dust should be reduced by:

- shifting the site of abrasive blasting away from other workers
- scheduling blasting outside normal working hours
- ceasing blasting in windy conditions
- stopping other work on a site and clearing people while blasting is taking place.

Housekeeping

Drift from abrasive blasting can be harmful not only to workers but also to members of the public. Good housekeeping can minimise the risk of exposure.

While other control measures should prevent dust escaping from the area where blasting is being done, any dust or residue that does make its way into the workplace should be removed as soon as practicable after blasting has finished. This includes the surfaces in an exclusion zone.

Where practicable, accumulated dust should be removed using wet cleaning methods, or High Efficiency filter vacuum methods.

Because workers undertaking cleaning work may be exposed to dust levels that exceed the exposure standard, they should wear PPE.

Facilities

Decontamination facilities should be provided to allow workers to shower and change clothes after the completion of blasting. Many types of dust (particularly lead dust) may enter the body by ingestion. It is therefore important that workers take care with personal hygiene by washing hands and face prior to eating or drinking. A clean area, separated from the blast site, should be provided for consuming food.

Further guidance on the type of facilities that should be provided is available in the *Code of Practice: Managing the Work Environment and Facilities*.

Personal protective equipment

PPE should include:

- an airline respirator of the hood or helmet type, fitted with an inner bib and a high visibility shoulder cape
- protective clothing (a jacket or protective suit)
- protective gloves (canvas or leather) protective footwear
- personal hearing protectors.

Regulation 44: If personal protective equipment (PPE) is to be used at the workplace, the person conducting the business or undertaking must ensure that the equipment is selected to minimise risk to health and safety including by ensuring that the equipment is:

- suitable for the nature of the work and any hazard associated with the work
- a suitable size and fit and reasonably comfortable for the person wearing it
- maintained, repaired or replaced so it continues to minimise the risk
- used or worn by the worker, so far as is reasonably practicable.

A person conducting a business or undertaking who directs the carrying out of work must provide the worker with information, training and instruction in the proper use and wearing of personal protective equipment; and the storage and maintenance of personal protective equipment.

A worker must, so far as reasonably able, wear the PPE in accordance with any information, training or reasonable instruction and must not intentionally misuse or damage the equipment.

As abrasive blasting is a high hazard activity, some PPE should always be worn regardless of other control measures in place.

Respiratory protection

Workers engaged in abrasive blasting should be supplied with and wear an airline positive pressure hood or helmet fitted with an inner bib and a high visibility shoulder cape, jacket or protective suit.

Respirator helmets must be supplied with breathing air of an adequate quality. If the air is supplied from compressed air cylinders, the source should be fitted with an alarm device that warns the wearer or an attendant when the cylinder pressure falls below a predetermined level. For information on air quality refer to *AS/NZS 1715: Selection, use and maintenance of respiratory protective equipment*.

Any air-fed respirator should have an alarm that warns and logs the incidence of carbon monoxide gas.

An air purifying respirator should also be worn by the pot attendant and any other person within the work area while abrasive blasting is in progress, during maintenance or repair work or during the clean-up of dust. For further information refer to *AS/NZS 1716: Respiratory protective devices*.

Care should be taken to ensure breathing air lines cannot be run over by vehicles or damaged by the blasting process. Air intakes to breathing air compressors should be situated well away from sources of contaminants, particularly exhaust gases from mobile liquid fuel engines, or areas where exhaust fumes may accumulate.

Respirators should be fitted for each person individually and if one is to be used by another operator, it should be disinfected and refitted before use. The tightness of all connections and the condition of the face piece, headbands and valves should be checked before each use.

Respirators should be selected, fitted, used and maintained in accordance with the manufacturer's instructions. For further information also refer to *AS/NZS 1715: Selection, use and maintenance of respiratory protective equipment*.

Protective clothing

To keep out dust and abrasive grit, protective suits or clothing should be worn and should have leather or elastic straps at the wrist and ankles and overlapping flaps at all suit closures.

Protective gloves should be industrial safety gloves or mittens of an appropriate material to reduce penetration of particulate matter. For further information refer to *AS/NZS 2161: Occupational protective gloves*.

Protective footwear should be made of material which reduces penetration from particulate matter, and where appropriate, should be waterproof. For further information refer to *AS/NZS 2210: Occupational protective footwear*.

If disposable clothing is worn, the clothing should be appropriately disposed of after use, without risk to the safety and health of others.

Helmets and eye protection

Helmets will provide protection from flying fragments to the eyes, head and neck.

Helmets should not be held or hung up by the air feed hose, dropped or left in areas where they might be exposed to dust and dirt or be subject to distortion. After removing the helmet, dust should be vacuumed and the cleaned helmet placed in an airtight plastic bag. It should be stored in a dust-free area, away from direct sunlight. At least once a week, the inside of the helmet should be washed with warm water and mild detergent.

The helmet cape requires frequent inspection, periodic cleaning and immediate replacement if damaged. You should never use tape to repair holes or worn areas. The inner collar should be replaced when the elastic becomes stretched out of shape.

For further information on the selection, use and maintenance of helmets refer to *AS/NZS 1800: Occupational protective helmets – selection, care and use*.

Protective eye equipment includes safety glasses, goggles, face shields, hoods or helmets with lenses designed to withstand medium to high velocity impact by flying objects. For further information refer to *AS/NZS 1336 Recommended practices for occupational eye protection* and *AS/NZS 1337: Eye protectors for industrial applications*.

Maintenance of PPE

The WHS Regulations require that PPE is maintained, repaired or replaced so as to ensure that it continues to be effective. A maintenance program should include procedures for:

- daily cleaning and inspection of PPE by the worker for wear and damage
- identification and repair or replacement of any worn or defective components of equipment
- regular periodic inspection, maintenance and testing of respiratory protective equipment in accordance with the manufacturer's instructions
- regular periodic testing of breathing air quality, in accordance with the manufacturer's instructions or, where manufacturer's instructions are not available, the instructions of a competent person.

3.3 PARTICULATE MATTER

Identifying particulate matter

Particulate matter is small particles or pieces of the substrate being blasted, or of the blasting medium which are generated during abrasive blasting. Particulate matter can also include water.

Workers carrying out abrasive blasting can be struck by particulate matter. Serious injuries or death can result from being struck by particulate matter discharged under high pressure.

Common injuries include:

- eye damage
- severe lacerations
- burns
- skin penetration.

Assessing the risks

You should observe workers undertaking abrasive blasting. This will allow you to see if they are following correct procedures and using the PPE provided. The risk of sustaining a serious injury from particulate matter is increased when:

- blasting in a confined space
- working in an elevated position
- the operator is out of the line of sight of a pot tender or there is no dedicated pot tender who can provide assistance if required.

Controlling the risks

Isolation

Abrasive blasting activities should be isolated from other workplace activities to minimise the possibility of workers being struck by particulate matter. This can be done by using blasting chambers, blasting cabinets, temporary enclosures and exclusion zones.

Abrasive blasting plant can also incorporate guards to reduce the possibility of particulate matter striking the operator.

Engineering controls

Abrasive blasting equipment should be fitted with a fast acting self-actuating cut-off device under the direct control of the nozzle operator that will immediately stop the flow of abrasive material.

The device most commonly used is called a 'dead man control' (see Figure 4).

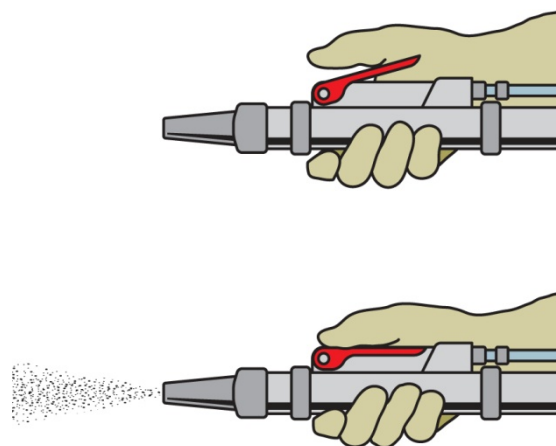


Figure 4: Nozzle with dead man control

Using a blast machine without a dead man control (under the direct control of the operator) is dangerous and may result in serious injury or death.

The dead man control is usually attached to the nozzle. When the nozzle is dropped, the air supply shuts off and prevents the hose from whipping and injuring the worker and the abrasive material firing at the operator or other people nearby. For more information on dead man controls, refer to the following section on abrasive blasting plant and equipment.

Administrative controls

When blasting, the nozzle should only be pointed at the work. A blast nozzle should never be pointed at any person. Blast hoses should be uncoiled when in use and operators should be

adequately trained in the use and maintenance of this equipment.

PPE

Workers exposed to high velocity particulate material should wear suitable PPE to protect against flying abrasive particles. The PPE should include:

- eye protection
- protective gloves (canvas or leather)
- protective footwear
- protective clothing (overalls, long trousers, blast suits, aprons)
- RPE

3.4 ABRASIVE BLASTING PLANT AND EQUIPMENT

Persons conducting businesses or undertakings who have management or control of plant at a workplace must ensure, so far as is reasonably practicable, that the plant is without risks to the health and safety of any person.

Designers of plant must ensure, so far as is reasonably practicable, that the plant is designed to be without risks to the health and safety of persons.

When purchasing abrasive blasting plant and equipment you should ensure that safety features have been incorporated into the design. The following information must be passed on from the designer through to the manufacturer and supplier to the end user:

- the purpose for which plant was designed or manufactured
- the results of any calculations, analysis, testing or examination
- any conditions necessary to ensure the safe use of the plant.

A supplier must give this information to each person who receives the plant (which may be in the form of a manufacturer's manual).

Air compressors and blast pots

All valves should be of a rating equivalent to that of the pressure vessel and be correctly attached. A safety relief valve should be fitted on the compressor or air supply system and regularly checked. Further information on the design of pressure vessels can be found in *AS/NZS 1200: Pressure equipment*.

Blow-down procedures (if applicable), should be developed and implemented. Never exceed the rated working pressure as this may lead to explosion.

A muffler should be attached to blast pots to minimise the noise from escaping air when the machine is depressurised.

Portable blast pots should have wheels and be ergonomically designed.

Planned inspection and routine maintenance should be carried out by a competent person. Further information can be found in *AS/NZS 378: Pressure equipment – In-service inspection, and the manufacturer's instructions*.

Nozzle

Where dry blasting is being conducted, an efficient means for the discharge of static electrical charge from the blast nozzle and the object being blasted should be provided.

The nozzle lining and threads should be checked for wear and damage. Use nozzle washers, and replace them when they show signs of wear.

Dead man controls (also known as fast acting automatic cut-off device)

Abrasive blasting equipment should be fitted with an automatic cut-off device (deadman control) near the blast nozzle so that it is under direct control of the nozzle operator to quickly stop the flow of abrasive material to the nozzle.

Dead man controls can be either pneumatic or electric. Pneumatic controls are only suitable for distances up to 40 metres because the response time increases with distance. Electric controls are recommended for distances over 40 metres as they respond almost instantly and response times do not increase with distance. Dead man controls are subjected to rough treatment because they are located at the nozzle which results in damage and rapid wear. Deadman controls (especially the lever and lever lock) should be inspected and tested several times each working day. Moving parts should be cleaned regularly to prevent jamming. You should also:

- replace the rubber buttons and seals as necessary to prevent air escaping and abrasive from entering
- inspect and clean control hose line fittings before connecting them to prevent dust and dirt clogging air passageways throughout the system which can damage control valve cylinder walls.

You should never modify, remove or substitute parts and never tape down or prevent free movement of the control handle. This

defeats the safety purpose of the remote control system and may cause serious injury if an uncontrolled nozzle is dropped.

Blast hoses, hose whips and couplings

Hoses should be constructed with anti-static rubber linings or fitted with an earth wire or similar mechanism to prevent electric shock. Static electricity may build up in dry blasting operations, from abrasive blasting equipment and/or from the surfaces being blasted. Static electricity can shock workers and create an ignition source, with the potential for explosion if there is a combustible atmosphere (for example, an atmosphere containing metal dust, organic abrasive or fine paint particles). You should ensure that:

- hoses or couplings are purpose designed
- the rated working pressure of a blast hose is not exceeded
- the hose from the pot to the blast nozzle is kept as straight as possible.
In situations where a hose needs to be curved around an object, a long radius curve should be used. The use of sharp curves may create rapid wear on the hose, leading to the possibility of the hose malfunctioning
- blasting does not take place with a coiled hose
- hose whip checks or hose coupling safety locks or both are fitted to hoses
- safety cables are used to support the weight of elevated hoses
- pin holes are not taped in the blast hose. The hole will enlarge quickly and will cause a blow-out
- blast hoses are coiled and stored away from water, oil and chemicals to prevent rotting
- coupling fit is checked
- screws provided by the coupling manufacturer are used
- the hose end fits uniformly flush with the coupling shoulder
- nozzle holders and couplings fit snugly on the blast hose. Reject those that are loose
- hoses that have a damaged outer cover are replaced
- all hoses or lines are positioned in locations where they are not subject to damage, fouling or restrictions
- hoses, hose whips and couplings are inspected, tested and maintained in accordance with the manufacturer's instructions.

Blasting cabinets

Blasting cabinets should be used for blasting small objects. The cabinets should be constructed from an abrasive resistant, non-combustible material and should also:

- have a sealed window so that the operator can view the object being cleaned
- be fitted with a dust extraction/collection system which has a sufficient air change rate to increase visibility and keep dust exposures less than the relevant exposure standards when the cabinet is opened
- have a dust tight light fixture, and
- have interlocked doors to eliminate the possibility of the machine being operated while the door is open.

In conjunction with the air change rate, a suitable clearing time should also be allowed before opening the cabinet.

Cabinets should be regularly inspected and maintained in accordance with the manufacturer's instructions, especially in relation to gloves, gasket, door seals and structural integrity.

Blasting chambers

Blasting chambers should be constructed from an abrasive resistant, non-combustible material designed to prevent the escape of dust and minimise internal projections on which dust may settle.

Blasting chambers should have a mechanical exhaust system that effectively extracts the dust from the blasting chamber and which is arranged so as to prevent re-entry of the extracted dust into the blasting chamber and the workplace. Extracted air should be passed through a filtering or cleaning device that removes airborne contaminants before discharge. In a down-draught air flow blasting chamber, the ventilation system should produce a minimum air velocity of 0.3 linear metres per second; and in a cross-draught air flow blasting chamber, the ventilation system should produce a minimum air velocity of 0.4 linear metres per second in the direction of extraction. The ventilation system ducts should be fitted with inspection ports and cleaning ports, ideally at locations where dust might be reasonably expected to accumulate. Bonding and grounding should be used to prevent static build-up.

Blasting chambers should also have:

- easily accessible operating controls and interlocked doors to prevent the machinery being operated while the door is open

- windows or inspection ports which are fixed in a metal sash and constructed of toughened safety glass, laminated safety glass or safety wired glass. Windows or inspection ports should be maintained so as to allow effective visibility
- an emergency exit located at the furthestmost position from the main entrance that is signposted and backlit so that it is visible if the power is cut
- a ventilation system kept in continuous operation whenever blasting is being done and for at least 5 minutes after blasting has finished or when cleaning, maintenance or repair is carried out on the chamber or cabinet, except where the operation of the ventilation system may create a hazard (in which case effective alternative means of ventilation should be provided)
- an illumination of at least 200 lux measured on a horizontal plane one metre above the floor of the blasting chamber or enclosure
- an electrical supply which complies with relevant standards, for example *AS/NZS 2381: Electrical equipment for explosive gas atmospheres* and *AS/NZS 3000: Electrical installations* (known as the Australian /New Zealand Wiring Rules).

Blasting chambers should be maintained so as to prevent dust from escaping. Doors should be kept closed during blasting.

Only abrasive blasting work, work incidental to abrasive blasting, or maintenance or repairs to the blast room or its equipment should be carried out in the blasting room.

Manufacturers of blasting chambers should conduct testing to ascertain the level of ventilation required under normal operating conditions. This should assist you to select a chamber appropriate to your needs.

Testing of the ventilation should be conducted on-site when the chamber is installed to ensure that it is operating to the design specifications. Ventilation should also be tested when there is a change in blasting procedures (e.g. use of a different abrasive material), after damage or repairs and on a regular basis (e.g. every 12 months). This testing can be conducted by an occupational hygienist or other competent person.

Temporary enclosures

Where possible the object being blasted should be fully enclosed. Where full enclosure is not possible, screening should extend two metres above the structure and blasting should be conducted downwards. Where persons outside the structure may be

exposed to dust, exclusion zones, signage and PPE should be used. Stringent monitoring may be necessary to ensure that people outside the structure are not exposed to dust levels greater than national exposure standards.

Temporary enclosures should have:

- dust extraction/collection systems fitted, and
- containment screens made of puncture- and tear-resistant materials (for example, woven polypropylene fabric or rubber) for high abrasion areas inside the enclosure. Selection should also consider fire retardancy, burst strength, and ultraviolet (UV) resistance.

Porous material like shade cloth will not prevent the escape of fine dust, and should not be used for temporary enclosures if the work generates silica, lead, or other toxic dusts.

Maintenance of plant and equipment

Regular inspection and maintenance is particularly important for abrasive blasting plant and equipment as the process is self-destructive by nature. Every blasting chamber, blasting cabinet, ventilating system duct, filtering or cleaning device and item of abrasive blasting equipment should be inspected by a competent person in accordance with the manufacturer's instructions. In addition, plant and equipment should be checked daily by the operator for wear and damage. You should keep log books and inspection reports containing a full history of service and repairs.

Further guidance on plant is available in the *Code of Practice: Managing the risks of plant in the workplace*.

3.5 RECYCLING OF BLAST MATERIAL

The recycling of blast material involves three stages - collection, cleaning and reuse of spent material that contains some useable abrasive grains. During abrasive blasting, the spent material has endured high velocity impact with the surface being cleaned, producing shattered abrasive and dust, combined with particles of the material being removed. The recycling process needs to separate these and allow the recovered abrasive to be reused efficiently and safely without an increase in dust levels. Abrasive that has become wet cannot be recycled as dust separation is not possible. It may not be possible to remove toxic chemicals such as lead paint from used abrasive and the abrasive should be disposed of in accordance with relevant environmental and waste management regulations.

Collection

Collection of the spent material from the blasting site is best done using the method that least disturbs the spent material.

Vacuum recovery equipment offers the best protection for operators. Using methods that generate dust (e.g. sweeping or compressed air blowdown) should be avoided.

Cleaning

The following contaminants should be extracted before the blast material is reused:

- oversized trash – all particles (e.g. rust, paint flakes and other foreign matter) that are of sufficient size to clog the blast machine metering valve or nozzle
- toxic dust – any toxic contaminants that have been introduced or released into the media (e.g. lead from lead paint material)
- nuisance dust – fine shattered abrasive grains
- respirable dust – powdered material that is respirable and will penetrate to the lower respiratory system.

If abrasive blasting has been carried out on a substrate containing grains of sand (e.g. foundry castings, concrete), it may subsequently contain a significant amount of crystalline silicon dioxide in a particle size range similar to that of the spent abrasive material which is to be re-cycled. Abrasive materials used in this kind of work should not be recycled unless it can be established that the concentration of crystalline silicon dioxide remains below the allowed amount.

Reuse

The collected material will contain various contaminants (see above) as well as the reusable abrasive grains. The contaminants should be separated from the media by passing through engineered equipment including airwashes, cyclones and screens as required, before it can be returned to the blast machine for reuse.

3.6 DISPOSAL OF WASTE

To minimise risks, waste products from abrasive blasting should be covered to prevent them from becoming airborne.

The waste material resulting from abrasive blasting should be disposed of in accordance with any local laws that apply to the disposal of waste materials.

4. OTHER HAZARDS AND CONTROL MEASURES

4.1 NOISE

Regulation 57: A person conducting a business or undertaking must manage risks to health and safety relating to hearing loss associated with noise. The person conducting a business or undertaking must ensure that the noise a worker is exposed to at the workplace does not exceed the exposure standard for noise.

Regulation 58: Audiometric testing must be provided to a worker who is frequently required to use personal protective equipment to protect the worker from the risk of hearing loss associated with noise that exceeds the exposure standard for noise.

Exposure to high noise levels can cause permanent hearing loss. Abrasive blasting equipment can generate various noise levels that may cause workers to be exposed to noise that exceeds the exposure standard.

The exposure standard for noise in relation to hearing loss, is defined in the WHS Regulations as an $L_{Aeq,8h}$ of 85 dB(A) or an $L_{C,peak}$ of 140 dB(C). There are two parts to the exposure standard for noise because noise can either cause gradual hearing loss over a period of time or be so loud that it causes immediate hearing loss.

In the abrasive blasting industry, the main sources of noise for the operator are:

- discharge of compressed air from the blast nozzle – 112 to 119 dB (A)
- the feed air inside the protective helmet – 94 to 102 dB (A)
- blast cabinets – 90 to 101 dB (A)
- air compressors – 85 to 88 dB(A).

Maximum noise levels up to 137dB(A) have been measured at the operator's position during blasting activities when the abrasive runs out.

Operators of small abrasive blasting cabinets are particularly at risk. They may not perceive the noise to be damaging because of the relatively short periods of use. However, average noise levels at the operator's ears have been measured between 90 - 101 dB (A). This means that at 101 dB(A), for instance, an exposure of unprotected ears of only 12 minutes is allowed in any eight hour shift so as not to exceed the exposure standard of $L_{Aeq,8h}$ 85

dB(A). Following such exposure, other work activities must not contribute to further noise exposure.

Unprotected workers and others close to the blasting process may also be exposed to excessive noise.

Control measures

- Using an alternative, quieter method to clean or prepare surfaces, where possible
- Isolating workers and other persons from the noise source by:
 - using blast chambers
 - relocating or enclosing noisy equipment - blast cabinets, air compressors, and grit pots can be located in sound proof enclosures or separate rooms away from the work area. In the open air, mobile enclosures lined internally with sound absorbent material could be used at locations where noisy work has to be carried out and other people may be affected. Such enclosures could reduce operator exposure by about five to 20 dB(A) depending on their construction.
- Using engineering controls, for example:
 - reducing the amount of pressure used to abrade the substrate
 - improving mufflers on blast pots
 - silencers on intake and exhaust systems
 - baffles and muffling materials in air supply hoses for blast helmets
 - sound attenuating material on walls and ceilings, and
 - sound transmission barriers around compressors.
- Using administrative controls, for example:
 - undertaking abrasive blasting out of normal working hours to minimise noise exposure to other workers
 - stopping other work and clearing people from a site while blasting is taking place
 - establish a rotation system for work to be carried out in shifts
 - establishing exclusion zones where noise exposure levels are in excess of the exposure standard and restricting entry to only persons with adequate hearing protectors

- regularly maintaining abrasive blasting plant and equipment
- providing quiet areas for rest breaks for workers exposed to noisy work, and
- limit the time workers spend in noisy areas by moving them to quiet work before their daily noise exposure levels exceed the exposure standard.
- Providing personal hearing protectors such as ear plugs, ear canal caps, ear muffs, and hearing protective helmets. Further information on requirements relating to PPE can be found in *AS/NZS 1269.3: Occupational Noise management – Hearing protector program*.

Further guidance on how to identify, assess, control and monitor exposure to noise is available in the *Code of Practice: Managing Noise and Preventing Hearing Loss at Work*.

4.2 HEAT

Heat is also a common hazard associated with carrying out abrasive blasting. Workers are at risk of heat strain due to working in hot, poorly ventilated or confined spaces and the type of personal protective equipment that is worn, for example blast helmets, protective suits or leather coveralls.

Heat strain is a serious medical condition which could lead to heat exhaustion and death.

When assessing the risks associated with heat, you should consider a number of factors including the workplace temperature, humidity, air movement, exposure to sources of heat, the work demands, how much clothing is worn (including PPE), individual risk factors, and whether the worker is acclimatised to the conditions.

Control measures

- fitting cooling devices to the air supply of blast helmets
- providing PPE that is selected and fitted to minimise the build up of heat and wearing cotton undergarments
- providing a cool, well-ventilated area where workers can take rest breaks or carry out other tasks
- scheduling work so that abrasive blasting is done at cooler times and
- ensuring cool drinking water is readily available.

Further guidance on controlling the risks of heat exposure is available in the *Code of Practice: Managing the Work Environment and Facilities*.

4.3 VIBRATION

The force of the abrasive moving through the blast hose transmits vibration to the hands and arms of operators holding the equipment. Prolonged use of abrasive blasting equipment may lead to a condition known as occupational Raynaud's disease (also called white finger or dead finger). It results from persistent microscopic damage to nerves and blood capillaries. It may also cause carpal tunnel syndrome.

Symptoms include:

- blanching (whiteness) and numbness in the fingers
- fingers are cold to touch
- loss of dexterity or increased clumsiness
- decreased sensitivity to touch, temperature and pain, and
- loss of muscular control.

Chronic exposure may result in gangrenous and necrotic changes in the finger. The condition may take months or years to develop. There is no effective treatment to reverse the effects of white finger.

The risk of injury or disease from vibration will vary depending on the equipment being used, the intensity of the vibration, frequency and duration of exposure, the force of grip applied by the worker, maintenance of the equipment and insulation provided by protective gloves.

Further information on measuring exposure to hand/arm vibration is available in *AS 2763: Vibration and shock – Hand transmitted vibration – guidelines for the measurement and assessment of human exposure*.

Control measures:

- Using an alternative method to clean or prepare surfaces, where possible
- Using engineering controls, for example vibration-reduced equipment such as vibration isolating handles incorporated into blasting nozzles and/or supports to reduce the pressure of the hand to control the nozzle
- Using administrative controls, for example reducing the amount of time an operator is required to operate a blast nozzle by job rotation or more frequent breaks. Frequent

maintenance of equipment may also reduce the level of vibration

- Using PPE, for example vibration absorbing gloves may assist in dampening vibration.

4.4 MANUAL TASKS

Regulation 60: A person conducting a business or undertaking must manage risks to health and safety relating to a musculoskeletal disorder associated with a hazardous manual task.

Abrasive blasting may result in musculoskeletal disorders from performing hazardous manual tasks, for example:

- back strain from lifting or pushing
- muscle strain from working in awkward positions
- strain from hose whip
- Occupational Overuse Syndrome from controlling the blast hose.

Ways of reducing the risk of musculoskeletal disorders include:

- appropriately designed plant and hoses which are tied to prevent hose whip
- reducing the amount of force necessary to perform tasks, for example, fixing wheels to heavy equipment, and moving heavy objects into and out of blasting chambers by using specially designed equipment
- ensuring workers do not have to perform manual tasks in excess of their capability
- job rotation.

Further information on how to manage the risks of hazardous manual tasks can be found in the *Code of Practice: Hazardous Manual Tasks*.

4.5 CONFINED SPACES

Regulation 66: A person conducting a business or undertaking must manage the risks to health and safety associated with a confined space at a workplace including risks associated with entering, working in, on or in the vicinity of a confined space (including a risk of a person inadvertently entering the confined space).

Hazards that may be encountered in a confined space include:

- Flammable gases or vapours, toxic gases or vapours, flammable, combustible or toxic liquids or solids, or potentially explosive dusts
- oxygen deficiency or excess
- physical agents such as thermal extremes, radiation, noise or flooding
- engulfment
- mechanical equipment.

A wide range of injuries can be sustained from working in a confined space including:

- burns
- electrocution
- asphyxiation and suffocation
- poisoning
- brain damage and death
- crush injuries.

A risk assessment must be carried out by a competent person before workers enter confined spaces. Any identified risks must be eliminated or minimised and a confined space entry permit issued for the work.

Control measures

- Elimination – assess the need to undertake abrasive blasting in a confined space
- Isolation – the confined space should be isolated to avoid the introduction of harmful substances or activation of moving parts (e.g. isolate the confined space from power sources, lock or tag all moveable components)
- Engineering – mechanical ventilation systems should be used to remove hazardous contaminants produced by the work being performed in the confined space
- Administrative – develop and document a method for confined space entry.

Further information on how to work safely in confined spaces can be found in *Code of Practice: Confined Spaces*.

APPENDIX A – SELECTING AN ABRASIVE BLASTING MEDIUM

Do not use:	Blast material which may be used:
<ul style="list-style-type: none"> • Materials with any radioactive substances where the level of radiation exceeds 1 becquerels per gram, so far as is reasonably practicable • Materials containing more than: <ul style="list-style-type: none"> ○ 0.1% antimony ○ 0.1% arsenic ○ 0.1% beryllium ○ 0.1% cadmium ○ 0.5% chromium (except as specified for wet blasting) ○ 0.1% cobalt ○ 0.1% lead (or which would expose the operator to levels in excess of those set out in Part 7.2 of the Regulations) ○ 0.1% nickel ○ 0.1% tin • Materials containing more than 1% free silica (crystalline silicon dioxide) including: <ul style="list-style-type: none"> ○ River sand ○ Beach sand or other white sand ○ Dust from quartz rock ○ Diatomaceous earth (pool filter material) 	<p>The following materials will not usually result in exposures greater than national exposure standards. However, you should check the Safety Data Sheet to ensure the composition of substances does not exceed prohibited levels</p> <ul style="list-style-type: none"> • ilmenite • aluminium oxide • garnet (low crystalline silica content only) • other rocks and mineral sands which do not contain significant levels of silica • metal shot • steel grit • crushed glass • sodium bicarbonate • plastic beads • glass beads • some metal slags (check content analysis before purchase) • dry ice <p>Note: There are environmental requirements in relation to abrasive blasting mediums. If in doubt, seek advice from your local council.</p>

<p>In dry abrasive blasting:</p> <ul style="list-style-type: none">• Recycled materials which have not been treated to remove respirable dust• Recycled materials for which treatment has not removed toxic materials to below the prescribed concentrations• Any substance likely to harm the upper respiratory tract <p>In wet abrasive blasting:</p> <ul style="list-style-type: none">• any substance that contains chromate, nitrate or nitrite	
--	--