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EYE PROTECTION PROJECT
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FINAL REPORT:

PREVENTION NOT REACTION

EYE SAFETY IN THE NSW COAL MINING INDUSTRY

Don Dingsdag, Stephen Dain, Chris Winder

A Project of

the Joint Coal Board Health and Safety Trust

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EXECUTIVE SUMMARY

(and Plain English Report)

1 EXECUTIVE SUMMARY

1.1 Background

This is a report of a Joint Coal Board Health and Safety Trust (JCB HST) funded research project investigating eye safety in NSW coal mines. The principal investigators in the project were: Dr Don Dingsdag (School for Social and Workplace Development, Southern Cross University), Associate Professor Stephen Dain (School of Optometry, University of New South Wales) and Associate Professor Chris Winder (Department of Safety Science, University of New South Wales). The project was for two years, and commenced in January 1995.

The Research Project Team investigated the current practices in eye protection through mine site inspections, interviews and questionnaire surveys with mineworkers and managers. Discussions were also held with safety professionals in mining, occupational health, optometry and also with eye safety equipment manufacturers. Thirty three mines were contacted, and twenty seven returned questionnaires to the Research Project Team. In all, 236 mineworker and 45 mine manager questionnaires were returned. These are regarded as being suitably representative.

1.2 Objectives of the Research Project

The Research Project Team developed eight objectives for study. These are briefly discussed in the Executive Summary below, and are developed in more detail in the body of the Final Report of the research project, entitled *"Prevention not Reaction: Eye Safety in the NSW Coal Mining Industry"*.

Objective 1: Current programs for the control of eye hazards in coal mining

Is the eye protection currently issued adequate and whether for certain areas or job descriptions alternative audit control measures, workplace systems and design may be more appropriate to control eye hazards.

The Research Project Team considers that eye protectors complying with AS/NZS *1337 Eye Protectors for Industrial Applications* and/or AS/NZS *1338 Filters for Eye Protectors* and selected and used in accordance with AS/NZS 1336 *Recommended Practices for Eye Protectors in the Industrial Environment* are appropriate or adequate for the coal mining industry. In the main, the use of eye protection in coal mines is similar to that in non-coal mining applications.

Eye protection is the major means of controlling eye hazards in the NSW coal mining industry. Little thought has been given to controlling eye

hazards through the hierarchy of controls (elimination, substitution, isolation, engineering controls, administrative procedures, and lastly, personnel protective equipment). One reason for this is that identification of eye hazards does not normally form part of routine safety audit procedures. Further, other issues can also contribute to the significance of eye and vision hazards, such as inadequate lighting.

Manager/worker awareness of the provisions of eye protection standards is low. There is an urgent need for the personnel involved in eye protection to be made aware of the provisions of the eye protection standards. Further, only those staff trained in eye protection standards should be the selectors of the appropriate eye protection for their work site. By definition, workers, who are trained in eye protection safety issues and policies and who have a practical hands-on knowledge of daily hazards in mines, are the experts in the risks and hazards of a mine site, not the eye protection suppliers.

Objective 2: Prescription spectacles and eye safety

How do issues such as wearing conventional prescription spectacles affect eye safety?

A substantial proportion of mineworkers are using prescription eye protection. Given the aging of the work-force in this industry, the trend of prescription spectacle use is likely to increase. Although there is no requirement, it has become common practice for mine employers to pay for prescription spectacles for those workers who need them.

While the adequacy of prescription spectacles for visual acuity is outside the terms of reference of this project (but presumed adequate), the adequacy of prescription spectacles for safety was found to vary considerably.

Safety issues relevant to prescription spectacles wearers include:

- use of glass lenses (which should be prohibited in the coal mining industry);
- glare protection with photochromatic lenses (which should be discouraged);
- lens thickness, especially for photochromatic lenses (which should be a minimum of 2.5 mm thick);
- daylight state transmittance (which should be at least 85%); and
- the problem of bifocal wearers and poorly positioned cap lights.

The compliance of prescription spectacles to Australian standards is uncertain, as there are no relevant standards at present. Whether prescription spectacles satisfy the performance requirements of standards

for safety eyewear is questionable, as there are no guidelines or recommendations on safety eyewear which can be used for compliance purposes.

The Research Project Team are not aware of any guidelines or requirements set by the JCB or the coal mining industry. The matter of selection and compliance with safety standards for prescription spectacles appears to be in the hands of assorted optometrists and optical dispensers who may have little or no understanding of the specific protection needs of coal mine workers. The dispensing of prescription eye protection is characterised by a lack of involvement by the coal mining industry and a trust in the skills and knowledge of their suppliers. Unfortunately, this is not an uncommon problem in other industries, which may be ill founded.

Objective 3: Use of eye protection

What types of eye protection programs assist with compliance with eye protection?

There are a range of approaches for the use of eye protection in the NSW coal mining industry, such as:

- formal mandated programs;
- voluntary programs;
- unformulated practices relying on a selection of eye wear being made available;
- no program or practices at all.

The Research Project Team concludes that mandatory eye protection programs by themselves do not work.

The Research Project Team also considers that compliance with eye protection is much more a product of a combination of the type of the eye protection program (mandatory or otherwise) and the mine's safety culture. That is, improved compliance was seen in those mines where management openly fosters a culture of cooperation, where compliance with safety procedures are encouraged.

Utilisation of eye protection programs will work providing that both management style and safety culture can be optimised.

Question 4: Enforcement of eye protection programs

How should eye protection programs be enforced?

Enforcement of eye protection is a difficult issue. Mine managers have an absolute legal obligation to enforce safety, and it seems logical that means, such as managers' rules or incorporation of safety into mineworker employment contracts or enterprise bargains, are useful ways to meet those obligations. However, managerial prerogative alone is not an effective enforcement approach, as it needs to be integrated with other workplace systems.

While incorporation of safety compliance in employment contracts or enterprise bargains provides a basis for management to insist on and enforce safety compliance, again, these measures will not be effective by themselves.

Emphasis on increasing compliance through non-punitive and cooperative approaches will be more effective than punitive or disciplinary approaches. While this could be interpreted as an abrogation of the managers' statutory responsibility to enforce safety, in fact the manager determines how such obligations are to be met, and there is no reason why a cooperative approach could not be used.

Question 5: Other problems of eye protection

Whether there are any other observable problems due to the wearing of eye protection? (If so identify such problems and design suitable alternative workplace strategies and systems).

The only major eye protection issue encountered by the Research Project Team was the widely held opinion by mineworkers that wearing non-prescription eye protectors can, in some way, damage or harm eyes. This opinion pervades the mining industry and was even heard expressed at one meeting at the JCB itself. This erroneous opinion is not confined to the coal mining industry.

The Research Project Team asserts most strongly that there is no possibility, not even a remote one, that the wearing of lenses, including non-prescription eye protectors, can damage or harm eyes. Even the wearing of incorrect prescription lenses by an adult will not lead to damage to the eyes. Vision may be blurred and/or uncomfortable and/or double for a time while wearing the lenses, but the eyes are not damaged.

The reluctance to wear eye personal eye protection does diminish the importance of considering control and/or non-PPE (personal protective equipment) procedures first.

Question 6: Current eye protection practices in the NSW Coal Mining Industry

Describe current eye protection practices and policies in coal mines in NSW and Queensland, with the aim of identifying suitable benchmarks.

The Research Project Team observed a range of benchmarks including:

- Open and expressed commitment of all levels of mine management, as well as head office management, to eye safety.
- Incorporation of compliance with eye safety programs in managers' rules.
- Development of appropriate consultative mechanisms that allow mineworker input into the design, development, implementation and review of eye safety programs, so that ownership of such a program belongs to all workers and management.
- Establishment of a specific consultative working group or committee of workers and management to develop an eye safety policy and program.
- Audit systems to undertake specific mine site safety assessments to identify eye hazards and risks.
- Training of all mine management and mineworkers to familiarise them with the:
  - range of eye hazards in mines,
  - the reasons for eye protection, and
  - selection, fit, use and maintenance of eye protection equipment.
- Designation of locations and tasks where eye protection must be worn.
- Selection of suitable eye protection to relevant Australian standards and approvals.
- Availability of a range of safety glasses of different types that workers can trial and choose, and readily available replacement of safety glasses or lenses.
- Availability of cleaning solutions and anti-fogging solutions at locations where they are needed.

These benchmarks were common features of programs at a number of mines which were attempting to deal with eye safety issues. However, the scope and content of eye protection policies, practices and programs were many and varied. Many were not useful on their own, but, as noted above, had a part to play in a total program.

One final benchmark, is the need for standard industry wide eye protection policy, program and practice. In the opinion of the Research Project Team, the major objective of these benchmarks and this program is to create a

climate which allows the existing safety culture to change to one that accepts eye safety as part of safe working.

Question 7: Evaluation of eye protection equipment in use in Australia

To evaluate eye protection equipment currently in use in Australia and, if necessary, develop eye protection designed specifically for the NSW and Australian coal mining industry.

Issues in underground mining: As a result of the discussions with mine personnel and eye protection suppliers and our own visits, it is apparent that fogging is the major problem and in need of active solving.

Fogging: Goggles generally are not yet a popular option, nor are integrated helmets, respirators and visors. There is a range of safety eyewear which fog in normal use and this is a major problem with compliance. Attempts have been made to solve the problem of fogging, but many have failed in the past, including coatings. However, following discussions with some manufacturers, better quality safety glasses have been produced which have substantially reduced the probability of fogging in trials by coal mineworkers.

Furthermore, provisions for fogging are not included in the eye protection standards. Consequently, there are no methods currently available to check compliance with overseas standards. The development or adaptation of a successful method of assessing anti-fog treatments is necessary.

Fogging may also be caused by the use of face masks and respirators. This is caused by poor or improper fit. These problems can be eliminated by training given to workers regarding correct use and adjustment of eyewear to maximise comfort and fit.

Mesh Eyewear: A second problem is with the use of mesh spectacles and goggles (called "blowfly glasses") which are being supplied to the mining industry. Some claims of compliance with AS/NZS 1337 have been made by suppliers, but these are false. The advantage of mesh is very obviously, that it does not fog. However the acceptability and use of mesh eye protectors is a significant safety concern, and their use in the coal mining industry should be eliminated.

Issues in open cut mining: There are three issues which appear to be particularly evident in the open cut mine sites.

Glare during the day: There are a significant number of problems related to glare during daylight working. Universal eye protection policies require the drivers and operators of machinery to wear eye protection while in cabs. Safety eyewear should comply with both the eye protection and sunglass standards.

Glare at night: There were a number of complaints about glare from lighting installations. These will not be solved by drivers wearing sunglasses (itself a safety concern), and would be better addressed by the proper design of lighting installation and vision tapered requirements in the access roads by a qualified illuminating engineer.

Fogging: This occurs when moving from an air conditioned cab to the outside. Better quality eye protection may solve this problem, but this is regarded as a transient issue, as such fogging usually evaporates quickly.

Objective 8: Training programs for eye safety in coal mines

To develop a training program for eye protection in coal mines which could be used as a "train the trainer" program, to ensure standardisation in the implementation of eye protection programs in the coal mining industry. Consideration should be given to directing the training at: (i) the employee who wears the eye protection; (ii) the safety officer/purchaser of eye protection/person who gives out and fits eye protection; and (iii) management (work systems constructors and enforcers).

The Research Project Team identified three main target groups for training: (i) mineworkers; (ii) members of the mine management team; and (iii) personnel involved with the delivery of eye protection programs within coal mines, including safety officers, staff who purchase safety eyewear, and staff who issue and fit safety eyewear. While training programs for each of these target groups are slightly different, there are a substantial number of features common to the content of training programs for each of these target groups, including: (i) introduction; (ii) legislation; (iii) structure of the eye and mining hazards that can damage the eye; (iv) the eye protection policy; (v) the eye protection program (including selection, fit, use, maintenance and review). Further, more detailed training (perhaps to the level of formal counseling) may also be necessary for those workers who persistently refuse to wear eye protection.

A fourth group was also identified that needed training, namely, the optometrists, optical dispensers and safety eyewear suppliers to the coal mining industry, which could be trained or retrained through professional bodies or the coal mining industry itself.

1.3 Conclusions

Eye protection is considered an important issue in the NSW coal mining industry. Procedures and programs for eye safety have been introduced over the past five years in a number of coal mines. Some of these have had success, but many fail.

This study has shown that there are many reasons why mineworkers choose not to wear eye protection:

- the normalisation of danger, so that the consequences of significant risks are ignored or the means for their control are circumvented;
- there is an falsely held belief that wearing eye protection will damage vision;
- not enough eye protection is issued or available;
- the range of eye protection available is limited and does not have mineworker acceptability (sometimes not for safety reasons, but for cosmetic or fashion considerations);
- eye protection is uncomfortable;
- eye protection easily fogs in humid conditions underground;
- eye protection is handed out without advice or training on its use or fit;
- there is a lack of cleaning materials and solutions where they are needed;
- there is a lack of encouragement to wear eye protection by managers and other workers;
- eye protection becomes easily scratched;
- the prevalent "macho" image or peer pressure of coal miners disdains the use of eye protection;
- mine management do not have an appreciation of the content of the eye protection standards;
- tensions between mineworkers and mine management often defeat well intentioned safety programs because they are imposed from above, rather than being implemented in a cooperative fashion.

A number of technical issues with regard to the performance of eye protection equipment are being resolved. Better quality eye protection, which is comfortable to wear is now available. Further, safety glasses with anti-fog surfaces are now available which perform much better than their predecessors, and which have been trialled with some success in the coal mining industry.

The widely held perception that wearing safety glasses will damage eyes or vision is wrong. **Wearing safety glasses will not damage eyes nor eyesight**. This misconception must not be used as an excuse for not wearing eye protection.

With the exception of issues specifically related to technical aspects of eye protection (which are being addressed by optometrists, safety eyewear manufacturers and safety practitioners), many of the barriers to compliance with eye safety procedures are related to the so called "culture" of the coal mine. Unless safety programs are developed in such

a way that they resolve the negative aspects of coal mining, safety culture (and in some mines there may be a management culture which has evolved counter to the mineworker culture), many well intentioned safety programs will not be successful.

Therefore, the development of an eye protection program should be conducted in a cooperative manner by consultation between mine managers and mineworkers. This should be as widespread as possible, and seek voluntary compliance with the eye protection program, once it is implemented. The program itself should be tailored to the individual needs of a mine, and should include as major components:

- the need for and content of an eye protection policy and the eye protection program;
- procedures for identification, assessment and ongoing maintenance of eye hazards;
- recommendations for control of eye hazards by means other than eye protection, such as improved lighting or dust suppression;
- recommendations for control of eye hazards by eye protection, including designated areas and designation of jobs or activities where eye protection should be compulsory;
- requirements for selection of eye protection;
- requirements for training programs in eye protection;
- requirements for issue and fit of eye protection;
- requirements for use of eye protection;
- requirements for maintenance or replacement of eye protection;
- requirements for review of eye protection programs;

Finally, the basis of any eye protection program should be firmly based in contemporary concepts of risk management.

1.4 List of Recommendations

Objective 1: Current programs for the control of eye hazards in coal mining

Recommendation: It is recommended that identification of eye hazards be included in routine safety audits, and that a wider definition of eye risks be used in the identification process.

Recommendation: It is recommended that the JCB develop a code of practice for the installation of lighting in coal mines (including temporary lighting).

Recommendation: It is recommended that specific areas of safety such as eye protection should be written into job descriptions for the entire

workforce in order to foster a sense of ownership of safety systems and an involvement in the development of a safer workplace and work practices.

Recommendation: It is recommended that the JCB seek representation on Standards Australia Committee SF/6 responsible for production of industrial eye protection standards to assist the committee in their work.

Recommendation: It is strongly recommended that safety officers/ personnel involved with the selection and purchasing of eye protection/personnel distributing and fitting eye protection in coal mines should be made aware of the provisions of the eye protection standards, and trained in their content.

Recommendation: The provisions of the eye protection standards should be included in all eye protection training programs.

Objective 2: Prescription spectacles and eye safety

Recommendation: The JCB should develop guidelines on the use of prescription spectacles in coal mines.

Recommendation: The JCB should develop an accreditation program by which vision care professionals are assessed before they become preferred suppliers of eye protection equipment to coal mines.

Recommendation: It is strongly recommended that the JCB require that prescription eye protection used in the mining industry comply with the new version of AS 1336, as soon as it is published.

Recommendation: It is strongly recommended that the JCB prohibit the use of glass lenses for any eye protection wear and prescription spectacles, in areas where it has been determined that eye hazards exist and eye protection is needed.

Recommendation: It is recommended that the JCB discourage the use of plastic photochromatic lenses in eye wear, particularly in underground mines until proved suitable.

Objective 3: Use of eye protection

Recommendation: It is recommended that any mine management wishing to improve eye safety should introduce eye protection programs using a cooperative approach, where workers are consulted.

Question 4: Enforcement of eye protection programs

Recommendation: It is recommended that any mine management wishing to improve eye safety should demonstrate commitment to eye

protection programs through a formal process of development and implementation and by complying with their requirements .

Recommendation: It is recommended that any mine management wishing to encourage eye protection compliance should implement non-punitive and consultative approaches.

Question 5: Other problems of eye protection

Recommendation: The JCB (or any mine manager) can, if it wishes, make the categorical statement that that the wearing of lenses, including non-prescription eye protectors, will not damage nor harm eyes.

Question 6: Current eye protection practices in the NSW Coal Mining Industry

Recommendation: The introduction of an eye safety program into a coal mine is best achieved through the following steps of: (i) management commitment, (ii) establishment of management/worker consultative processes, and (iii) the development of an eye safety policy with concurrent development and implementation of an eye safety training program for all staff.

Recommendation: Development and implementation of a properly constituted eye safety program is essential to change poor safety practices or inappropriate safety cultures.

Question 7: Evaluation of eye protection equipment in use in Australia

Recommendation: It is recommended that the selection, use and maintenance of eye protection equipment in coal mines be made in compliance with AS/NZS 1336, 1337 and 1338.

Recommendation: It is strongly recommended that the use of mesh eyewear be prohibited in coal mines. If it is not possible to prohibit the use of mesh eyewear in coal mines, it is recommended that stringent guidelines be issued for the situations and locations where mesh eyewear may be used.

Recommendation: It is recommended that the use of tinted lenses in safety eyewear underground should be discouraged, especially if lenses do not comply with AS/NZS 1337.

Recommendation: It is recommended that cleaning materials for safety eyewear (solutions and tissues) should be available in areas at the workplace, for example near the coal face, where they are needed.

Recommendation: It is recommended that instruction be given to workers wearing eye protection on how to ensure a good fit of eyewear, on how it should be used properly, and how it should be maintained in good working order.

Recommendation: It is recommended that instruction be given to mineworkers wearing masks and half-face respirators on how to ensure a good fit, to alleviate the problem of fogging from expired breath.

Recommendation: It is recommended that the provision of a selection of sun glare eye protectors be made in compliance with AS/NZS 1337 (as well as AS 1067).

Recommendation: It is recommended that guidelines be developed by a qualified illuminating engineer for use in open cut mines so that lighting installations in access roads are subject to proper design features (such as lighting installation and vision tapered requirements). Such guidelines should be consistent with AS 1680.1 and specific to open cut mines, where illumination of dark rock strata may be different to other types of mines.

Objective 8: Training programs for eye safety in coal mines

Recommendation: It is recommended that where not currently present, specific training on eye safety and eye protection be made part of general safety and specific eye protection policies and programs.

Recommendation: Training should be aimed at the target groups indicated in this report (mineworkers, mine management team and personnel involved with selection, purchase, issue, use, fit and maintenance of eye protection), and should contain at least the relevant elements listed therein.

Recommendation: It is recommended that individual mine managers, mine groups or more preferably, peak industry associations, explore the development of a policy for the selection of suppliers of safety eyewear based on accreditation or demonstrated competencies in occupational eye safety.

SECTION 2

INTRODUCTION

2 INTRODUCTION

2.1 Eye Safety as an Occupational Health and Safety Issue

2.1.1 Eye Injuries at Work

The range of eye injuries at work that are possible is not small, and include:

- foreign bodies in the eye;
- foreign bodies penetrating the eye;
- chemical, gas or thermal burn;
- chemical irritation;
- bruising;
- laceration of the eye;
- radiation;
- welders flash;
- infection; and
- other causes.

Particularly hazardous processes which can lead to eye injuries include:

- grinding;
- cutting;
- hammering;
- chiseling;
- lathing;
- welding;
- blasting;
- handling hazardous chemicals;
- handling explosive tools.

Further, it should also be noted that vision related injuries are not just eye injuries. A visual component is possible in slips, trips and falls, in walking into or stepping on an object, or by being hit by a moving object.

2.1.2 The Incidence of Eye Injuries

Up to about one quarter of all eye injuries are related to activities in the workplace (Veale, 1972; Fiest and Farber, 1989; Tielsch and others, 1989; Dannenberg and others, 1992). Work related eye injuries are common but have received little attention compared to other occupational injuries.

Most eye injuries typically occur in male workers aged 20 to 40 who are in their most productive years, and most occur in workers not wearing eye protection (Veale, 1972; Macewen, 1989). Almost all such injuries are preventable.

In a study of 635 workplace related penetrating eye injuries in the USA, Dannenberg and others (1992) found that the commonest cause of eye injuries were projectiles, sharp objects, blunt objects and blasts. The absence of safety eyewear was a major risk factor for eye injury. When they were injured, 6% of workers were wearing safety glasses, a further 3% were wearing other eyewear.

Failure to use eye protection may relate either to not having such eyewear available, or a decision by the worker not to wear the eye protection available. It is probable that in cases where eye protection is worn, but where eye injuries occur, that the failure to prevent injury may be due to the use of poorly fitting safety glasses or to circumstances where foreign material entered the eye from the side of the glasses or where the safety glasses may have fallen off.

Indeed, Veale (1972) reports that if the reasons why eye injuries were caused are assessed then a clearer picture emerges:

o protection provided but not worn	42%
o protection not provided	20%
o protection incorrectly fitted or adjusted	10%
o just passing through eye hazard area	6%
o wrong type of protection	6%
o lack of maintenance of eye wear	4%
o uncertain, protection appropriate and worn correctly	12%

Important in this data is that eye protection must be relevant to the eye hazard and must be worn correctly. There are many injuries due to activities where the worker might have considered that eye protection was not necessary. While eye protection practices may have changed since 1972 (particularly with regard to provision of eye protection), these figures are still relevant in the 1990's.

2.1.3 Types of Eye Hazards and their Control

Potential hazards to the eyes may be divided into categories:

- **Physical** - mechanical or architectural; dust and flying particles; high speed flying particles and molten metals.
- **Chemical** - splashing of irritant or toxic liquids; gases and vapours; and dusts.

- **Radiation** - ultra violet (from welding), visible, infra-red or laser.

The need for eye safety and eye protection is not restricted to the coal mining industry, and eye protectors are used in many industries and occupations.

To assist employers in selecting the right sort of eye protection for the relevant eye hazard, Standards Australia have introduced a number of standards for eye protection. These include:

- AS 1067 *Sunglasses and Fashion Spectacles* (1990)
- AS 1336 *Recommended Practices for Eye Protection in the Industrial Environment* (1982)
- AS/NZS 1337 *Eye Protectors for Industrial Applications* (1992)
- AS/NZS 1338 *Filters for Eye Protectors* (1992)

These standards outline performance criteria for how eye protection, and components of eye protection should perform during use. A commentary on these standards is shown in Appendix 1.

The recommended practices for Eye Protection in the Industrial Environment are set out in AS 1336. This standard draws on AS 1470 *Health and Safety at Work - Principles and Practice* and AS *2243 Safety in Laboratories Part 1: General* and *Part 5 Non-ionising radiation.* As with other hazards, and where eye hazards are involved (perhaps even more so), the primary objective should always be to use engineering controls wherever possible in order to eliminate the existing hazard, for example, using wetting to minimise dust generation.

Where it is not possible to eliminate or control eye hazards, personal eye protectors should be supplied to operators and visitors in areas where eye hazards occur and should be worn at all times. Safety spectacles provide adequate protection from most smaller and low velocity flying particles coming from work areas in front of the operator. The attachment of suitable side shields provides additional protection against flying particles and stray radiation from welding operations.

The general use of safety spectacles needs to be supplemented by the ready availability of other types of eye protectors designed for specific applications and must provide protection against a wide range of hazards. The selection of the appropriate eye protection is often complicated by multiple hazards being encountered, for example fume, radiation and impact being simultaneous risks in welding.

Safety spectacles are not designed to provide protection against many of the hazards encountered in industry (for example, when welding). Where greater protection is required it should be in the form of wide-vision goggles, face-shield or hood. These can be obtained with indirect ventilation to minimise the ingress of dust or droplets. Face-shields which

provide protection for the face as well as the eyes afford the highest level of protection.

With welding hoods, some may be old and scratched and may obstruct vision. Some hoods can not be worn with prescription spectacles. Workers with poor eyesight can not strike an arc without lifting the welding hood first and then striking the arc. These workers are exposing themselves and their eyes to intense welding flash which can be a cause of serious eye injuries. Nowadays this is unnecessary, because welding hoods are available with filters that are clear, and quickly darken once an arc is detected.

Where protection is required against excessive sun glare or glare from visible radiation, eye protectors fitted with tinted lenses should be used. Eye protectors worn by persons driving vehicles must comply with the requirements of AS 1337. Welders, and others exposed to Ultraviolet and Infra-red radiation should use lenses which comply with AS 1338.

Some lasers represent special hazards to the eyes and suitable precautions should be taken from direct exposure to lasers and to reflections of laser beams. Eye protection which is designed to provide adequate protection against specific laser radiation is outlined in AS 2211 for specific applications. At this stage, reference should be made to BS EN207 and BS EN208 for requirements for eye protectors. Eventually, technically identical Standards will be published as AS/NZS 1338.4 and 1338.5.

Several eye protection options are available to those who wear prescription spectacles. Wide-vision goggles, clip-on spectacles and prescription safety spectacles made in accordance with the Standard are three such options.

Employees who wear contact lenses should also wear eye protectors when working in eye hazard areas, as contact lenses cannot be considered to replace eye safety procedures. A formal policy and procedure may be necessary in workplaces where the wearing of contact lenses interacts adversely with workplace hazards (for example, in chemical exposures which can soften contact lenses). In the event of an injury, contact lens wearers should advise first aid personnel that they are wearing contact lenses. If a chemical or hydraulic oil splash incident occurs, contact lenses should be removed immediately (if possible, using only gentle force) and medical attention sought.

Eye protectors are tested for optical quality and mechanical strength with dust proofness, gas-tightness, their ability to protect against chemical splashes and ability to protect against molten metals being optional tests. The person responsible for the purchase and issue of eye protection should ensure that the eye protectors have been tested and approved for protection against the appropriate hazard, for example, high impact eye

protectors do not necessarily provide protection against chemical splashes.

However, many mines and mine companies do not have policies, procedures or programs in place that reflect these standards, although, some mines or companies may actually have such procedures in place.

When choosing eye protection, it is necessary to consider

- the nature of the risk;
- the type of job being done and the particular situation where work is being carried out;
- the type of eye protection required (protection from splashing, side shields),
- problems with some types of eye protection, such as sweating in goggles, or poor fit of face-shields when respiratory protection also has to be worn;
- any situations which could result in a eye injury.

Strategies to prevent eye injuries should concentrate on identifying eye hazards through appropriate risk assessment and risk management approaches, including control of eye risks using the hierarchy of controls. The hazard identification, assessment and control process should identify hazards, hazardous operations, hazardous tasks, jobs and environments, and determine the feasibility of changes to tools, equipment and machinery. Improvements in engineering controls, administrative procedures, education and training and behavioural practices will all assist in reducing the risk of eye injury.

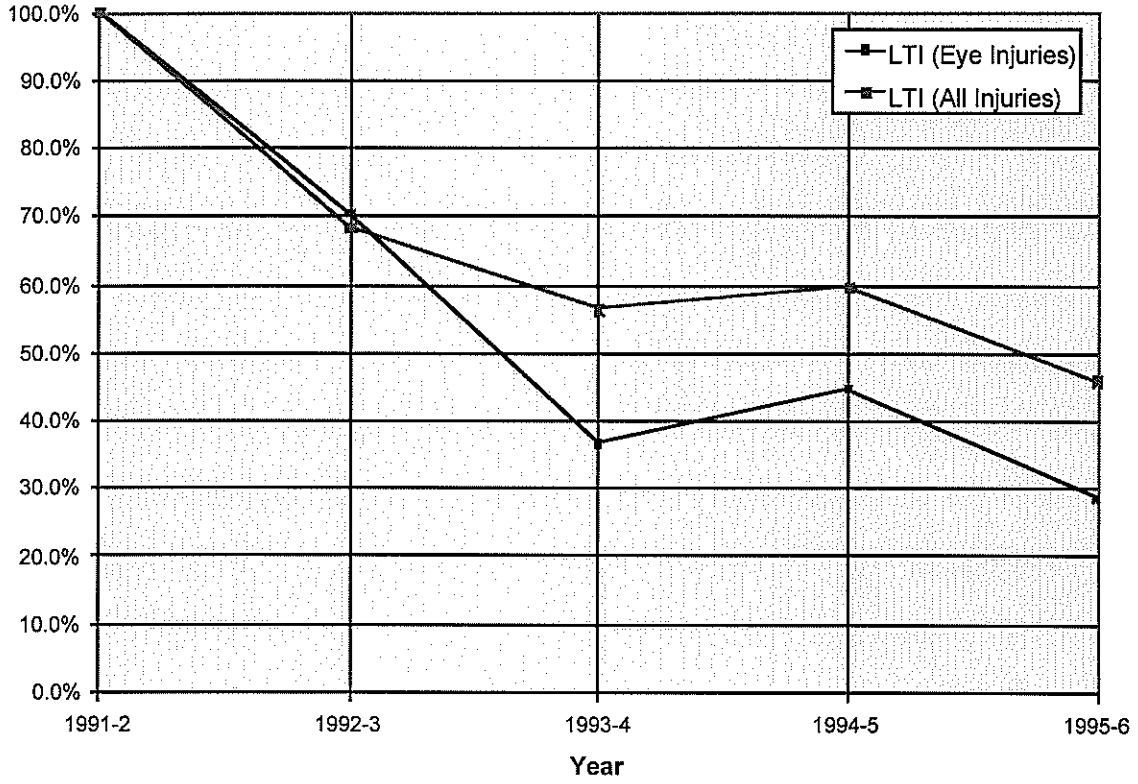
However, because the control of eye hazards in some occupations is intrinsically difficult at all times, eye protection remains an essential element of eye injury prevention in many work settings, especially considering the large number of projectile injuries. Accordingly, it would be beneficial to wear safety glasses routinely in some areas where eye hazards exist.

One further point, is that a focus of protection of the eye will protect the eyes, but not necessarily vision, or visual acuity. For example, some injuries in coal mines are due to the particular circumstances of working underground. Slips, trips and falls may be caused by a mineworker being unable to see properly. This suggests that some injuries to other parts of the body may have a visual component. These are generally not identified in safety or eye hazard audits, as they are less obvious. Therefore, the contribution of poor lighting to poor vision, and the contribution of poor vision to accidents cannot be assessed.

2.2 Eye Safety in Coal Mines

Eye safety and eye protection are important issues in coal mining. Workers' compensation statistics on lost time injuries supplied by the Joint Coal Board show that there has been a steady decline in injury rates since at least 1984. Data from 1991-2 is shown in Figure 1.

Figure 1: JCB Workers' compensation Statistics



It should be noted that these decreases have been accompanied by a reduction in the size of the work force, but a relative increase in the hours worked by the remaining workforce. As these changes have a tendency to cancel each other out, the data in Figure 1 has not been normalised for employment. There was a 17% decline in the size of workforce from 1991-1995 which, if incorporated into these statistics, indicates that all injuries fell 44% (not 54%) and eye injuries fell 34% (not 28%) over the same period.

These decreases in injury rates have occurred at a time when there has been a greater emphasis on safety and safety management in this industry (Hopkins, 1994; Worksafe, 1994). However, changes in workers' compensation requirements, under-reporting of accidents, encouragement of injured workers to continue working, rejection of medical certificates, efficient claims management, and better managed rehabilitation processes are probably more critical reasons why injury rates have fallen. These practices are more about reducing coal mines insurance premiums and impact only indirectly on safety performance.

However, reasons for the larger decline in eye injury rates since 1992-3 is not known, except as part of the general trend. There has been some attention to eye safety as part of general safety, but the Research Project Team is aware that most eye protection programs (where they exist) were not formulated until at least 1993-4, and possibly later. These initiatives may have added to the even greater decline in the period 1994-6.

Further, the emphasis on lost time injury rates as a measure of safety performance has been questioned (Kletz, 1993). The lost time injury frequency rate is more a function of claim practices and injury management, and indicates that it is not a useful indicator of safety trends (Hopkins, 1994). Other, perhaps more relevant measures of safety performance could be used instead of the rather crude lost time injury rate. Further, lost time injury frequency rates actually measure failure, and need to be complemented by positive measures that relate to prevention. These might include improvements in work design, increased awareness of safety or compliance with safety systems, increases in training, or the speed with which safety concerns are dealt with or safety committee recommendations are followed up (Shaw and Blewett, 1995; Worksafe, 1995).

Many mine managers have been implementing eye safety programs. Some of these programs have been voluntary in nature, some mandatory. However, they all suffer from varying degrees of noncompliance. That is, workers do not use the eye protection that is supplied for their use. There is a range of issues that need to be considered in the development of a compliance program within the framework of a PPE program, which can contribute to improving compliance, including: (i) compliance to standards; (ii) development of an action plan to deal with noncompliance; and (iii) implementation of a plan to assess the effectiveness of the action plan (Jackson and others, 1994).

However, before such action can be considered, barriers to compliance must be identified. Problems such as user comfort, dust, glare and fogging have all been indicated as reasons why compliance with eye protection is often poor among mineworkers. Other barriers may also exist. For example, the reasons why some brand names are more popular than others is sometimes based on reasons not related to safety (but to factors like image or perceptions of style). Ultimately, regular education programs which emphasise the health benefits of personal protective equipment will lay solid foundations for the promotion of PPE (Ewigman and others, 1990).

The New South Wales coal mining industry has been at the forefront of developing eye safety programs, and a number of approaches have been introduced in an attempt to deal with the problem. These include:

- making the wearing of eye protection part of managers' rules;
- designating certain areas of the mine as mandatory for the wearing of eye protection; or

- introducing voluntary programs.

Some of these measures have been more successful than others. While such initiatives are useful attempts to come to grips with the eye safety problem, they are piecemeal, often poorly implemented. However, to a large degree, it appears to be the "safety culture" of a mine which drives compliance with eye protection requirements.

2.3 The JCB HST Eye Safety Research Project

The diversity of tasks and variety of work environments create vastly different hazards and possibly, different needs for eye protection. Until members of this project visited a substantial number of mines , it was not known whether eye safety practices differed from mine to mine or if the introduction of mandatory eye protection programs in some coal mines produced benefits. Inconsistencies in standards for eye protection also added to the confusion.

To address this problem, the Joint Coal Board Health and Safety Trust funded this research project to investigate eye safety in coal mining.

A total of eleven objectives were listed in the original grant proposal:

- Whether the eye protection currently issued is adequate and whether for certain areas or job descriptions alternative audit control measures, workplace systems and design may be more appropriate.
- How issues such as wearing conventional prescription spectacles affect eye injuries?
- Is there a higher utilisation of eye protection in coal mines where compulsory eye protection policies exists? If so, why?
- If the utilisation of eye protection is lower in the enforced or unenforced samples we intend to investigate why this is so.
- Do mandatory eye protection programs work?
- How should eye protection programs be enforced?
- Whether there are any other observable problems due to the wearing of eye protection? (If so, to identify them and to, design alternative workplace strategies and systems designs).
- To observe current eye protection practice and policy at mine sites in NSW, Queensland, Victoria, Tasmania, the United Kingdom, the USA, Canada, Germany and France. If current policy and practice in NSW coal mines are found to be inadequate to research and design criteria for setting benchmarks in eye protection practice for the NSW and Australian coal mining industry.

- To test eye protection equipment currently in use in Australia and overseas coal mining industries. If eye protection equipment in NSW and Australian coal mining industry is found to be unsuitable to design standards specific to the needs of the Australian coal mining industry or to incorporate provisions of existing standards.
- To develop eye protection designed specifically for the NSW and Australian coal mining industry.
- To conduct workshops and train the trainer programs, to ensure standardisation in every facet of the implementation of eye protection programs.

Specifically, data was collected through:

- interview questionnaires with representatives of mine management;
- self administered questionnaires to mineworkers; and
- qualitative workplace inspection of at least thirty coal mines.

The research project was carried out by researchers at Southern Cross University and the University of New South Wales. This report outlines the results of that project.

SECTION 3

METHODS

3 METHODS

The collection of data on eye protection practices in the NSW coal mining industry was conducted through development and administration of management and worker questionnaires, and through workplace surveys of selected mine sites in NSW (and a few in Queensland).

The Research Project Team also had formal and informal discussions with mining professionals, occupational health and safety professionals and manufacturers and suppliers of eye protection equipment.

3.1 Questionnaire Development

Initially, it was considered that one questionnaire would serve to collect data from both workers and managers in coal mines.

After initial enquiries in the industry, this approach was considered impractical, as it was expected that representatives of management would (and should) know more about eye protection policies than mineworkers.

Therefore, two questionnaires were developed:

- a detailed six page questionnaire for management representatives questions with questions about eye protection, eye protection policies and standards, and attitudes to eye safety. "Management representatives" included the mine manager, undermanagers, engineers, safety officers, deputies or examiners and similar grades; and
- a simpler four page questionnaire for mineworkers with questions about eye protection practices and attitudes to eye safety for minweorkers. "Mineworkers" included production workers, maintenance workers, tradesmen, underground and pit-top workers in underground mines and similar workers in open cut mines.

The questionnaires were piloted with two groups, one with coal mining industry knowledge and one with skills in questionnaire design. Both groups provided useful material which led to finalised versions of the questionnaires.

Interestingly, both groups considered the questionnaires were too long, and that their lengthiness could lead to incomplete of data acquisition because employees filling out questionnaires would become impatient and perhaps not answer all questions. Consequently, the questionnaires were shortened and modified.

The finalised questionnaires are shown in Appendix 2 (management questionnaire) and Appendix 3 (worker questionnaire).

3.2 Mine Site Inspections

A number of Joint Coal Board Health and Safety Trust funded projects required access to coal mines. Therefore, some logistical arrangements had to be made so that mines were not inundated with researchers. As a result, mine site visits were initially arranged through the Joint Coal Board Health and Safety Trust, through personal contact between one Board member and chief executive officers of coal mining companies. This contact was most useful, as it sought (and obtained) high level management support for the project, and increased awareness of the project aims and objectives.

Following this procedure, the project team contacted each mine individually for permission to visit the mine, to conduct an inspection, and to administer the questionnaire. There was some resistance by a minority of mine managers who were reluctant to allow the project team to visit to survey mines, but this was eventually resolved through negotiation. Other mine managers were most helpful, and provided every assistance to the project team. Ultimately, a random and representative group of open cut and underground mines were selected from each coalfield.

Members of the project team were invariably welcomed to mines on visits, and no barriers were placed on access of the team to representatives of management or workers. In general, it became obvious that eye safety is an issue of some concern in coal mines, and the project team were offered the support and assistance it needed.

The usual format of a visit was:

- an informal telephone contact to the mine manager to ask permission for a visit, including purpose of visit and purpose of project;
- to finalise arrangements for the visit on the specific day. This included names of project team attending, names of contact person(s) at the mine, the need for access to management representatives and workers to administer questionnaires, and where time permitted, a visit to the mine to examine eye protection policy and practices;
- the visit was then conducted. From a logistical perspective, visits were arranged at the same times in the different regions, so that more than one mine could be visited a day, and four or five mines could be visited in two to three day periods. This meant that most visits were two to four hours in length;
- follow up contact after the visit, to make sure that questionnaires were completed and forwarded to the project team.

The visits varied in content and scope. Some visits were with mine managers or delegates, while others were coordinated with the site safety personnel or members of the occupational health and safety committee.

Arrangements for the completion of questionnaires varied. In some cases, questionnaires were left with the mine manager, safety officer or union representative to be distributed to mineworkers at a later time. At other mines, time was set aside for the project team to talk directly to mineworkers as they completed questionnaires. During one visit, the mine manager arranged for thirty workers to complete the worker questionnaire, while at others smaller numbers of workers were contacted. In all cases the project team took care to explain that responses to questions on the questionnaires were confidential and that only summary data would be presented in the final report.

Where questionnaires were left for completion at a later date, the project team also took great care to explain the sorts of mineworkers that the questionnaires should be distributed to.

These arrangements did not affect the quality of the data obtained, and in all, it can be concluded that representative amounts of data were collected about eye protection practices in coal mines. These findings were substantiated by observations made by project team members during the visits, interviews and walk through surveys.

Of the thirty three mines surveyed, twenty seven provided at least one questionnaire for analysis. Figure 2 provides a summary of the numbers of mines that provided data to the Research Project Team.

Figure 2: Summary of Research Data Acquisition

Number of mines contacted and surveyed	**33 Mines**
↓	
Number of mines returning questionnaires	**27 Mines**
↘ **Manager questionnaires**	**17 Mines**
↘ **Worker questionnaires**	**22 Mines**

On a mine by mine basis, mineworker questionnaires where received from 66% of all mines contacted, and manager questionnaires were received from 52% of all mines contacted. This response rate is quite acceptable for surveys of this nature, and much better than that usually predicted by various questionnaire models (Jackson, 1988).

3.3 Data Handling

Handling of questionnaires: Some questionnaires were filled in during visits, but many were forwarded to the Research Project Team after the visit (pre-paid envelopes were supplied for this purpose). In some cases,

towards the end of the project, reminder telephone calls were sent to those mines which had not returned their questionnaires. While this did not affect the findings of the questionnaire survey, it did delay data analysis.

Missing data: One major problem with data analysis was that many individuals filling out questionnaires wrote illegible or unreadable answers. While it was possible to decipher some of these responses, in other cases such responses were recorded as missing data. In other questions, responders declined to answer at all - this was especially prevalent in manager questionnaires. While the use of long questionnaires with many questions can inhibit the number of responses received, it was felt that the large number of questions were justified.

However, there were some questions which contained so many missing data that it was not possible to draw any firm conclusions from them. Such responses were not included in this report.

Data entry: Data was entered into a personal computer using the Microsoft database Excel (version 5) for Windows. This allowed the creation of spreadsheets and simple descriptive statistics.

3.4 Data Analysis

Data analysis was conducted using the Statistical Package for the Social Sciences (SPSS). The SPSS for Windows version 6.1 was used.

SECTION 4

RESULTS

4 RESULTS

This section presents the results of the empirical field and questionnaire findings, covering:

- data relating to the acquisition of research data;
- data relating to questionnaire responses by mineworkers;
- data relating to questionnaire responses by mine managers.

4.1 Mines Data

4.1.1 Mines Surveyed

In all, over thirty mines were contacted and surveyed. These are listed in Table 1.

Table 1: List of Mines Surveyed

COALFIELD	MINE	TYPE
NSW Hunter	South Bulga/Saxonvale	Open/Underground
	United Colliery	Underground
	Camberwell	Open Cut
	Drayton	Open Cut
	Endeavour	Underground
	Rix's Creek	Open Cut
	Hunter Valley No 1	Open Cut
	Mount Thorley	Open Cut
NSW Newcastle	Wyee	Underground
	Myuna	Underground
	Newstan	Underground
	Munmorah	Underground
	Cooranbong	Underground
	Newvale	Underground
	Ellalong/Pelton	Underground
NSW Southern	Oakdale	Underground
	Appin	Underground
	Tower	Underground
	South Bulli	Underground
	Cordeaux	Underground
	Tahmoor	Underground
NSW Western	Baal Bone	Underground
	Vickery	Open Cut
	Gunnedah	Open/Underground
	Angas Place	Underground
Queensland	Saraji	Open Cut
	Norwich Park	Open Cut

Almost all mines were located in NSW (94%), with just over a third situated in the Hunter region (36%). Over half mines were underground (63%) and approximately one third of the sample was from open cut mines (the remainder were combined open cut and underground mines).

To preserve anonymity, mines were randomly allocated a identity (ID) number. It should not be possible to identify a particular response with a particular mine in the rest of this report.

4.1.2 Questionnaire Responses

A total of 236 mineworker questionnaires and 45 mine manager questionnaires were returned to the Research Project Team. These are shown in Table 2.

Table 2: Overview of the Numbers of Questionnaires Returned

Sample Characteristics	Categories	Type of Responses			
		Manager Q's		Worker Q's	
		No	%	No	%
Region	NSW Hunter	13	29%	61	26%
	NSW Southern	7	16%	29	12%
	NSW Newcastle	7	16%	66	28%
	NSW Western	4	9%	20	8%
	Queensland	11	25%	41	17%
	Missing	2	4%	19	8%
	TOTAL	**45**		**236**	
Type of mine	Open cut	21	47%	64	27%
	Underground	16	36%	132	56%
	Both	4	9%	21	9%
	Missing	2	4%	19	8%
	TOTAL	**45**		**236**	

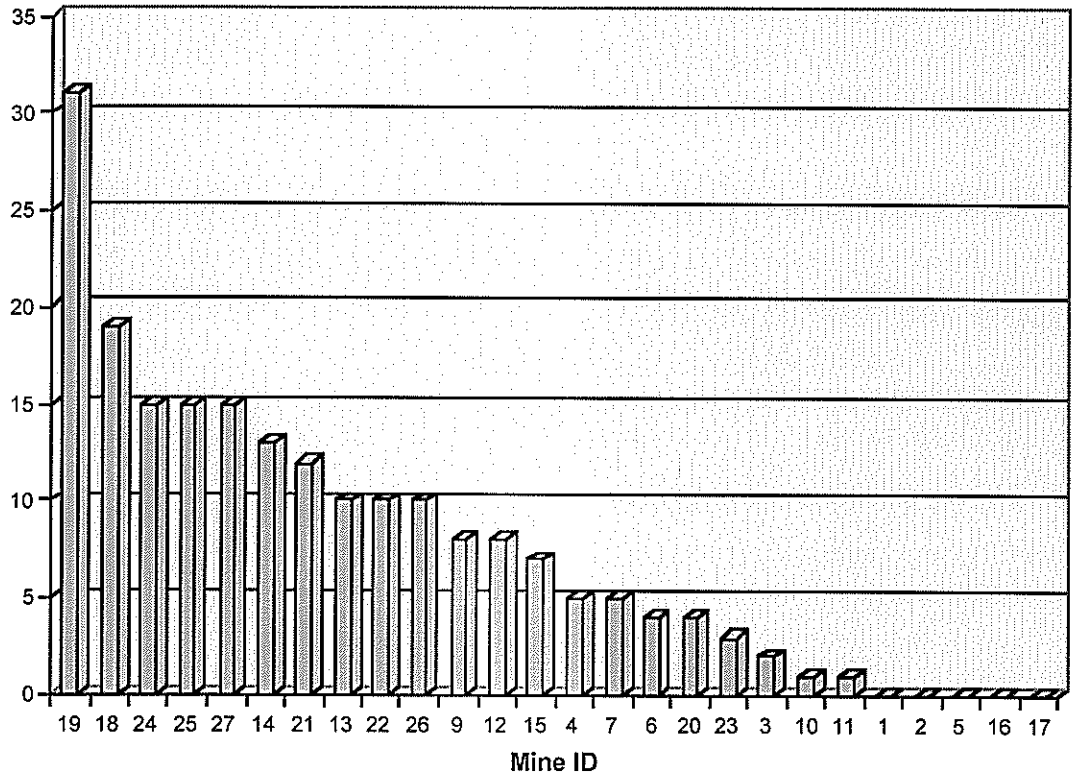
This data can be considered to be representative of the mines surveyed.

The number of questionnaires returned varied from mine to mine. As previously noted, at one visit, the mine manager brought an entire team of thirty workers together, and after a short address by the project team member visiting the site, duly completed worker questionnaires (incidentally, the 31st questionnaire was completed by the mine manager as part of that group, accounting for one entry of "mine manager" in mineworker job categories).

4.1.2.1 Number of Responders (Mineworker Questionnaires)

A total number of 236 mineworker questionnaires were returned to the Research Project Team. Of these, it was not possible to identify the mine in 19 cases. This left 217 questionnaires from clearly identified mines. Data on numbers of mineworker questionnaires/mine returned is shown in Figure 3.

Figure 3: Number of Mineworker Questionnaires/Mine



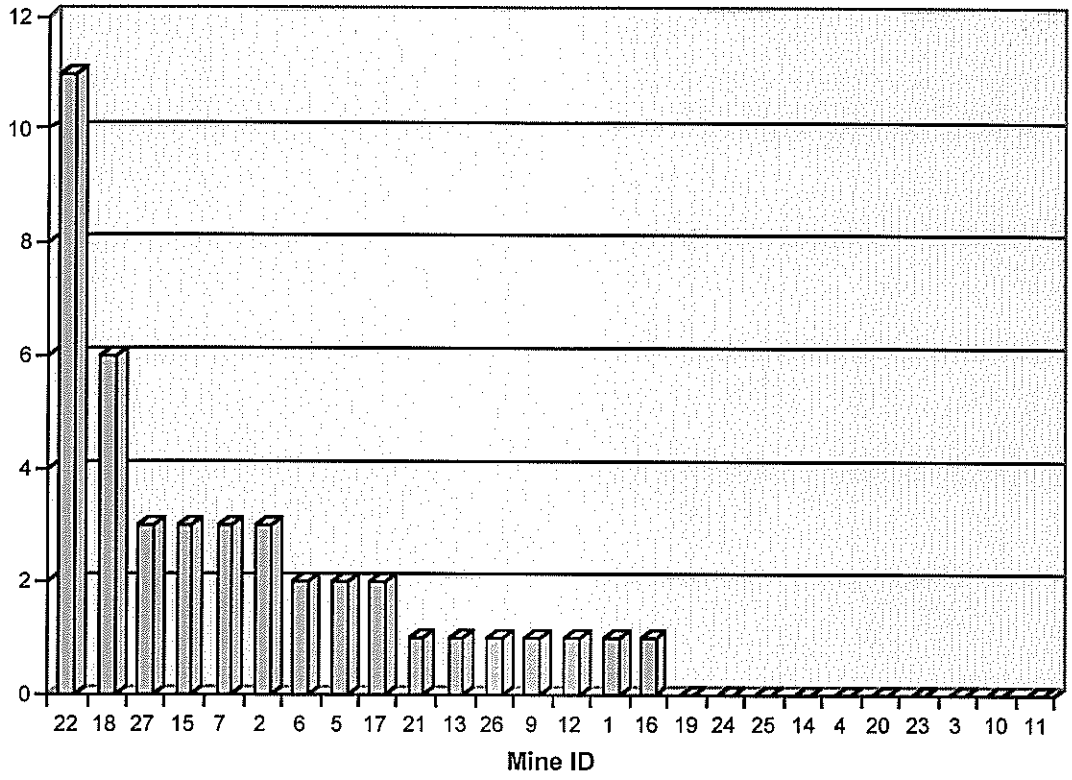
The number of questionnaires/mine varied from 1 to 31, with an average of 9.9 ± 7.3 (standard deviation). Five mines declined to return questionnaires to the Research Project Team, even after reminder phone calls.

4.1.2.2 Number of Responders (Mine Manager Questionnaires)

A total number of 45 manager questionnaires were returned to the Research Project Team. Of these, it was not possible to identify the mine in 2 cases. This left 43 questionnaires from clearly identified mines

Data on numbers of mine manager questionnaires/mine returned is shown in Figure 4.

Figure 4: Number of Mine Manager Questionnaires/Mine



The number of questionnaires/mine varied from 1 to 11, with an average of 2.5 ± 2.5 (standard deviation). Ten mine managers declined to return questionnaires to the Research Project Team, even after reminder phone calls.

It can be seen from Figure 4 that questionnaires were returned from seventeen out of twenty seven mines, which seems low. However, this means that 63% of the mines surveyed returned questionnaires to the Research Project Team. Further, as virtually all mines returning manager questionnaires included at least one from the mine manager, obtaining a response rate of nearly two thirds is considered representative of this population.

4.2 Mineworker Data

4.2.1 Age of Mineworkers

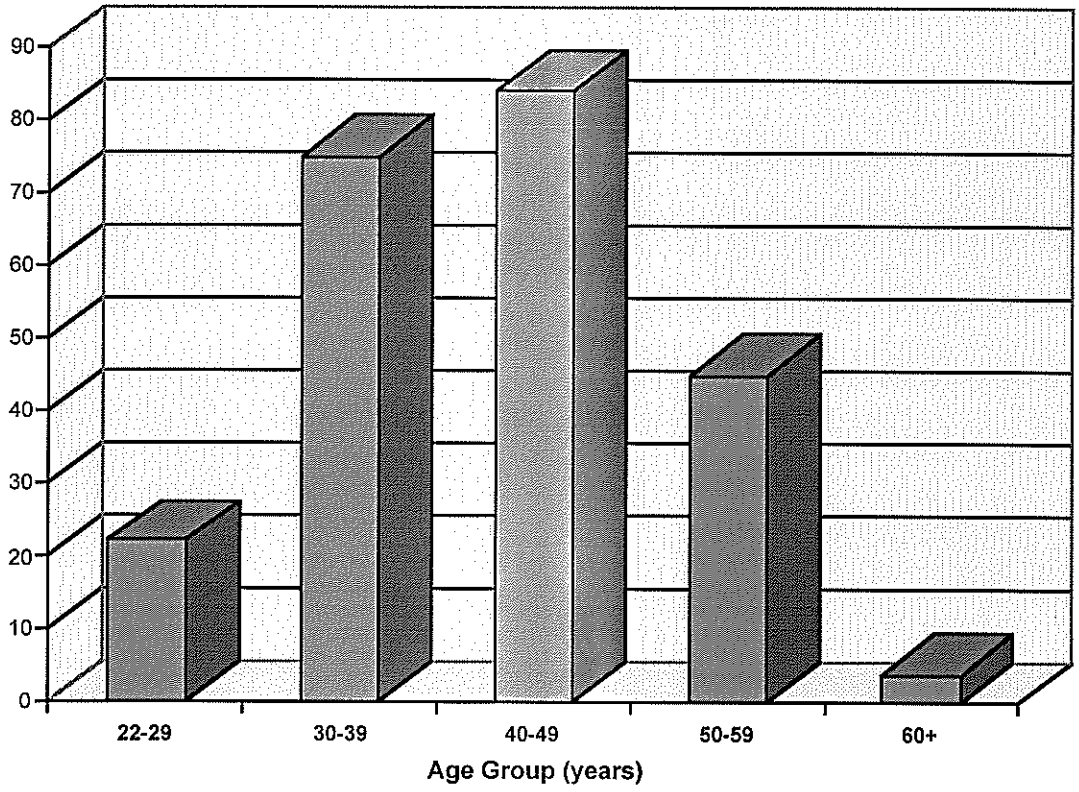
For the past ten years, the workforce in the coal mining industry has decreased 26% from nearly 19,000 in 1985, to just under 14,000 in 1994 (Mineral Resources/Joint Coal Board, 1995). This has been against a background of increased productivity (3110 tonnes/employee in 1984-5 to 5940 tonnes/employee in 1993-4, which is an increase of 91%).

The fall in numbers of workers is due to both attrition and retrenchment. This has meant that a fairly substantial pool of unemployed experienced

workers has formed, who have to compete for jobs with younger entrants. To assist finding jobs for retrenched workers, a "closed book" policy is in operation, in which retrenched mineworkers are given preference for new jobs opening up in other sectors of the industry. This means that the current coal mining workforce is an aging workforce.

The age of mineworkers who completed is shown in Figure 5.

Figure 5: Age of Mineworkers Surveyed



The median age of mineworkers in this industry, as reported by the Joint Coal Board is 42 (JCB, 1995). The data in Figure 5 supports this finding, in that the average age is in the area of 40 plus.

An additional factor which has contributed to increased productivity is that workers are working longer hours. This has the potential to increase exposure to health and safety hazards, including eye hazards.

Therefore, in the area of eye protection, problems of longer hours of work, increased hazard exposure, and an aging workforce, all reinforce the need for closer attention to the identification of eye hazards and introduction of systematic programs for the prevention of damage to eyes and maintenance of vision.

4.2.2 Gender of Mineworkers

The coal mining workforce, is predominantly male. This is supported by the questionnaire data, where of 233 responders, only two were female. This gives a rate of 0.9%, which if anything, is probably an overestimate.

4.2.3 Job Categories of Mineworkers

Mineworker responses to the questions responses to the questions "What is your job title?" or "What do you do?" were analysed. However, there are a range of job categories and classifications in this industry, some traditional, some imposed by legislation, and some mine specific. To overcome this confusion, and to establish the profile of mineworker responders, these job classifications were aggregated into major categories of "production", "support" and "administrative" categories. The job categories of mineworker responders are shown in Table 3.

Table 3: Job Categories

Category	Total	Job description	Number
"Production"	145 (65%)	Blasting crew/shotfiring	3
		Chock man	1
		Crane operator	2
		Driver	2
		'Fed'/Federation	9
		Local check inspector	1
		Long wall worker	4
		Machine man	10
		Plant operator/machinist	38
		Production supervisor	11
		Production worker	64
"Support"	75 (34%)	Bathhouse work	2
		Boilermaker	1
		First aid officer	2
		Fitter	49
		Painter	1
		Storeman	2
		Technician/electrician	17
		Trades assistant	1
"Adminstrative"	4 (2%)	Deputy	2
		Mine manager	1
		Office worker	1

Obviously, some of these categories overlap, such as production worker, Fed, Federation and chockman. However, they are listed as they were described on questionnaire replies. Similarly, a worker questionnaire from a person who describes himself as "mine manager" is probably in the wrong category (as discussed above).

The concept of fixed job descriptions in the coal mining industry has changed over the last ten years or so, and the demarcation between tradesmen (such as electricians) and production categories (such as "Feds") has declined, especially in underground mines. The introduction of continuous mining crews from the mid 1950's, lead to a re-examination of "down time" due to breakdowns. At the time, managements realised that having tradesmen on hand, but essentially doing nothing, was economically inefficient and the mining workforce realised that idle hands minimised the production bonus that became common in the industry form the mid to late 1950s. When breakdowns occur, aside from the obvious loss to production, the substantial bonus that accrues to everyone in the mine irrespective of production status, from office worker to manager, is affected. As a menas of reducing production down time, it became common for crew members to help each other as required, initially in contravention of union demarcation. More recently, these practices have become part of the core of multiskilling and broadbanding and in some respects, the coal mining industry has been at the forefront in the development of such initiatives, which are now common in many industries. Consequently, whether workers are "production" or "support" has become blurred. Therefore, the responses to the questions "What is your job title?" or "What do you do?" should be interpreted cautiously.

This can also be seen in mineworker descriptions of their day to day activities (see Table 4).

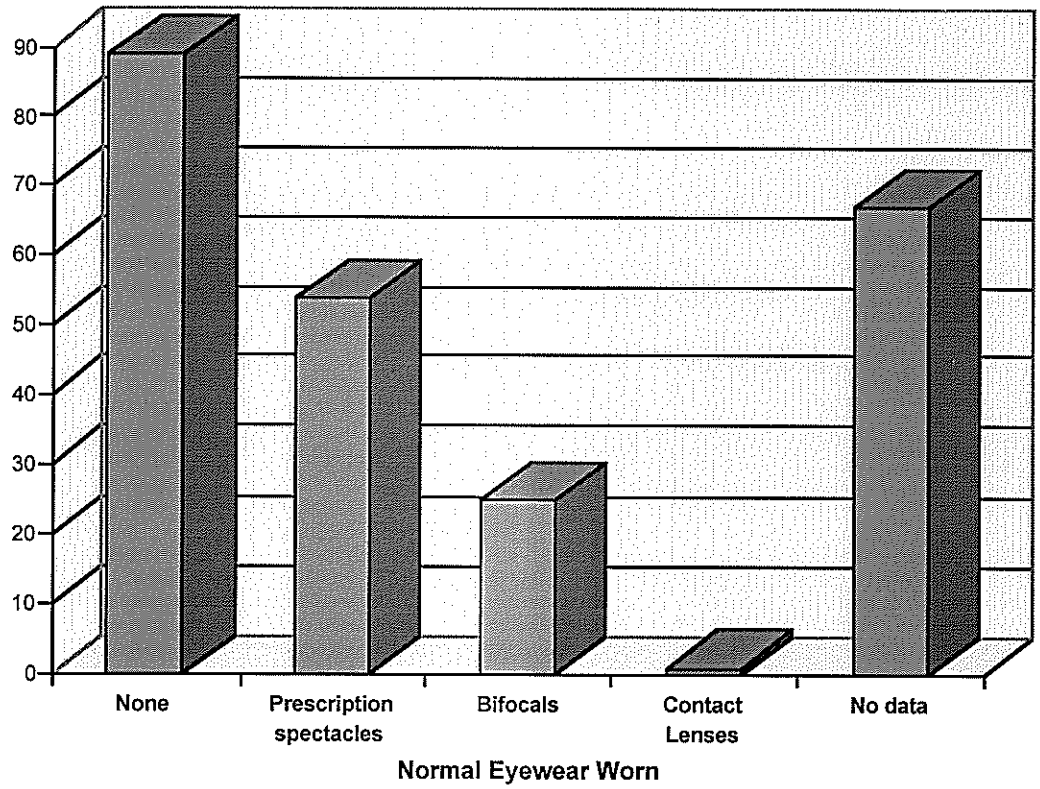
Table 4: Type of Work carried Out

Category	Total	Job description	Number
"Production"	62 (39%)	Dragline operator	1
		Loaders and drilling	12
		Longwall	4
		Operating dozers	46
"Service"	89 (57%)	Bath house work	4
		Boilermaker	1
		Cleaning and maintenance	1
		Coordinate first aid	1
		Electrical work	2
		General duties	40
		Laboratory preparation	1
		Repairs and maintenance	45
		Service machinery	11
		Statutory check inspector	3
		Surface materials	2
		Work on all mine equipment	28
"Adminstrative"	6 (4%)	"Responsible for all"	3
		Office work	3

4.2.4 Normal Eyewear

Among all categories of mineworkers, a significant factor in the use of safety glasses is the eyewear usually worn (for example, prescription spectacles or contact lenses). A question was asked of the eyewear normally worn by mineworkers: Analysis of responses from this question are shown in Figure 6.

Figure 6: Normal Eyewear Worn by Mineworkers



No answer was recorded for 68 questionnaires (28%), 89 (53% of responders) reported that they normally did not wear eyewear, and 80 (47% of responders) reported that they normally wore eyewear of some description. Of these, 54 wore prescription spectacles, 25 wore bifocals and 1 questionnaire responder reported that he wore contact lenses (see Table 5).

Table 5: Eyewear Normally worn by Mineworkers

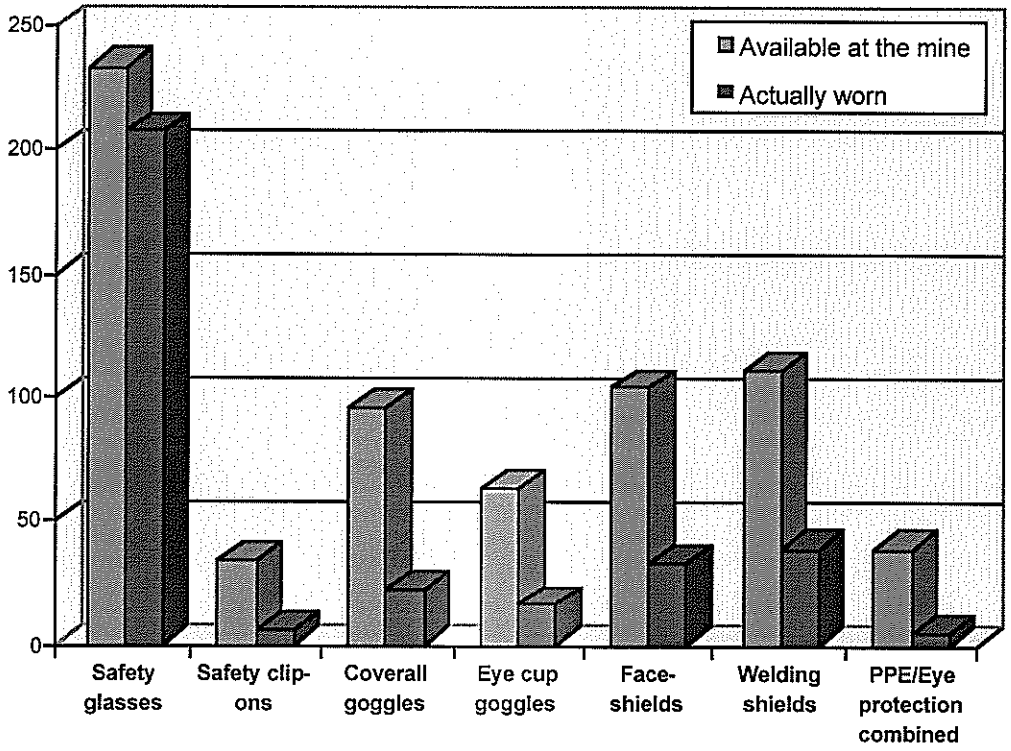
Type of Eyewear	Number of Responders	% of total	% of responders
None	89	37.71	52.66
All prescription eyewear	80	33.90	47.34
Prescription spectacles	54	22.88	31.95
Bifocals	25	10.59	14.79
Contact Lenses	1	0.42	0.59
No data	67	28.39	
Totals	236	100.00	

Of the 54 mineworkers who reported that they wore prescription sunglasses, 53 noted that they were supplied by their employer (the last person did not report on who supplied his glasses).

4.2.5 Safety Eyewear

Data on availability and use of eyewear by mineworkers is shown in Figure 7.

Figure 7: Availability and Use of Safety Eyewear by Mineworkers



A wide range of safety eye protection is available in coal mines, from ordinary safety glasses through to welding helmets and sophisticated combination personal protective equipment/eye wear. Obviously, more safety eyewear is available than used. All but three mineworkers reported that safety glasses were available, and virtually all mineworkers (89%) reported they wore safety glasses at one time or another. Use rates of other eye protection was not as great, however the use of coverall glasses (23%) may have been predominantly by prescription glass wearers, as one can cover the other.

In general, it can be said that most well known manufacturers of safety glasses supply to the coal mining industry, and virtually all safety glasses comply with the relevant eye safety standards.

One issue that was noted in a few underground mines, was the use of tinted lenses in eye safety wear. Different tints were available, included "smoky", blue and yellow tints.

It appears that some personal eye protection suppliers have been promoting the use of yellow tinted lenses in underground mining. For many employees, the wearing of yellow lenses gives a sense of enhanced contrast and superior visual performance. The explanations for the phenomenon include the link with the chromatic aberration of the eye where some individuals can become quite short sighted to blue light. Removal of the blue information removes the blurred image. There is a counter argument to this that removal of the blue information takes away some of the information which allows an accurate focus on objects. The second argument in favour of yellow lenses is that short wavelengths are scattered more than long wavelengths and so yellow lenses will remove scattered light and improve contrast. Unfortunately the situations in which scattered light is a significant problem (for example, fog) are situations of large particle scattering (Mie scattering) which is not wavelength dependent. Small particle scattering is greater with shorter wavelengths (Rayleigh scattering) but the reduction of visual acuity is minimal unless very long distances (several kilometres) are involved. Clouds are white because of Mie scattering, the sky is blue because of Rayleigh scattering.

The bottom line is that visual functions are not significantly improved by the use of yellow lenses and this has been consistently the findings of several studies (see Kelly and others 1984 for a review). The downside is that yellow lenses reduce the amount of light available in underground mines where light is at a premium this is particularly critical.

Yellow lenses are available with AS/NZS 1337 certification as untinted so it is difficult to argue against their use. They meet the 85% luminous transmittance requirement and must be considered as good as untinted lenses. However, there are lenses available without AS/NZS 1337 compliance with transmittances as low as 60%. These are to be avoided at all cost. Therefore, it is particularly important to establish that yellow lenses comply with the untinted requirements of AS/NZS 1337.

The Research Project Team considers that the use of tinted lenses in safety eyewear underground is a cosmetic affectation which could possibly degrade vision and detract from safety in poorly lit areas, if lenses do not comply with AS/NZS 1337.

A second, more serious issue was in the use of mesh eyewear. The use of mesh glasses was not common, but where it occurred, workers (mainly underground) had a preference for the mesh "blowfly" eyewear. Indeed, some workers felt that wearing mesh eyewear did not give the feeling of being "closed in" that normal eye protection sometimes gave. Miners also considered that the loss of visual quality that mesh eyewear confers is not a problem underground, because the level of lighting is quite low anyway, and is not noticeable when wearing mesh eyewear. The Research Project

Team has major reservations about the use of mesh eyewear because they may not (indeed cannot) comply with relevant eye protection standards, and do not offer an adequate level of protection. Anecdotal evidence is available to suggest that a low velocity impact on mesh eyewear may protect the eye against impact damage, but can leave a mesh imprint on the surface of the cornea of the eye.

In unsolicited responses, some mineworkers noted personal preferences for certain brands and makes of eye protection on their questionnaires. However, the Research Project Team did not want to be placed in the position of endorsing or not endorsing the various makes of safety glasses in use, and therefore no analysis of the various responses to specific makes of eye protection was made. It is interesting that in some mines, workers have a higher acceptance of some of the more well known (but not necessarily better) brand name eyewear. For example, some workers are reluctant to put on what they perceive as "cheap" eyewear. Whether this is due to performance or image is not known, although the name of manufacturer of eyewear is identified as a possible barrier to compliance.

4.2.6 Duration of Wearing of Eye Protection

The duration of time that mineworkers wore eye protection is shown in Figure 8.

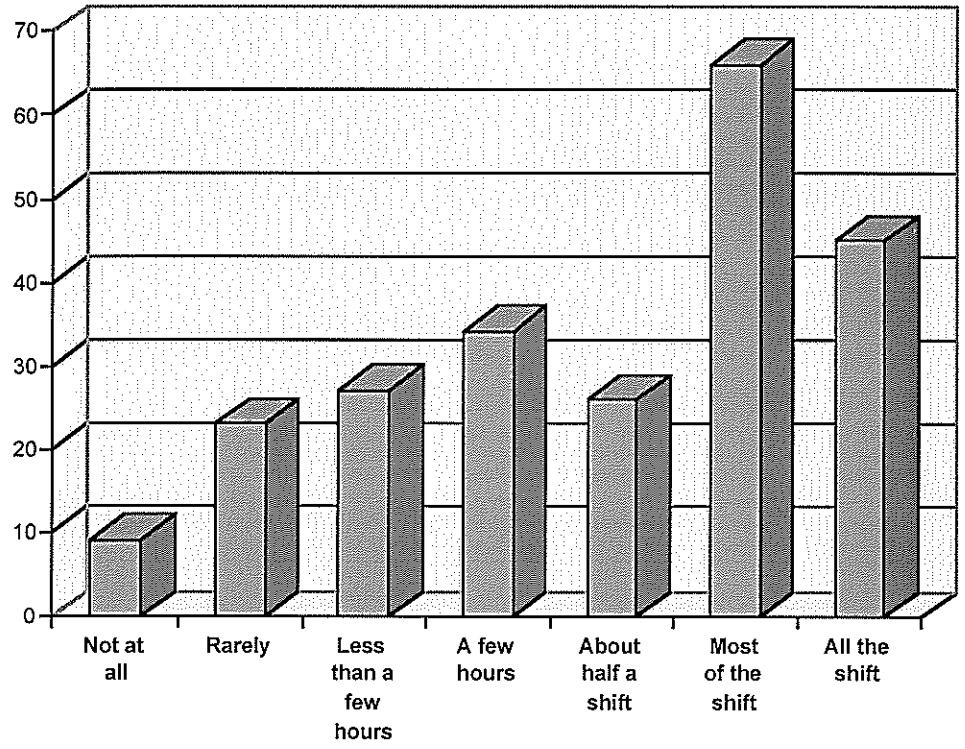
Nearly half the responders (48%) wore eye protection for most or all of the shift, which indicates a reasonable level of compliance. There is a bimodal tendency in this data, with about 40% of mineworkers wearing safety glasses for less than half the shift. Of these, nine workers, or 4% did not wear eye protection at any time.

Further, the 14% of workers who reported that they never or rarely wore eye protection are a group that should be targeted in future training and compliance programs.

Whether these results are representative of the usual use of eye protection is not known, and it is possible that responders are over-cautiously reporting their use of eye protection. However observation of eye protection practices at coal mines during visits suggests that the results reported in Figure 8 are probably representative.

Bearing in mind that these results indicate mineworkers reporting compliance with eye protection in a questionnaire requesting such data, the possibility of over-optimistic reporting exists. This being the case, the possibility that at least 4% of a total workforce of 14,000 is not wearing eye protection is a significant problem.

Figure 8: Duration that Mineworkers Wear Safety Glasses



4.2.7 Rules Regarding Eye Protection

Mineworkers were asked questions on whether they knew if:

- any rules on eye protection were operating in the mine;
- these rules were written down;
- there were particular jobs or situations where eye protection should be worn;
- there were particular locations when eye protection should be worn.

Responses to these questions are shown in Figures 9-10.

Most mineworkers (89%) were aware of rules for the use of eye protection at the mines where they worked. A smaller percentage (76%) of miners were aware of written rules for eye protection, but this number should be interpreted with caution, as a small number of mines lacked written eye protection policies.

A small minority of miners answered that they did not know, or couldn't remember, whether written policies existed in their mines. While this may be an issue for attention in training programs, it does point to some candour in mineworker responses, and suggests that the answers received are representative of prevailing knowledge and attitudes.

Figure 9: Mineworker Knowledge of Informal/ Written Rules for Eye Protection

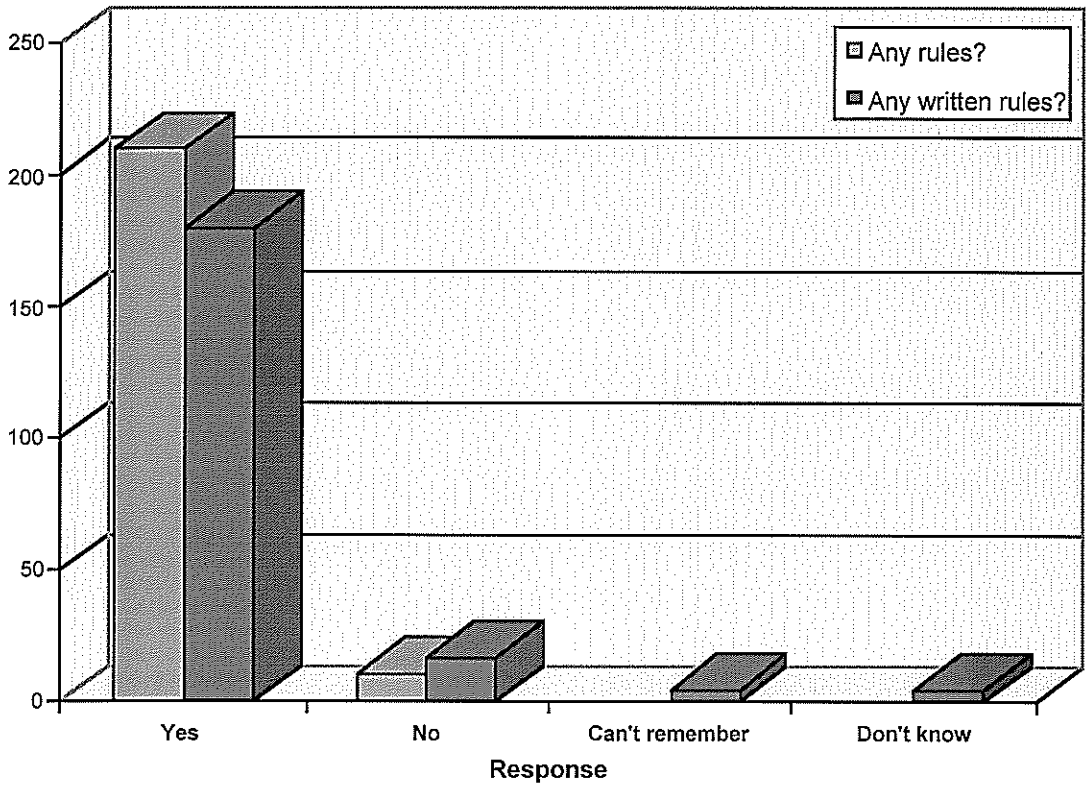
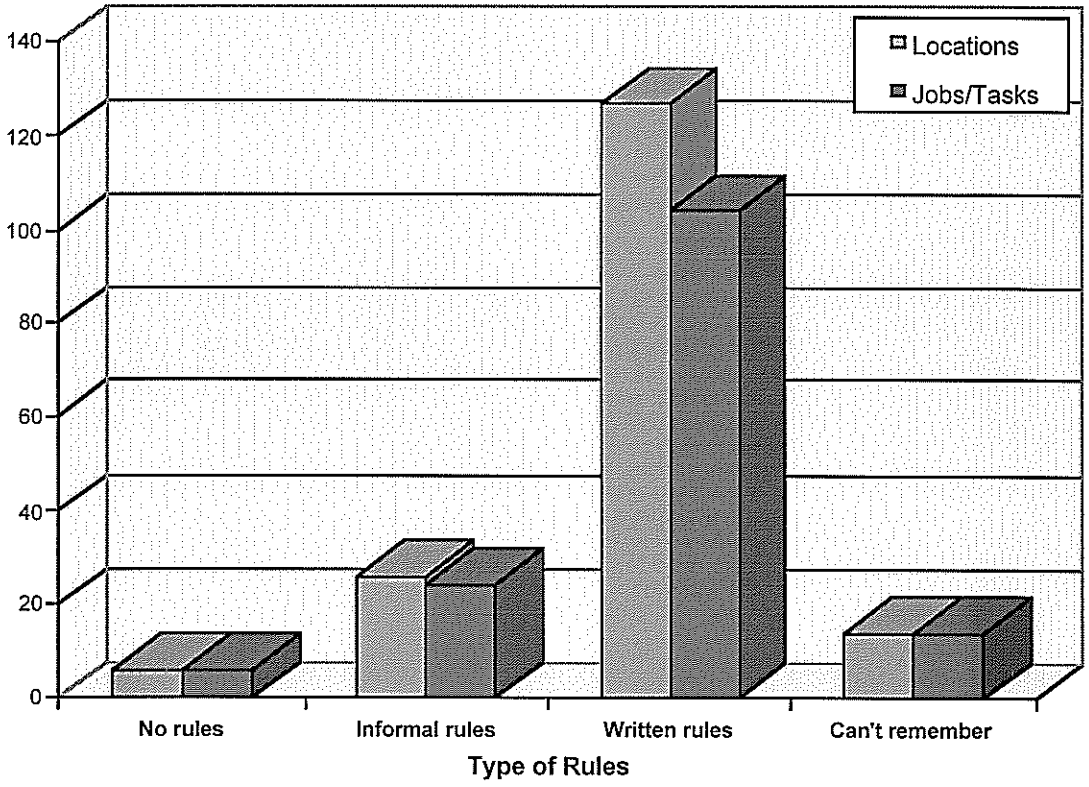


Figure 10: Mineworker Knowledge of When/Were Eye Protection to be Worn



One minor problem with this data is in the columns "written rules". In some mines, eye protection was global in nature, and all workers were required to put on eye protection as they left the office area or bathhouse.

In such cases, it is relatively easy to remember if a written policy exists on where eye protection should be worn. In other mines, only specified areas were designated as eye protection zones, such as workshops or the coal face. In these circumstances, it may be slightly harder to recall if such procedures are written or informal.

While the number of responses indicated that written rules on locations or jobs/tasks where eye protection should be worn, the number of responses of "no rules", informal rules" or "can't remember" is relatively significant. These responses indicate inadequate attention by both management and workers to the detail of eye hazard recognition and eye protection practices.

Mineworkers also identified a number of locations where eye protection should be worn:

- facework;
- roof bolting;
- where there was "severe dust";
- fuelling up machinery;
- using grinding equipment;
- in dusty areas;
- "hosing down";
- when welding.

Seven workers reported that eye protection should be worn using words such as "when you think you need them" and two workers reported "can't remember" in this section.

4.2.8 Mineworker Concerns about Eye Hazards

4.2.8.1 Concerns reported in questionnaires

The wearing of eye protection is not necessarily something which all mineworkers accept. Many mineworkers see the reason for eye protection, but some do not. Mineworkers reported a range of problems caused by the wearing of eye protection, including:

- fogging.
- glare;
- eyestrain;
- tired eyes;
- blurred vision;
- watery eyes;
- dust.

These data are shown collectively in Figure 11 to provide an overall picture of the concerns raised by mineworkers.

Firstly, as has been seen in earlier figures, the comments reported by mineworkers are basically bimodal. That is, they appear to consist of two groups of workers. The first group has little or no problem with wearing eye protection - the responses from this group appear on the left hand side of the figure. However, a number of concerns with wearing eye protection are raised in the second group, and the responses from these workers are seen in the peaks in the middle of the graph. It is likely that this second group of workers would have the most difficulty with wearing eye protection, and the reasons for noncompliance and their solution, need to be identified before effective training can be delivered.

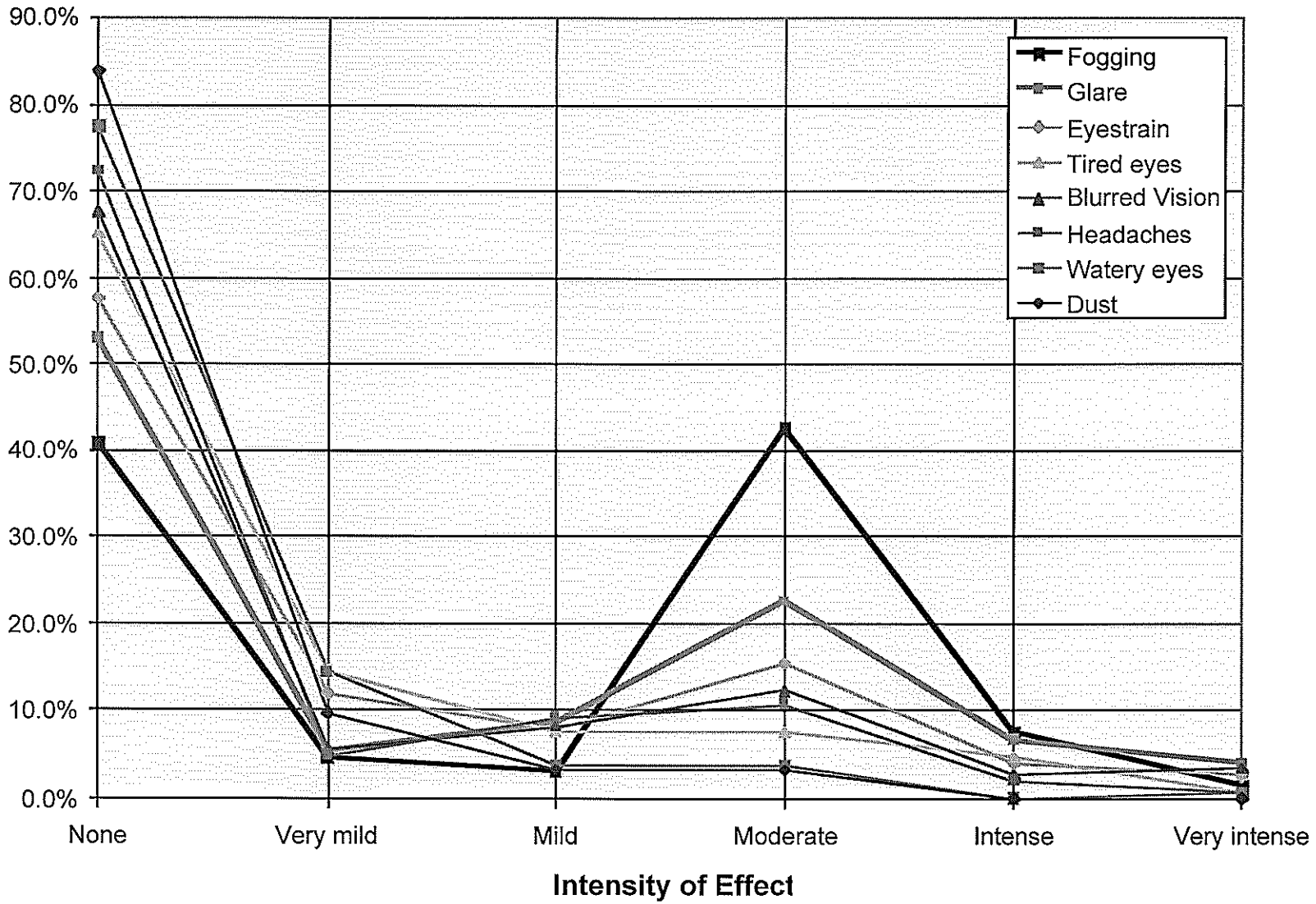
Fogging: It was immediately apparent that the commonest problem with eye protection, mentioned in all mines, was fogging. This is borne out quantitatively by the data in Figure 11, where over 40% of workers reported "moderate" fogging. In this, the term "moderate" can be considered an expression of a significant impediment to compliance. It is highly likely that these data would be even higher in underground mines, as fogging is mainly a problem underground, the data above is aggregated from both underground and open cut mines, and in pit top occupations in underground mines.

Glare: It is clear from the data in Figure 11, that glare is the second most common complaint reported by mineworkers. This was also found in discussions with mineworkers during mine site inspections. Glare appears to be a different issue underground than in open cuts

The problems of glare underground are due, in the main, to the positioning of fixed lighting and cap lights. Safety glasses sometimes have bevelled edges, angles or corners which can disperse or refract light which is perceived as glare. The choice of glasses without such edges, or with edges that are covered with nonrefractive materials may alleviate this matter. More significantly, scratched or abraded lenses will also increase glare, and this problem can be solved by the widespread availability of replacement lenses and eye protection.

The user factors are only part of the issue of glare control. The location, type and aiming of lighting provided are also essential considerations. The research team are aware that a project related to the lighting of underground mines was undertaken at University of New South Wales some years ago but are unaware of which type of mining was involved, what the outcomes were and what if any, implementations of recommendations were carried out.

Figure 11: Mineworker Concerns about Wearing Eye Protection



For the purposes of the present project, the lighting of underground mines has not otherwise been addressed. The general principles of lighting design may be found *in AS1680.1 Interior Lighting: General Principles and Recommendations.* The lighting of underground mines is a complex and challenging issue beyond the scope and terms of reference of this research project. However it is important to bear in mind the interactions of the many factors in a workplace.

Cap lights also produce glare. These are normally positioned to cast light forward and can be adjusted to high or low beams. Convention among miners dictates that lamps should be set on low beam when working in groups to avoid dazzling colleagues and temporarily restricting their ability in mobility and work activity. Dazzling and glare may be alleviated by the fitting of adjustable brackets to the light fixture. The research team is aware that an adjustable bracket is already being manufactured commercially. The use of such a fitting may also assist in solving the concerns of bifocal wearers (see below).

In open cut mines, the effects of glare are associated with the intensity of sunlight during the day, and inappropriate positioning of lighting during night shifts. While glare from sunlight can be prevented using appropriate sunglasses, problems arise when working close to dawn or dusk (when the sun is low in the sky). A second issue with the use of sunglasses, is when they are used by drivers of heavy machinery at night, who wear sunglasses to minimise the intensity of night lighting. Problems can arise when driving from a brightly lit area to an unlit area, when for a short period of time the eyes are not adjusted to dark conditions.

The correct selection, design and location of luminaires (light fittings) is just as important in open cut mines as it is in underground mines. The use of appropriately qualified illuminating engineers should resolve the problems associated with inappropriately installed lighting. In particular, the provision of graduated intermediate lighting levels on access and exit roads will ensure a gradual change in the eye's sensitivity at the same time as providing sufficient illumination for the driving task.

One further issue identified by the research team in mine site inspections, was the fogging of sunglasses when workers entered air-conditioned cabs. However, this is considered only a minor problem, as the fogging soon evaporates. This should not detract from fogging in underground mines, which is a major problem.

Dust: The Research Project Team initially considered that dust would be a major impediment to the use of eye protection. Mine environments contain airborne contaminants, and deposits of dust are commonly observed on miners, equipment and in the working environment. It was also thought that dust would stick to lenses, either by static electricity or because of the use of lens cleaning or anti-fog solutions. Further, it was anticipated that dust would increase problems of abrasion. However, the data in Figure 11 indicates that dust was not a significant factor impacting

on the use of eye protection by mineworkers. There are a number of possible explanations for this:

- In underground mines: (i) the size of coal mine dusts, which contain substantial quantities of non-respirable particles which drop quickly out of the air; (ii) improvements in ventilation, which remove inspirable dusts; and (iii) changes in dust suppression technology and strategies.
- Dusts are also encountered in open cut mines, but the methods of working are different, and as a consequence, mineworkers are exposed to less dust than underground miners. Being in the open environment also reduces dust levels substantially, by natural and airborne dispersion. The lower humidity levels in open cuts may contribute to the propensity for dust to stick to lenses.

Other concerns raised by mineworkers include eyestrain, tired eyes, blurred vision, headaches and watering. These will be discussed below.

4.2.8.2 Misconceptions reported by mineworkers during mine site inspections

It was also apparent in discussions with mineworkers, that there are a number of common misconceptions about wearing eye protection, some of which relate to the factors discussed above.

The most prevalent concern about the use of safety eyewear can be summed up by the commonly heard statement "I won't wear safety glasses because they will damage my eyes" or the question "Can you guarantee that my eyes won't be damaged if I wear eye protection?"

There are no known nor conceivable reasons why eye protection could possibly have any deleterious effect on vision. This is based on knowledge of optics, lens materials and the eye. Since this is entirely self evident, to anyone associated with visual science and optometry, there have been no long term studies to which reference can be made nor are there likely to be. This does not mean that the information that eye protectors cannot damage eyes should be delivered with any less assurance. However, that is not to say that inappropriately constructed, inappropriately selected, inappropriately fitted and/or inappropriately used eye protectors may not be uncomfortable physically or during use.

Visual capabilities decline as a function of age from about 20 years old. By the mid 40s at least half the population will be wearing glasses for reading. By the early 50s the vast majority will need assistance for reading and many will also be needing assistance at distance when they have had perfect vision previously. As a consequence for mineworkers, it is inevitable that some will associate these changes with the wearing of eye protectors and, in the case of underground miners, with visually poor working conditions. It is important for mineworkers to realise and accept that the decline in vision is a normal consequence of aging.

Concerns that eye protectors may damage eyes may be symptoms of a resistance to the wearing of eye protectors particularly in a authoritarian imposed universal wearing regime. However, the new AS/NZS 1336 will be quite explicit on this issue. At this stage AS/NZS 1336 is due for publication. It is, as yet, a confidential document, but its publication will make every effort to dispel any suggestion of the possibility of detrimental effects from the wearing of eye protectors.

The key to making eye protectors as acceptable as possible to the wearers is in providing a choice of attractive and comfortable styles. The days when industrial eye protectors were universally cumbersome and uncomfortable are long since gone.

4.2.9 Impediments to the Use of Eye Protection

Workers listed a range of factors which affected their compliance with wearing eye protection. Reasons include:

- fogging;
- feeling closed in;
- tired eyes;
- watery eyes;
- eye strain;
- blurred vision;
- feeling disorientated;
- headaches;
- glare;
- irritation from dust.

However, while the list of factors was quite long, every mine visited nominated fogging as the most prevalent reason why eye protection was not worn.

4.3 Mine Manager Data

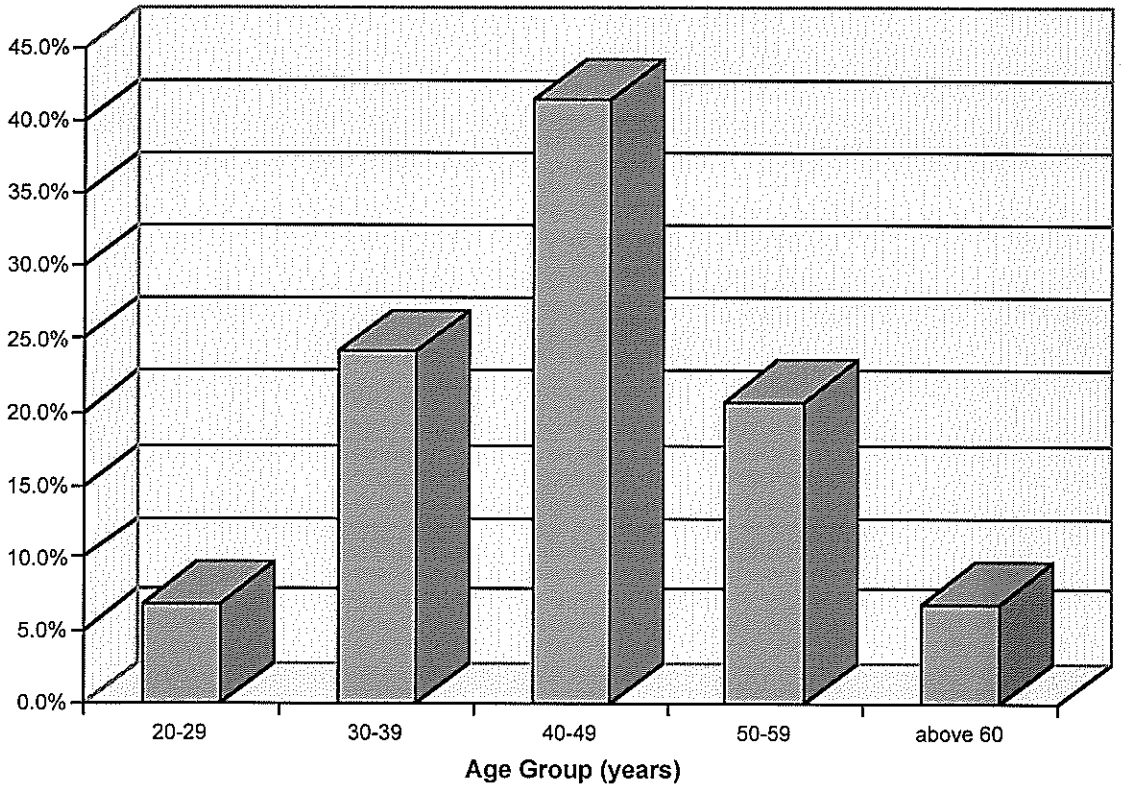
As already noted, 45 manager questionnaires were returned, from seventeen mines. One mine sent back eleven manager questionnaires (plus ten mineworker questionnaires, so there is no confusion about all eleven being part of the management team).

For the purposes of discussion below, the term "mine managers" will be used to denote members of the mine management team, not the term mine manager, as specified in the Coal Mines Regulation Act 1982.

4.3.1 Mine Manager Demographics

Age: The age of mine managers is shown in Figure 12. The age distribution is similar to that seen for mineworkers, again with an indication that mine managers are an aging population. The average age of mine managers is probably slightly older than mineworkers, reflecting the experience and expertise of these workers.

Figure 12: Age of Mine Managers

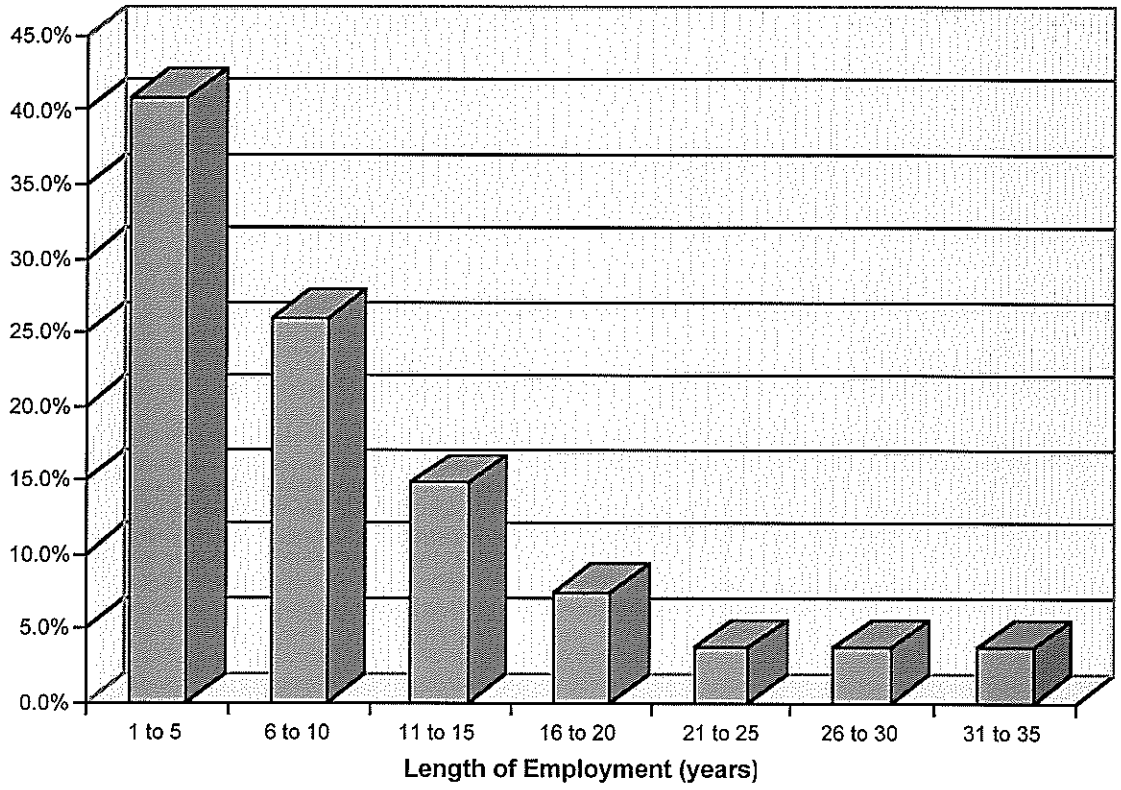


Gender: All mine managers were male.

Experience: The length of employment in the coal mining industry of mine managers is shown in Figure 13.

Length of experience ranged from one year to thirty two years, with a average of 9.6 years. This indicates that most mine managers have a long experience in this particular industry.

Figure 13: Length of Employment



Job Classifications: Job classifications reported by manager questionnaire responders included:

- mine manager;
- safety coordinator;
- engineer;
- supervisor;
- safety systems analyst;
- superintendent - coal quality;
- geologist;
- head of maintenance workshop.

These managers also listed their main tasks and responsibilities:

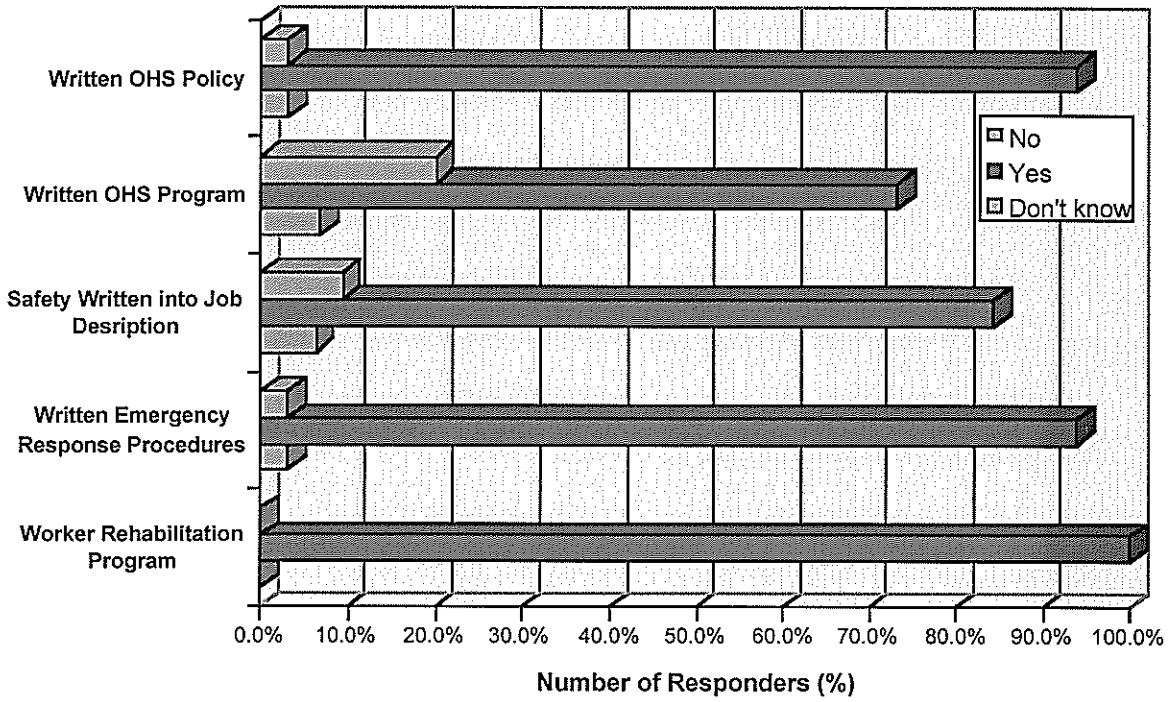
- manage production, maintenance, quality;
- in charge of planning department;
- repair heavy machinery;
- manage all mechanical devices;
- coordinate and administer safety systems;
- panel supervision;
- training coordinator.

It can be seen that many of the managerial functions of a coal mine are represented in this data.

4.3.2 Management awareness of OHS issues

Question 1.1 of the Management questionnaire asked a range of questions about OHS policies, programs, emergency procedures and rehabilitation systems. Results of this analysis are shown in Figure 14.

Figure 14: Management Awareness of OHS Issues



In this regard, a "policy" is regarded as a written statement of intent, which includes commitment to occupational health and safety, and to the development of an OHS program. The OHS program is a formal system which addresses occupational health and safety issues.

Figure 14 indicates that there is good awareness for those systems whether required by law or as part of contemporary mining practices such as rehabilitation programs, emergency response procedures and OHS policies. However, where there is less regulatory attention to such systems, awareness is reduced. Managers seem to be more aware of the need for written OHS policies than the need for a written OHS program. This indicates that there is a communication discrepancy in which general OHS policies are being given lip service and not translated into real work practices.

Not shown in Figure 14 are the answers to the question "Is the OHS Program working?" Managers answered this question with a Yes (60%), Sometimes (3.3%), No (16.6%), and Don't know (20%). A compliance

rate of 40-50% is very low, suggesting that OHS programs do not have a high priority in all coal mines.

Worker and management compliance with OHS programs is problematic. The results reveal that although some managers and workers recognise that OHS programs exist, many do not comply. The fact that managers answered this question honestly is positive in that it indicates that there are compliance issues amongst managers and workers that need rectification.

Policies and programs are sometimes not being incorporated into managers' and workers' job descriptions (although it is acknowledged that there have been significant changes in this area recently). There is of course already a legal responsibility for managers under the CMRA to adminster all aspects of safety. A legal responsibility of duty of care also exists under the NSW Occupational Health and Safety Act 1983 (OHSA). However, specific areas of safety such as eye protection should be written into job descriptions for the entire workforce in order to foster a sense of ownership of safety systems and an involvement in the development of a safer workplace and work practices.

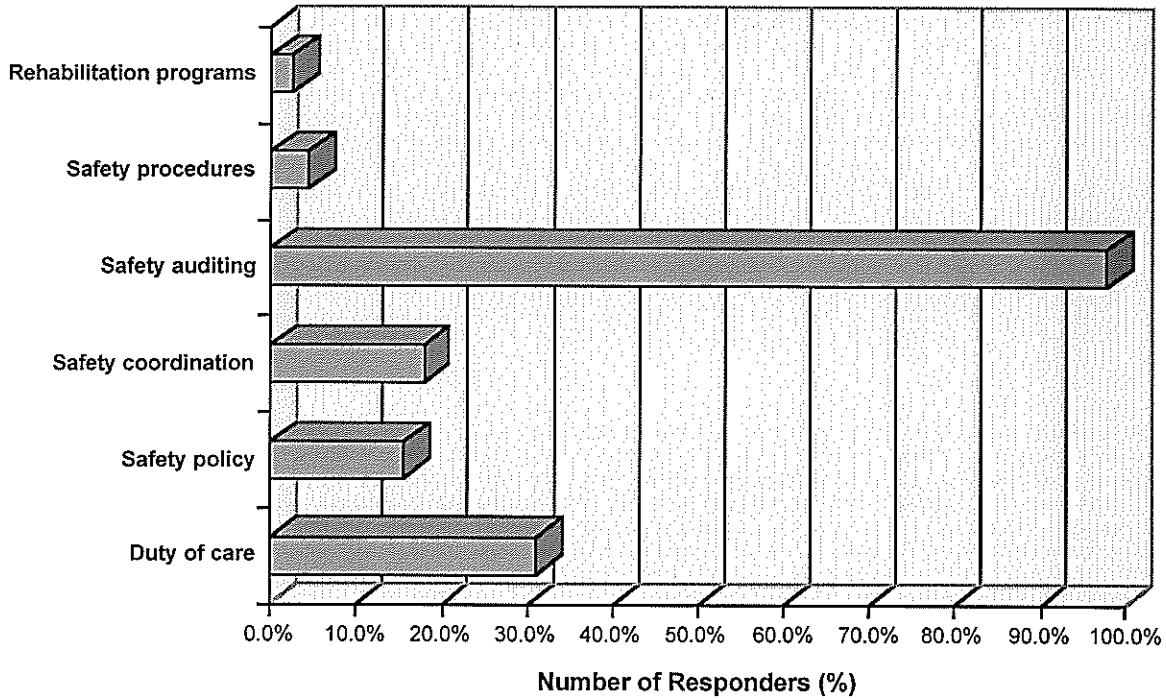
4.3.3 Direct management responsibilities

The need for policy and program development is supported by the results of the analysis of answers related to individual manager responsibilities, shown in Figure 15.

This section surveyed whether managers wrote safety policies or procedures, or were involved in other essential aspects of safety management, such as rehabilitation programs. Not present in Figure 15, but revealing in its candour, was the comment by one manager, which was: "I don't know what my OHS responsibilities are".

All but one manager indicated that they were involved in safety auditing, but many managers had minimal involvement in rehabilitation programs and in developing safety systems. Some managers were responsible for non-specific aspects of safety such as coordinating safety and perceived that they had a general duty of care to provide their workers with a safe working environment. While positive, the notion of having a general duty of care is non-specific and often indicates a lack of hands-on involvement in implementing safety systems in the workplace.

Figure 15: Direct Health and Safety Responsibilities



4.3.4 Management perceptions about health and safety issues

One further question asked what managers felt were the main health and safety issues in the mine where they worked (see Table 6).

Table 6: Main Health and Safety Issues at the Mine

OHS Issue	Mentioned
Back injuries	7
Materials handling	5
Eye safety	4
Ageing workforce	4
Safety awareness	4
Lack of management commitment to OHS	3
Slips, trips and falls	3
Strains and sprains	3
Cultural problems/unhappy workforce	3
Housekeeping	2
Motivation	2
Noise and Hearing protection	2
Dust and fumes	1
Environmental control	1
Injuries caused by machinery	1
Injuries caused by uneven ground	1
Lost time due to injuries	1
Recurring injuries	1
Soft tissue injuries	1
Tooling condition	1

When looking at this Table, it must be remembered that no prompting was present on the questionnaire, and that these responses were unsolicited.

There are a general range of health and safety issues in the mining industry. Some of these were expected, because of their obvious impact on the coal mining industry or because of their frequency in day to day activities.

However, others, for example, lack of management commitment or the safety implications of an aging workforce, point to knowledgeable management faced with the reality of the workplace and the practicalities of safety in a dangerous occupation.

Further, managers showed a similar awareness when asked about the difficulties in dealing with health and safety (see Table 7).

Table 7: Difficulties in Dealing with Health and Safety Issues

OHS Issue	Mentioned
Lack of cooperation	8
Lack of senior management commitment to OHS	5
Lack of commitment to workers concerns	3
Cultural change	2
Need to incorporate safety into all facets of daily work	2
People don't wear safety specs	2
Resources	2
Dealing with root causes of problems	1
Individual perceptions	1
Interpreting the OHS Act *(Note: not the CMRA)*	1
Lack of awareness	1
No time for retraining or refresher courses	1
People don't think management is committed	1
The physical working environment is dangerous	1
Union resistance to compulsory use of safety equipment	1

Again, these responses were unsolicited, and seem to indicate that no one is taking responsibility for OHS particularly mine managers, undermanagers and other decision-makers such as safety officers and engineers. This may be a factor in the "conspiracy of complacency" discussed below in Section 5.3.5.

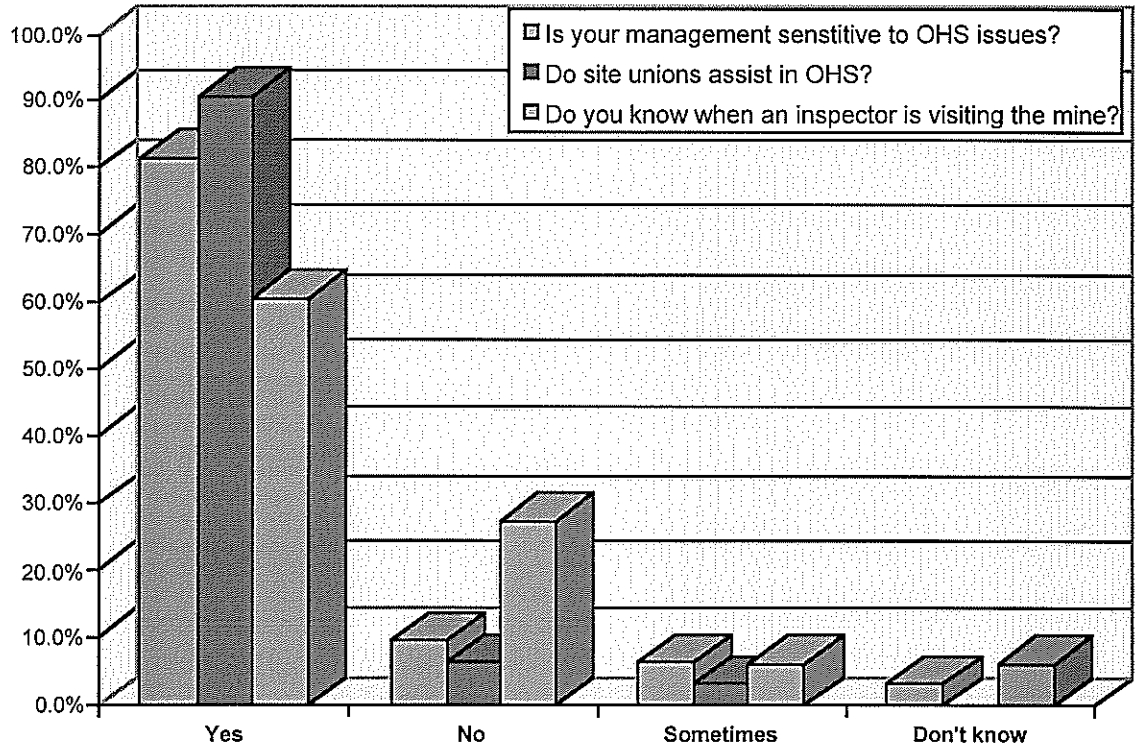
The uneven commitment to safety awareness is further explored in Figure 16, which examines management awareness of OHS issues.

This graph indicates that there is a belief that unions help with the improvement of safety. Interestingly, many managers believe that the unions are more committed to safety than senior management. In fact, in some interviews managers were privately cynical about the level of

commitment demonstrated by senior management and where relevant, "head office".

The results of Figure 16 also reveal that many managers know when an inspector is visiting the mine. Indeed, many workers could also tell when an inspector was coming, as there would be a flurry of activity to tidy the mine up and make it more presentable and observant of safety and protection policies. This is problematic and possibly indicates that some safety inspections conducted by mines inspectors will not be as efficient in identifying problems as unannounced visits would. For example, eye injuries may be endemic, but existing practices prevent them from being brought to the attention of the inspectorate.

Figure 16: Awareness of OHS Issues



Further questions asked about factors that affect the ability to deal with health and safety issues are shown in Figure 17.

The most important factors that affect managers' ability to deal with health and safety issues are shortage of staff, worker noncompliance with rules and time. It is revealing that production or financial restraints do not appear to be important issues that affect the ability of individual managers to deal with health and safety.

Managers were also asked to rank these issues into order of importance. This is shown in Table 8. Interestingly, 58% of responses ranked worker non-compliance with rules as first or second.

Figure 17: Factors that Affect Ability to deal with Health and Safety Issues

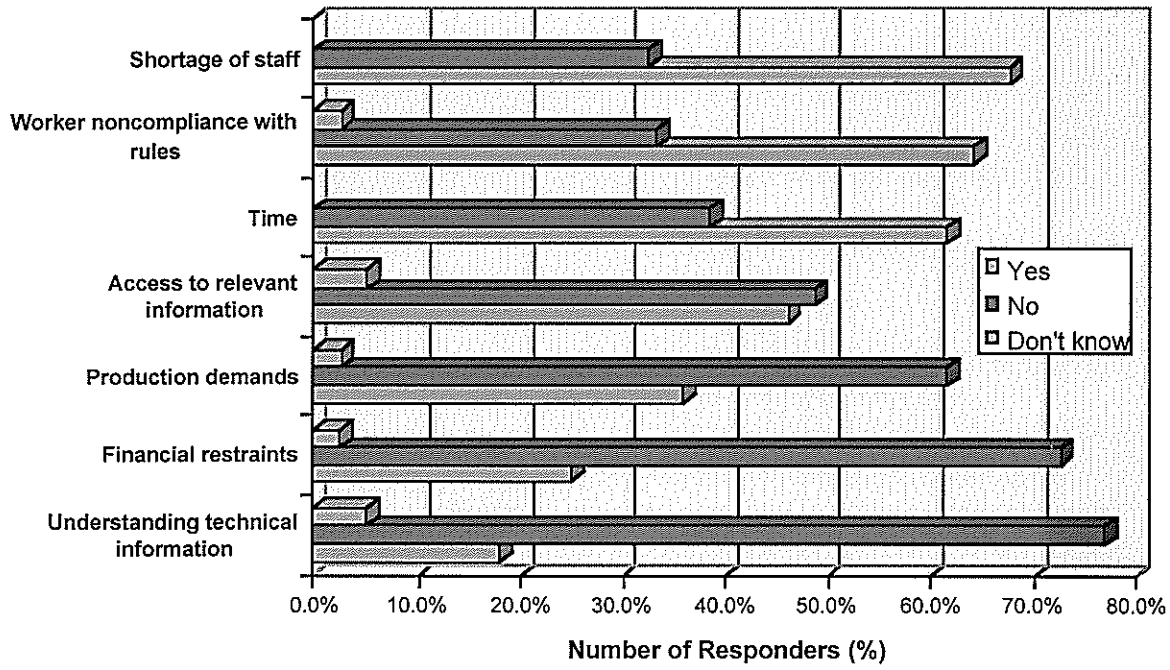


Table 8: Factors that Affect Ability to Deal with Health and Safety

Factor	Ranked first	Ranked second	Ranked third
Worker non-compliance with rules	1	1	7
Time	2	5	2
Access to relevant information	2	3	3
Shortage of staff	4	2	1
Production demands	5	3	6
Understanding technical information	5	5	4
Financial restraints	7	5	4

The belief that health and safety issues are significantly influenced by worker behaviour is notable, and permeates the health and safety literature on coal mining (see for example, Quinlan and Bohle, 1993; Dingsdag, 1993; Hopkins, 1995).

4.3.5 Management awareness of eye safety issues

The main control for eye hazards in coal mines is eye protection. This is a form of personal protective equipment (PPE), and indeed, PPE is used extensively in coal mines to protect workers against workplace hazards.

For example, helmets (head protection), safety boots (foot protection), ear muffs (hearing protection) and respirators (respiratory protection) are all commonly used in the coal mining process.

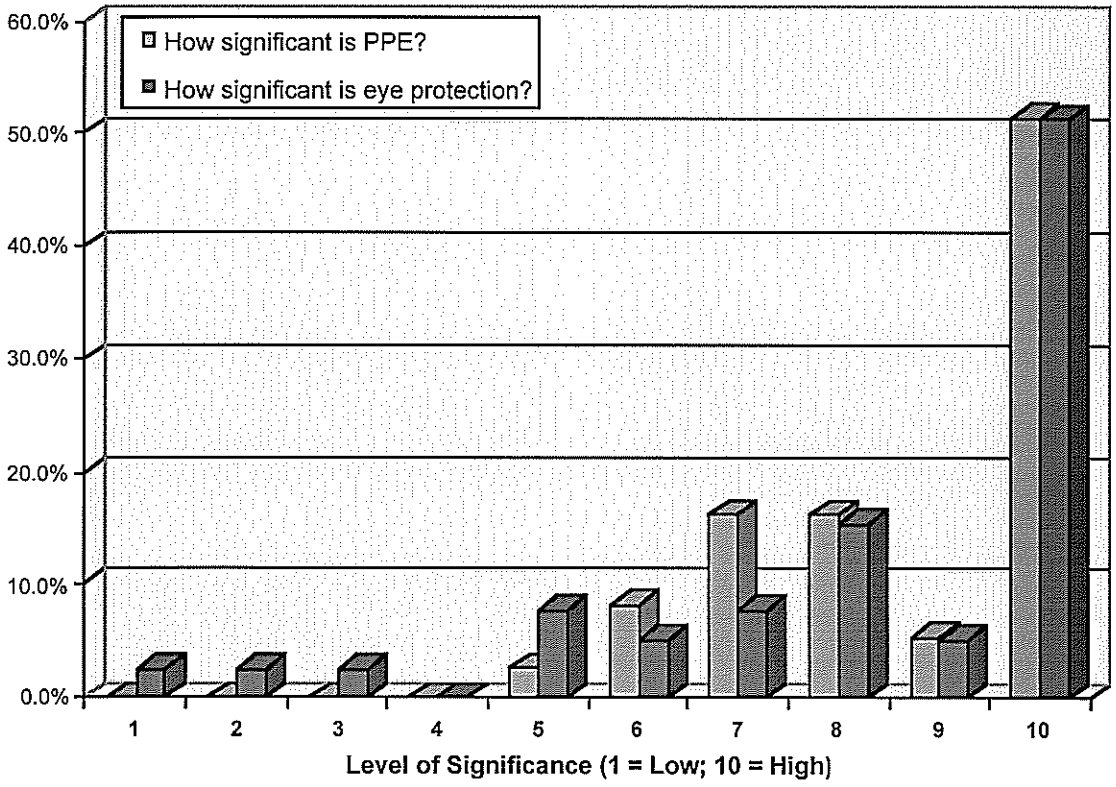
The management questionnaire explored issues related to the use of PPE by asking about the level of significance of PPE in coal mines, on a scale from one to ten. A second question was asked about eye protection. These results are shown in Figure 18.

It is quite apparent that managers consider that PPE is a highly significant safety issue, with no manager scoring less than 5/10, and over a half giving a score of 10/10.

It is also apparent that managers consider that eye protection is a significant safety issue, with only three managers scoring less than 5/10, and about one half giving a score of 10/10.

It is apparent from Figure 18 that eye protection is a significant issue, and that it is only slightly less important than personal protection.

Figure 18: Significance of PPE and Eye Protection in Coal Mines



Nineteen managers responded that they were personally aware of accidents involving personal protection. Where provided, details of specific accidents were:

- "chemicals under pressure";
- "struck in face with chain block using hammer and chisel" (2 reports);
- "roof bolting underground";

- "at night unclean or scratched safety glasses obstruct vision" (3 reports).

Some of the descriptions of PPE incidents reported above include PPE incidents with eye protection. A separate question sought data on this topic, and thirty managers responded that they were personally aware of incidents involving eye injuries. Where provided, details of specific incidents were:

- "dust, oil and particles in the eye" 17 reports;
- "roof bolting underground" (2 reports);
- "eye strain due to poor quality glasses" (2 reports);
- "falling particles";
- "welding flashes".

It is apparent that manager knowledge of incidents involving PPE (including eye protection) was quite high. This question was asked to gauge the interactions between incidents and use of PPE, but unfortunately, it was not precise enough to delineate a response such as:

- the incident would not have occurred if the worker had worn eye protection; or
- the incident occurred even though the worker was wearing eye protection.

This data is therefore not as useful as it could be, but serves to indicate that most managers are aware of incidents where PPE and eye protection are important factors.

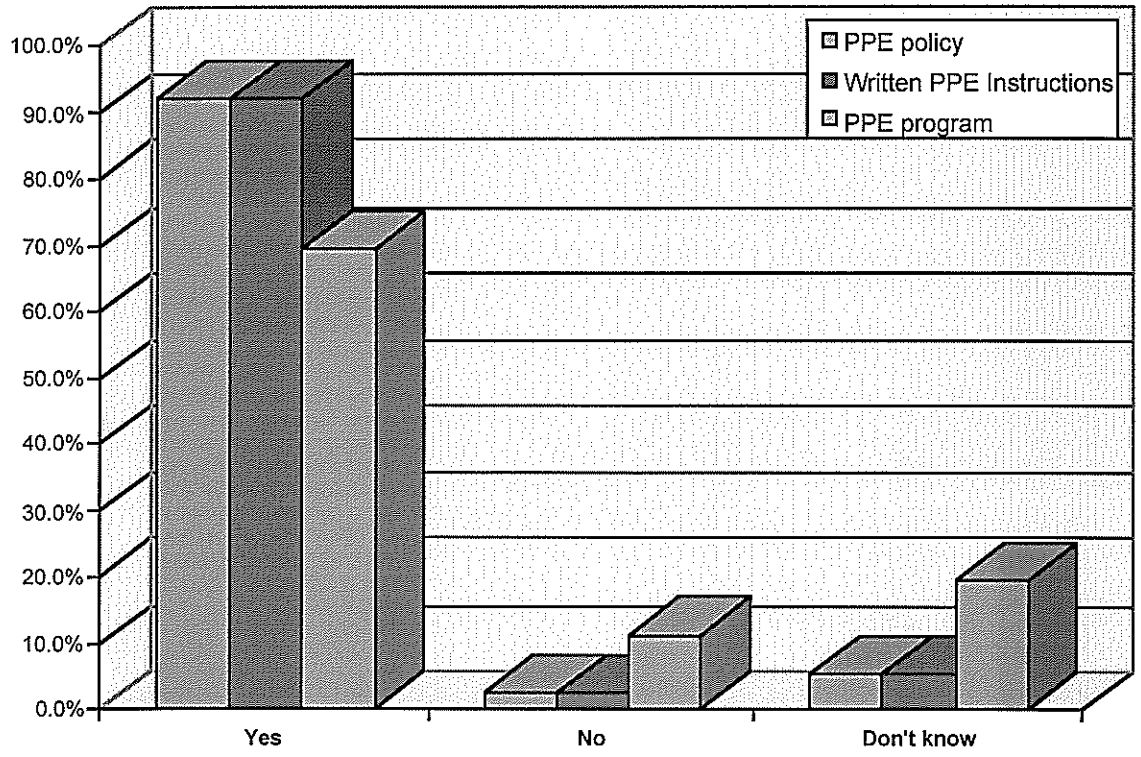
4.3.6 Policies and Programs for PPE

There are a range of options available for personal protection equipment in coal mines. These can be loosely described as

- nothing;
- a policy (suggesting a statement of intent, but not necessarily any formal procedures) but no program;
- written procedures (with or without a policy); or
- a formal program.

Figure 19 provides data on the availability of policies, written instructions or programs for personal protection equipment in coal mines.

Figure 19: PPE Policies and Programs



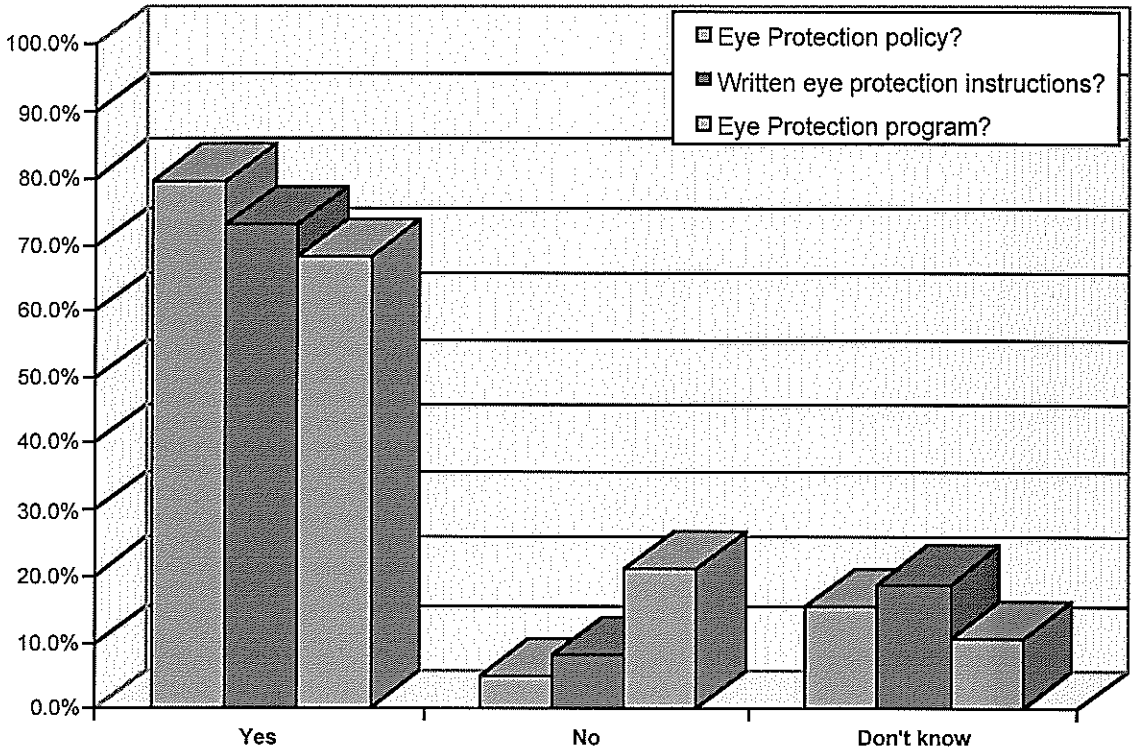
This data indicates that some form of PPE policy was available in over 90% of mines visited. This accords well with information from mine site inspections, where it was concluded that only two mines visited did not have any formal PPE activities. The Research Project Team are aware that this situation has changed in the two mines concerned at least indirectly because of the visit from the Team. However, 30% of coal mines did not have a formal PPE program.

4.3.7 Policies and Programs for Eye Protection

Figure 20 shows the corresponding data for eye protection policies and programs. The number of mines with policies and programs for eye protection was much less, in the range 70-80%. There was also a relatively high "don't know" response, suggesting that the real picture may be quite uncertain.

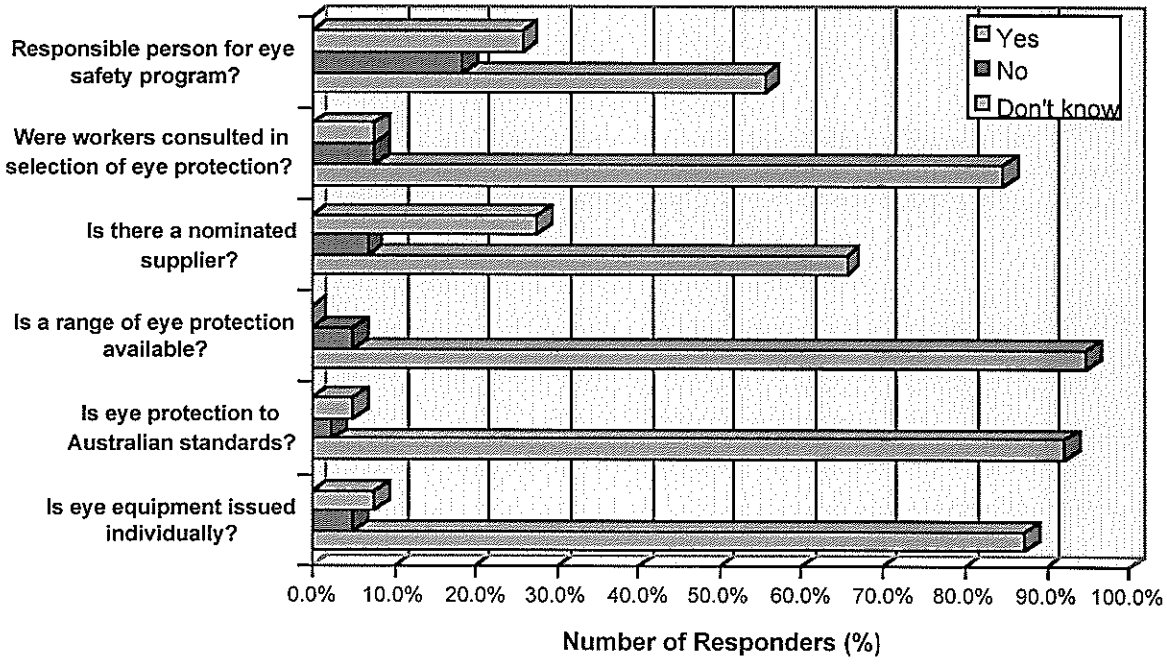
No formal assessment of these programs was made (for at least compliance with AS 1336) although it was apparent that their content was quite variable. However, it became obvious during the course of the research project that some of these programs were not adequate, in that they did not contain all the relevant components that the Research Project Team considered necessary for a well developed eye protection program, such as selection, range of choice, fit, use, maintenance, training and review.

Figure 20: Eye Protection Policies and Programs



Some questions were asked about some requirements of eye protection activities. These are shown in Figure 21.

Figure 21: Eye Protection Requirements



Generally, mine managers reported that they followed contemporary occupational health and safety practice, by consulting with workers,

purchasing safety eyewear to Australian standards and issuing equipment to individual workers.

Nominated Responsible Person: Only 55% of managers noted that their mine had a nominated responsible person for eye safety. This is an important finding, because technically, it would automatically form part of a formal eye protection program, and serves as a validation measure of the true number of formal programs.

Where nominated, the responsible person was indicated as:

- 27% nominated the Mine Manager;
- 27% nominated the safety coordinator and/or the safety committee;
- 9% nominated senior department heads;
- 18% indicated that individual employees were responsible;
- 18% didn't know.

From a safety perspective, some of these responses are unacceptable (especially the last two), and again serve to indicate the variation in attention given to eye safety in coal mines.

Selection of eye protection: Further information on the way in which eye protection was chosen also indicates the level of lack of formal procedures. This includes:

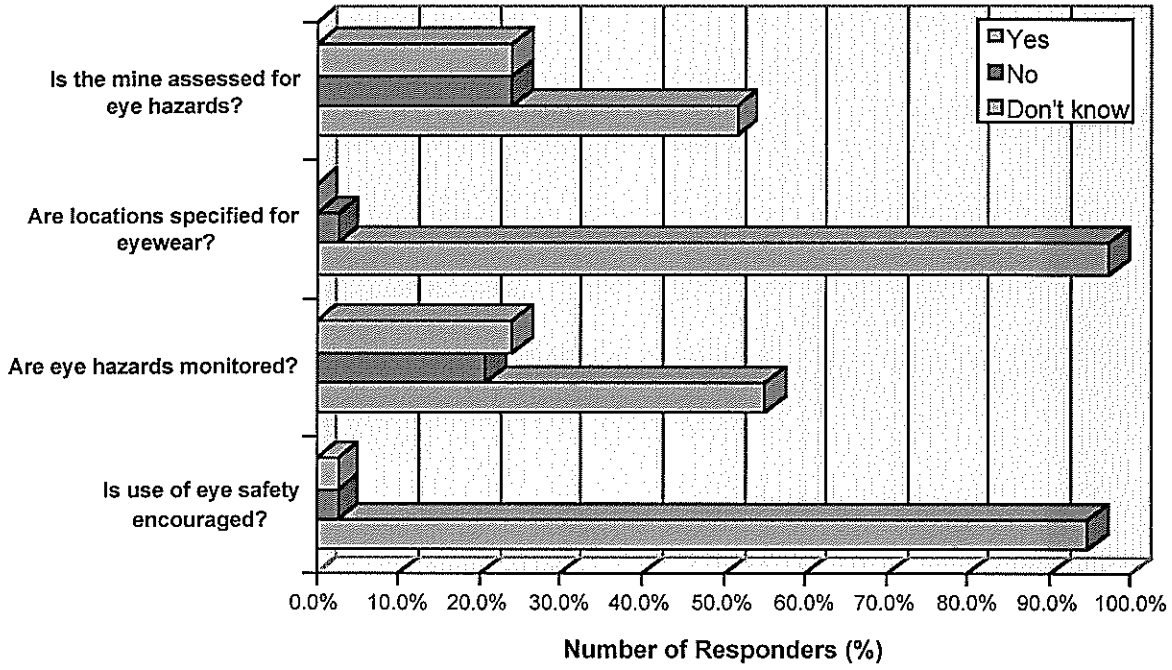
- 29% had no formal procedure;
- 2% stated "no choice, they get what they are given";
- 47% allowed their workers to choose their eye protection by personal choice;
- 7% noted "trials and consultants";
- 2% noted that eye wear was selected from material safety data sheets, and "the men had a choice";
- 13% indicated that "the safety committee selects from suppliers".

Obviously some of these responses indicate more rigorous attention to eye safety others. It is also clear that responses such as "no formal procedure, or "they get what they are given" would indicate that eye protection was not a high priority at that mine site, and that no formal program existed.

Standards: Only 15% of mine managers were able to specify at least one of the eye protection standards (AS 1336-8), with 71% noting that safety eye wear was purchased to "Australian standards" in general. While it is perhaps unfair to expect that mine managers would know all the Australian standards. regarding safety equipment, this is still a low percentage.

Further details about operational activities for eye safety are shown in Figure 22.

Figure 22: Eye Protection Programs: Operational Activities



Assessment for Eye Hazards: Only just over 50% of managers reported that assessment of the workplace was made to identify eye hazards. This is an exceptionally low figure, bearing in mind the importance of safety assessments in general, and the role of managers in the safety assessment process. A similar finding could be made for monitoring of eye hazards.

Location specific requirements for wearing eye protection: As already mentioned, the ways in which areas could be designated for compulsory eye protection varied from mine to mine. These areas could be specified as generic (for example all areas underground or past the bathhouse) or specific (for example, in at the face or in maintenance workshops). Therefore, it is difficult to evaluate the answers from this question.

Details of job locations for which eye protection was compulsory include:

- 27% entire mine site;
- 27% grinding, welding, chipping;
- 18% workshops;
- 18% according to specific rules;
- 3% when using hammers;
- 3% changing teeth on shovel, loader;
- 3% drilling.

Again, it is apparent that some mines have extensive areas where eye protection is required, while others designate specific locations. However, there is no doubt that this matter has been given extensive consideration (although not necessarily through a formal safety assessment process).

Encouragement: About 65% of managers reported that the use of eye protection was encouraged. Where stated, eye protection was encouraged by a range of means, including:

- 3% through posters;
- 3% from inspections/audits;
- 19% by awareness programs, posters, availability;
- 28% through crew talks;
- 41% through a compulsory policy.

The high proportion of "Yes" answers to "Is use of eye safety encouraged?" does not accord with what the Research Project Team observed during mine site inspections. It is probable that these responses reflected what was ideally hoped for rather than actual observance.

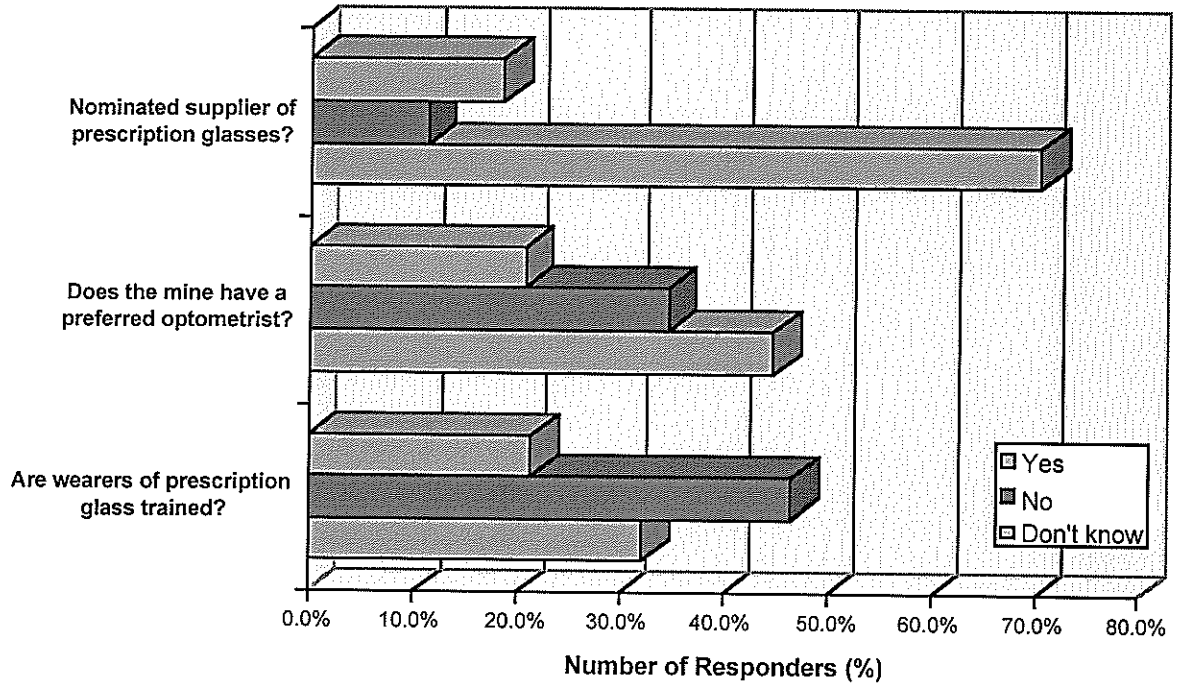
4.3.8 Prescription glasses

While eye protection programs target all workers, the issue of the worker who already wears prescription glasses needs to be included in an eye protection program, as they may wear prescription spectacles that do not protect against occupational eye hazards. Figure 23 shows issues relating to prescription glass wearers.

It was apparent that it was common practice in all mines for the mine to pay for the costs of some if not all prescription glasses. Many mines (71%) had a nominated supplier of prescription glasses, and over 50% had a preferred optometrist.

Virtually all such prescription spectacle lenses were made from non-glass materials, although the Research Project Team noted once or twice that glass lenses were present in some prescription spectacles. Each mine should consider as a formal policy that prescription spectacles with glass lenses should be prohibited from all mine areas. Similarly, the use of photochromatic lenses (lenses that darken in sunlight) should be discouraged, especially underground).

Figure 23: Prescription Spectacle Wearers



One problem requiring urgent consideration was the training of prescription spectacle wearers in eye safety. It was apparent only about one third of prescription spectacle wearers received training in the use of prescription spectacles *as safety glasses.* Further, the responses indicating the suppliers and optometrists as the provider of such training suggest that such training was informal or *ad hoc* at best. Of the 19/45 managers who identified the source of training for prescription wearers:

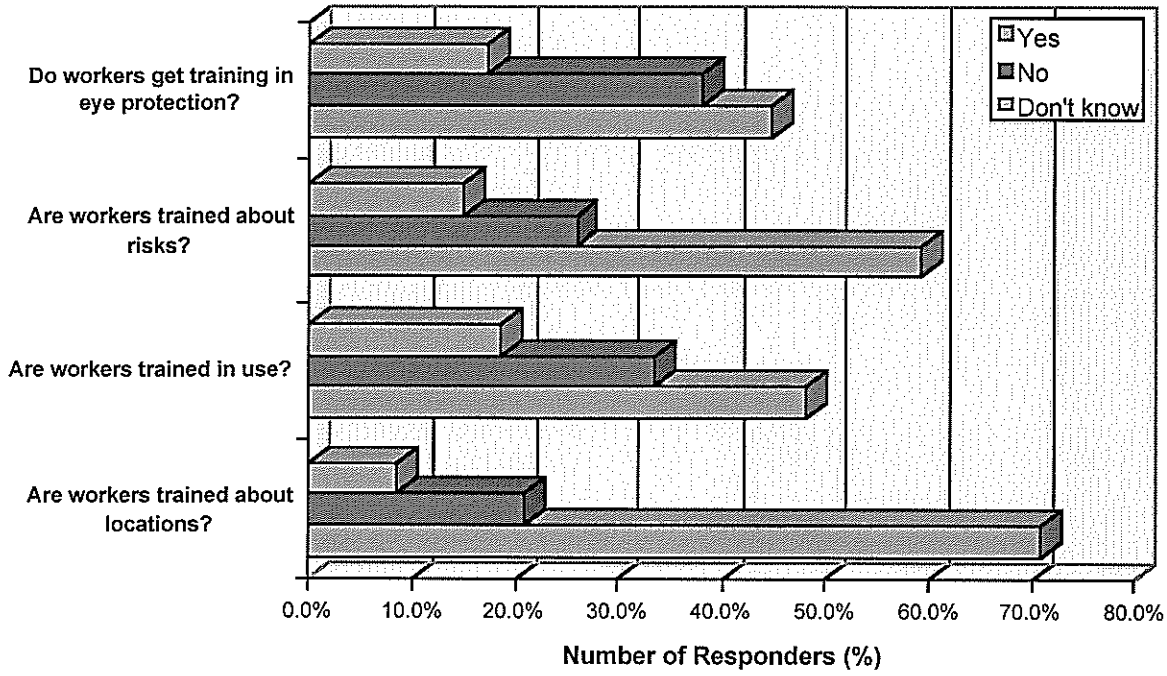
- 8 nominated "no-one";
- 6 nominated the optometrist or the optical dispenser (that is, someone outside the mine);
- 3 didn't know;
- 2 nominated their manager or the superintendent.

Consideration for the training of prescription wearers would need to be an important component of a training strategy for eye safety.

4.3.9 Training in Eye Protection

Training in coal mines is now a major part of normal day to day activities. Training in safety is also a major effort. The role that eye safety and eye protection plays in safety training is shown in Figure 24.

Figure 24: Training in Eye Protection



Eye safety does not seem to form a significant part of training programs, with less than half of the mine managers reporting that eye training is given. Other data (not shown in Figure 24), reports that most of this training is delivered through induction training. Eye safety training appears to be mainly aimed at giving mineworkers knowledge about the risks to sight and the eyes, and about locations where safety eyewear should be worn.

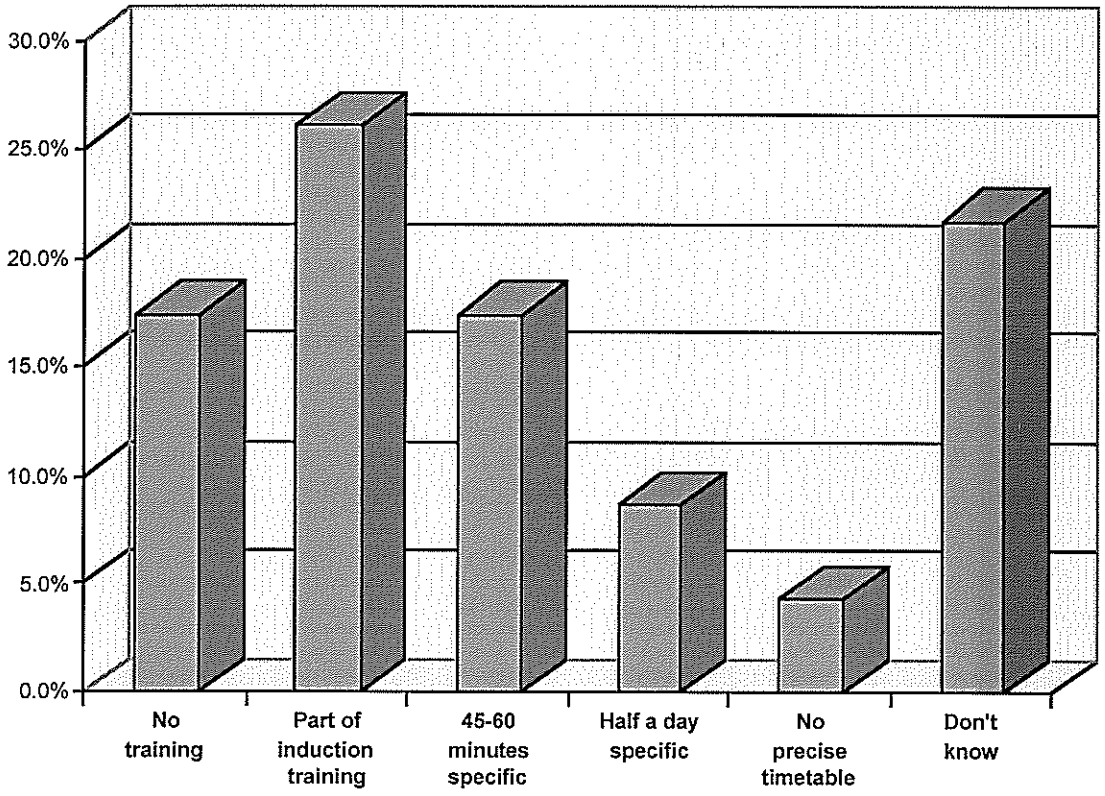
Providers of eye safety training were nominated by 25/45 managers:

- 5 didn't know;
- 4 nominated "no-one";
- 5 nominated the training coordinator;
- 9 nominated the safety officer or safety department;
- 1 nominated the undermanager;
- 1 nominated the "optometrist".

The Research Project Team also consider the handing out of eye wear without a training component on fit of eye wear is inadequate, and that more attention should be given to the proper use and fit of safety eyewear. Indeed, these are specific requirements of AS/NZS 1336.

The duration of such training is shown in Figure 25.

Figure 25: Duration of Training Sessions in Eye Protection



Only 6 of 23 mine managers who responded to this question were able to specify a time (45 minutes, 60 minutes, and half a day). All other answers could be considered as "none", suggesting that there are very few mines with specific training for eye protection, apart from inclusion in induction training and perhaps some on the job instruction.

Similar conclusions can be drawn from the eighteen responses that indicated the frequency of such training:

- 3 didn't know;
- 4 noted "no training given";
- 6 noted "once in the history of employment at the mine";
- 2 noted "twice in the history of employment at the mine" ;
- 1 noted "quarterly";
- 2 noted "annually".

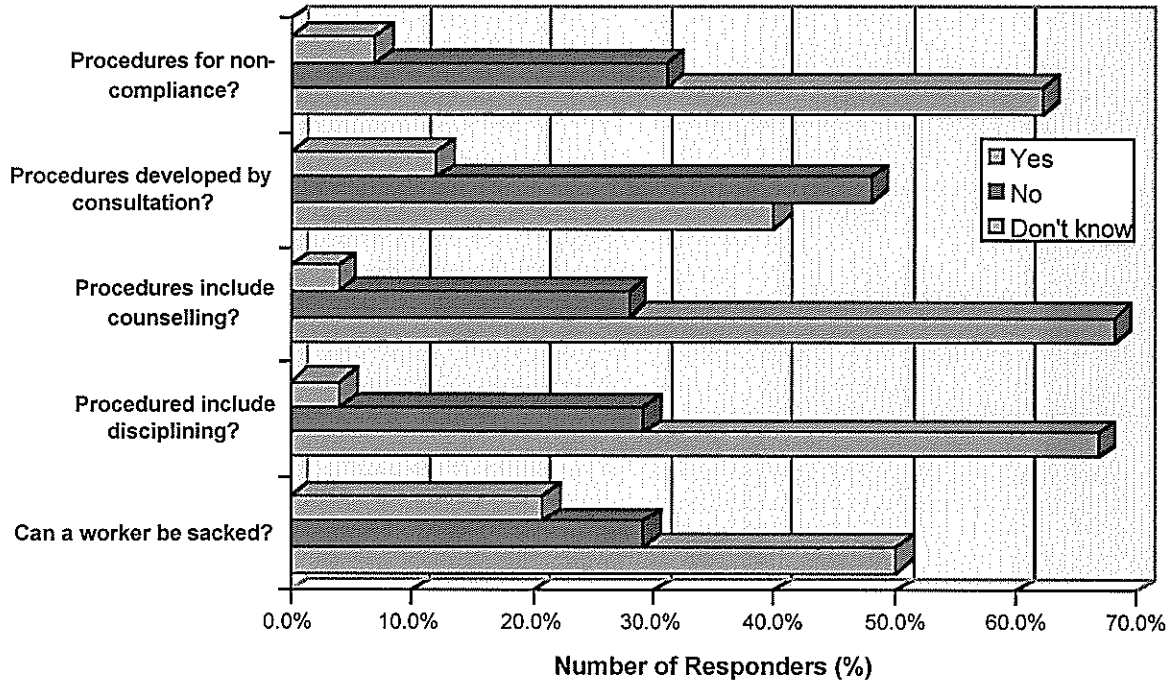
The last two responses also corresponded with mines who designated specific training sessions of a fixed duration.

It can be concluded from this data that while many mines report specific programs for eye safety, that training, which is an important component of such programs, is in fact, a formal part in only a few mines. This provides support for the concept that few eye protection programs are adequate for their stated purpose.

4.3.10 Enforcement of Eye Protection

Questions were also asked about the enforcement of eye protection programs. These data are shown in Figure 26.

Figure 26: Enforcement of Eye Protection



In interviews with mine personnel, the enforcement of the wearing of eye safety equipment was identified as a particularly troublesome issue. Some mine managers insisted that they had policies and procedures in place to deal with both non-compliance and more importantly, persistent non-compliance, including counseling and disciplinary measures. The concept of the "three strikes and you're out" approach was widespread, in which non-compliance (with all safety issues, not just eye safety) was common. This approach allows three levels of response, ranging from informal counseling, formal counseling (with record keeping), and disciplinary procedures (sometimes including termination of employment). However, it must be emphasised that these are procedures that have been developed, sometimes not in consultation with site union representatives, and their utility must be questioned as in some cases, they have not been enforced.

In other mines, safety personnel supported this finding, noting that while counseling and disciplinary procedures were in place, they were rarely invoked, and no-one could remember them being invoked for transgressions of any eye protection requirements. Most managers involved with compliance (safety officers, training coordinators and so forth) felt that using a counseling or disciplinary measure would be counter-productive, choosing to focus on encouragement in the short

term. This was supported by answers to the question: *Has anyone ever been sacked?* (under disciplinary procedures). There were no "Yes" responses, 71% of managers answered "No", and the remainder answered "don't know" or "no procedures".

The Research Project Team were of the view that the short term response of encouragement rather than punishment was the right course to adopt, although further attention to measures of compliance would allow better decision making on the appropriate response to choose when encouragement no longer works and compliance levels out or declines.

4.3.11 Review of Eye Protection Programs

The quality of data on review of eye safety programs was very poor, and can only be reported as raw data:

- 7 managers didn't know;
- 8 managers stated their eye safety procedures weren't reviewed;
- 9 managers noted their procedures were reviewed; and
- 4 noted "not applicable, no eye protection program".

A similar picture emerges from data on how often the program is reviewed:

- 2 managers didn't know;
- 1 manager stated their eye safety procedures were reviewed annually;
- 2 managers stated their eye safety procedures were reviewed monthly;
- 6 managers noted reviews were ongoing or during safety committee and supervisor audits; and
- 6 noted "not applicable, no eye protection program".

4.3.12 *Management Attitudes to Eye Safety*

The last part of the Management questionnaire asked questions which were hoped to tease out some attitude aspects of eye safety. For ease of interpretation, the questions are reproduced below, with their corresponding scores.

3.2 If you were in a situation where you were on your way to do something. Say you are going through the mine and you see one of the mineworkers doing something a bit risky with a piece of mining equipment. He's not wearing his safety glasses. He's been with you for years, he's good at his job. Which would you do?			
Reasons	**Yes**	**No**	**Don't know**
I'd be obliged to put a sign on the equipment saying that safety glasses must be worn when in use	**56%**	**40%**	**4%**
I wouldn't be obliged to do or say anything to him because he's trained and is good at his job and knows the risks involved.	**15%**	**81%**	**4%**
I'd be obliged to tell him to wear safety glasses.	**89%**	**2%**	**9%**
I'd be obliged to tell him to be careful not to get chips in his eyes when using the equipment.	**57%**	**43%**	**0%**
3.3 Just say you asked the guy to put the safety glasses on and he said he didn't find them comfortable. You'd already bought a few different types of glasses and none of them he liked. Which would you do?			
Reasons	**Yes**	**No**	**Don't know**
I'd be obliged to make him wear the safety glasses even though he thought they were uncomfortable	**85%**	**13%**	**3%**
I wouldn't be obliged to do or say anything. I'd fulfilled my responsibility and got him a variety of different safety glasses.	**7%**	**89%**	**3%**
I'd be obliged to ask him to buy his own safety glasses at his own expense. I'd fulfilled my responsibility and tried to find him safety glasses.	**8%**	**89%**	**3%**
3.4 Would you circumvent safety if production targets need to be met?	**0%**	**100%**	**0%**

The responses to these questions indicate that mine managers have a good appreciation of their occupational health and safety responsibilities. In all cases, at least 89% of responders provided the most effective answer to deal with the hypothetical situation outlined. The 100% "No" response to the question "Would you circumvent safety to meet production targets?" is most reassuring.

SECTION 5

DISCUSSION AND CONCLUSIONS

5 DISCUSSION AND CONCLUSIONS

5.1 Causes of Eye Problems in Mineworkers

The majority of managers and workers were aged between 40-49 years (38%) with 20% aged between 50-59 years. This aging work force in the coal mines has implications for the health and safety of the industry, particularly in relation to eye safety. With aging there are often changes of refraction in the eye lens which requires progressively more frequent attention to the care of the eyes and often frequent changes of prescription spectacles. People over the age of 40 are particularly vulnerable to failing eye sight due to lens (of the eye) refraction. Normal aging does not cause increased blurred vision or sensitivity to glare. But with aging there is an increasing incidence of pathological conditions/diseases of the eye which do cause increased light sensitivity and blurred vision, for example:

Increased blurred vision can be due to:	o	Cataracts
	o	Presbyopia (lens unable to change shape to allow close vision)
	o	Macular degeneration (the centre of vision is blurred)
Increased sensitivity to glare can be due to:	o	Cataracts
	o	Corneal damage (this may be worse in mines due to prolonged dust exposure)

The study of age realted effects in coal mining has not shown any specific problems (Butani, 1988), although Laflamme and Menckel (1995) have investigated age related accident risks in a range of industrial settings, and conclude that many of the safety problems are restricted to activities that are "age impaired". Age related accident problems can also be specific in terms of injury type.

5.2 Eye Protection Programs in Coal Mines

Section 2.3 outlined the eleven objectives of the proposal to the JCB HST. These were revised in the light of experience and subsequent discussion with the JCB HST to eight objectives for the final funded research project. These are individually discussed below.

5.2.1 *Current programs for the control of eye hazards*

Question 1

Is the eye protection currently issued adequate and whether for certain areas or job descriptions alternative audit control measures, workplace systems and design may be more appropriate to control eye hazards.

Methods

Questionnaire, site visits and discussions with suppliers and manufacturers of eye protection.

Results and Observations

The sole means of controlling eye hazards in the NSW coal mining industry is by eye protection equipment. This is not necessarily incorrect, but little thought has been given to controlling eye hazards through the hierarchy of controls (elimination, substitution, isolation, engineering controls, administrative procedures; and personnel protective equipment). For example, in most underground mines visited, the location of temporary lighting is placed at heights where it can contribute to glare.

One reason for this practice is that identification of eye hazards does not normally form part of routine safety audit procedures. Further, the perception of eye hazards in the coal mining industry appears to be limited to those that cause acute traumatic injury - it also tends not to address issues such as glare and poor vision.

In the past, safety has not received sufficient attention in any industry. The health of workers and the conditions they were required to work under was neglected, and workers had minimal rights regarding the conditions of their employment. This situation no longer applies, yet because the incidence of traumatic eye injuries is low, eye safety is not given sufficient attention. However, tramatic eye injury is not the only from of eye damage in coal mines.

If suitable eye hazard identification processes were used, a better understanding of the relative risks of eye hazards could be made, and more considered selection of suitable controls could be devised. With regard to the control of eye hazards, the hierarchy of controls should be applied. For example, the problems of lighting noted above could be improved substantially if electricians were trained to select and position lights and fittings which improved vision and minimised glare, rather than issue tinted safety glasses.

Australian Standard 1336 sets out the recommended practices on eye safety. With regard to the use of eye protection, the performance requirements for occupational eye protectors are set out in Australian Standards (AS) 1337, 1338.1, 1338.2 and 1338.3. In addition, eye protection for users of lasers is set out in BS EN 206 and 207. Eventually these will be taken up as AS/NZS 1338.4 and 1338.5 but, due to delays in the Laser Safety Committee, the timetable for this is not clear. In addition, the requirements for welding curtains are set out in Australian Standard 3957-1991. The use of these standards is intended to be industry wide and specific needs and applications to be assessed within each industry. In particular, AS/NZS 1336 gives examples of hazards, appropriate control measures and appropriate eye protection. A section on the use of these standards is attached at Appendix 1.

Discussion

In general, the use of eye protection in coal mines does not differ from non-coal mining applications. However, there seems to be a lack of awareness of specific eye protection issues in the NSW coal mining industry. Further, there are substantial regions of mine sites, such as workshops, where the eye protection required is essentially the same way as in non-mining industry workplaces as a whole. That is, the most common eye protection used will protect workers against most eye hazards.

The Research Project Team considers that eye protectors complying with AS/NZS 1337 and/or AS/NZS 1338 and selected and used in accordance with AS/NZS 1336 are appropriate and sufficient for the coal mining industry. Further, eye protectors with WorkCover NSW approval and used in the approved way are appropriate and sufficient for the coal mining industry. In particular, it should be noted that WorkCover NSW has not approved mesh eye protectors for any industrial applications. One area of concern is that there is some confusion about whether WorkCover NSW exercises jurisdiction in the coal mining industry, including issuing approvals for eye protection. The Research Project Team has not been made aware of any product approval scheme in the NSW Coal Mining Industry to parallel that of NSW WorkCover so that the possibility of selection and use of inappropriate eye protective equipment may exist. The information available to mine managers and safety personnel seems to be solely that provided by the representatives of the eye protection manufacturers and suppliers.

The Research Project Team also notes that the coal mining industry is not represented on Standards Australia Committee SF/6, which develops the eye protector standards, whereas NSW WorkCover is represented. While it is appreciated that JCB personnel may not have expertise in the matters of eye protection, they do have expertise in the working conditions and safety in coal mines. In general, committees such as SF/6 comprise three groups in very approximately equal proportions. There are the

manufacturers of eye protection equipment, the industry representatives of the users of eye protection (such as the JCB) and experts in eye protection (for example, NSW WorkCover).

Conclusions

Manager/worker awareness of the provisions of eye protection standards is low. This makes it difficult for the coal mining workforce to assess whether the available eye protection they have is appropriate to its needs.

Better systems of hazard identification and risk control should be developed to manage eye safety issues more effectively. One means of achieving these measures is to incorporate hazard identification procedures into routine safety audit processes. Another measure would be to have accountability built into incident and near hit reporting systems so that the reasons for eye injuries can be identified and acted on.

Further, selection of relevant controls needs to consider the hierarchy of controls.

There is an urgent need for the personnel involved in eye protection to be made aware of the provisions of the eye protection standards and to be the selectors of the appropriate eye protection for their work site. By definition, they are the experts in the risks and hazards of a mine site, not the eye protection suppliers.

Recommendation: It is recommended identification of eye hazards be included in routine safety audits, and that a wider definition of eye risks be used in the identification process.

Recommendation: It is recommended that in conjunction with the coal mining industry, the JCB develop a code of practice for the installation of lighting in coal mines (including temporary lighting).

Recommendation: It is recommended that specific areas of safety such as eye protection should be written into job descriptions for the entire workforce in order to foster a sense of ownership of safety systems and an involvement in the development of a safer workplace and work practices.

Recommendation: It is recommended that the JCB seek representation on Standards Australia Committee SF/6 to assist the committee in their work.

Recommendation: It is strongly recommended that safety officer/personnel involved with the selection and purchasing of eye protection/personnel distributing and fitting eye protection in coal mines should be made aware of the provisions of the eye protection standards.

Recommendation: The provisions of the eye protection standards should be included in all eye protection training programs.

5.2.2 Prescription spectacles and eye safety

Question 2

How issues such as wearing conventional prescription spectacles affect eye safety.

Methods

Questionnaire, site visits and discussions with suppliers of eye protection and members of Standards Australia Eye Standards Committees.

Results and Observations

It is noted from survey findings that a substantial proportion (47%)of workers are using prescription eye protection (see Section 4.2.4). This represents a considerable proportion and, given the aging of the work-force referred to in Sections 4.2.1 and 5.1, this trend is likely to increase. Prescription eye protection is not covered by Australian standards and the Research Project Team are not aware of any guidelines or requirements set by the JCB or the coal mining industry itself.

Although there is no requirement, it has become common practice for mine employers to pay for prescription spectacles, presumably to safety standards, for those workers who need them. In most mines surveyed, employers pay the total cost, but in a few others, where workers wish to obtain better quality or fashion prescription spectacles, a partial payment is made by the mine, covering the costs of standard frames and lenses.

The matter of selection and compliance with safety standards for prescription spectacles appear to be in the hands of assorted optometrists and optical dispensers who may have little or no understanding of the specific protection needs of coal mining workers. Consequently, the dispensing of prescription eye protection has developed to one of a total lack of control by the mining industry and reliance on a trust, which may be ill founded, in the skills and knowledge of its suppliers.

The Research Project Team is particularly aware of one instance, where an attempt to remedy the lack of industry control failed, because a coal mine safety officer approached the Optics and Radiometry Laboratory at UNSW for advice before this study was even conceived. In this case the safety officer had approached some practitioners, offered them familiarisation (not training in the formal sense) with the workplace and

directed workers to them. This enlightened approach was objected to by other practitioners in the locality. It is clear that education and training of vision care professionals in the needs of coal mining workplaces is required and the JCB should consider means by which it might require education and training before accepting practitioners as appropriate suppliers.

The setting of standards for industrial prescription eye protection is not a simple matter, however. As recently as 12-13 September 1996, Standards Australia Committee SF/6 completed the revision of AS 1336. This is likely to be issued before the end of 1997. In this revision, the committee has addressed the prescription eye protection issue by setting out guidelines on appropriate materials, dimensions and frames for prescription eye protection. It is noteworthy that this is an area in which Australia leads the world, even the International Organisation for Standardisation is only just beginning to address the issue. The deliberations of the Standards Australia committee are confidential and the contents of the draft standard are not yet public knowledge, but it is a strong recommendation that the JCB require that prescription eye protection used in the mining industry comply with those guidelines as soon as they are published.

The major problem with prescription eye protection is seen when the needs for eye protection are coupled with the need for glare protection and there may be perceived advantages in photochromatic lenses. At this stage, the only photochromatic lenses which comply with AS/NZS 1337 are glass. Photochromatic hard resin lenses do not lighten quite sufficiently to meet the requirement of 85% luminous transmittance in the light state. Glass is a markedly inferior eye protection material. In eye protectors with photochromatic lenses complying with AS/NZS 1337, the lenses must be a minimum of 3 mm thick. With prescription eye protectors, there has been, until now, no guidance on lens thickness and it has not been unusual to find glass lens thickness as low as 1.8 mm supplied into the mining industry. This is not adequate eye protection.

It is possible that AS/NZS 1337 will be amended so that the light state transmittance requirement will be 80% in line with the European Standards, towards which the Australian and New Zealand eye protection standards are likely to move in the next few years. This will permit photochromatic hard resin lenses to comply with AS/NZS 1337 provided they have a minimum centre thickness of 2.5 mm and minimum edge thickness of 2.0 mm.

There is no justification for the supply of any form of photochromatic lenses to underground workers. The rationale for supplying such lenses (or safety glasses) to drivers in open cut mines is a little insecure since the ultraviolet absorption of the windows and windscreens will prevent the photochromatic lenses darkening fully and the roof of a cab will reduce the UV incident by around 50% anyway.

One further point, is the problem of bifocal wearers and poorly positioned cap lights, referred to in Section 4.2.8.1 above.

Conclusions

A substantial number of workers in the coal mining industry require prescription spectacles. This tendency is likely to increase as the work force ages.

At present, there is no standard to which prescription spectacles can comply. Similarly, the issue of lens thickness is problematic.

This will change with publication of the new version of AS/NZS 1336, later in 1997. Once the new AS/NZS 1336 is published, issues of safety requirements for prescription spectacles and of appropriate thickness should be solved for the moment. It remains for the JCB to bring AS/NZS to the attention of the appropriate personnel.

The need for prescription lenses to be photochromatic should be addressed, even on an individual basis. The use of tinted clip on eye protectors, over their prescription eye protectors will often be the more appropriate solution for cab based workers. Their lower popularity is probably more due to appearance or lack of brand name or the necessity to carry another piece of equipment, more than anything else.

Recommendation: The JCB should develop guidelines on the use of prescription spectacles in coal mines.

Recommendation: The JCB should develop an accreditation program by which vision care professionals are assessed before they become preferred suppliers of eye protection equipment to coal mines.

Recommendation: It is strongly recommended that the JCB require that prescription eye protection used in the mining industry comply with the new version of AS 1336, as soon as it is published.

Recommendation: It is strongly recommended that the JCB prohibit the use of glass lenses for any eye protection wear and for prescription spectacles, in areas where it has been determined that eye hazards exist and eye protection is needed.

Recommendation: It is recommended that the JCB discourage the use of plastic photochromatic lenses in eye wear, particularly in underground mines.

5.2.3 Utilisation of eye protection

Initially, there were three questions, the Research Project Team sought to answer:

> *Is there a higher utilisation of eye protection in coal mines where compulsory eye protection policies exists?*
>
> *If the utilisation of eye protection is lower in mines with enforced or unenforced programs.*
>
> *Do mandatory eye protection programs work?*

At the time these objectives were formulated, the project team members felt these were separate issues. However, during the course of the investigation, it was found that these three questions actually cover the same issue, that is, compliance with eye protection programs. Therefore, they should be dealt with as part of an integrated discussion:

Question 3

What types of eye protection programs assist with compliance with eye protection?

Methods

Questionnaires and workplace visits.

Results and Observations

The level of utilisation of eye protection was difficult to establish from workplace visits because of the unique way in which workplace visits are perceived by mineworkers, and observational analysis by an outsider often changes normal activities. The project team cannot be certain that the intervention of their visit did not increase compliance with the factor being investigated. That is, when informed that researchers into eye safety were visiting the mine, workers chose to wear safety glasses, when normally they did not. This is a common problem experienced in many workplace investigations of this nature.

For example, when project team members were escorted by mine officials in underground mines, mineworkers observing the progress of the customary orange illumination from an official's safety lamp down roadways were seen in crib-rooms putting on helmets, and fumbling in pockets and crib-boxes to locate safety glasses. This does not necessarily mean that mineworkers were doing this for the benefit of the

project team member, but indicates that there is an "expected" level of safety compliance which may not be observed when officials, workplace safety inspectors or researchers are absent.

Discussion

With regard to the utilisation of eye protection in mines where mandatory, voluntary, or no eye protection programs existed, the project team concludes that compliance with eye protection is much more a product of a combination of the type of the eye protection program (mandatory or otherwise) and the mine's safety culture: That is, improved compliance was seen in those mines where management openly fostered a culture of cooperation. This includes:

- mineworkers and managers working together to supply the most suitable eye protection;
- discussion of safety issues at all levels;
- acknowledgment and implementation of mineworker suggestions;
- mineworkers and managers working out where and when eye protection should be worn;
- mineworkers and managers involvement in proactive activities to identify, remove or control eye safety hazards before accidents or near hits occurred.

Four examples illustrate this point:

- At an underground mine which did not have a written eye protection program, but where eye protection was made available on request, most mineworkers did not wear eye protection.
- At an underground mine where the mine manager noted that mandatory eye protection was part of managers' rules and included in employee contracts, he was insistent that compliance underground was "close to 100%". The project team were not allowed underground at this mine, but there was a strong impression from discussion with other personnel at the mine that the manager's claims of the workforce's compliance were untrue. This mine's management style was autocratic and non-consultative. Also, it was the practice at this mine to issue mesh eyewear and visors so that eyewear purchased was not to Australian Standards and this suggested a lack of attention to detail in safety matters.
- At one open cut mine with a mandatory eye protection program and a cooperative safety culture, project team members observed almost all mineworkers wearing eye protection. Further, the level of detail to housekeeping and attention to other safety matters at this mine was by far the greatest seen in all mines visited during the project. Again, this serves to suggest that safety culture and

management style are important in fostering a safe working environment.

- At one underground mine with a voluntary eye protection program, and a cooperative safety culture, project team members observed the highest degree of compliance with eye protection. Again, attention to detail in safety matters was high at this mine. For example, this mine was the only site visited that put project team members through a safety induction session before going underground.

These four examples suggest that both management style and a cooperative environment are important factors in encouraging compliance. However, there was no evidence of a high level of compliance in mines where mandatory eye protection programs existed, in the absence of a cooperative environment.

Conclusions

Mandatory eye protection programs alone do not work.

Utilisation of eye protection is a function of both management style and safety culture.

Utilisation of eye protection programs will work providing that both management style and safety culture can be optimised.

Recommendation: It is recommended any mine wishing to improve eye safety should introduce eye protection programs based on a cooperative approach.

5.2.4 Enforcement of eye protection programs

Question 4

How should eye protection programs be enforced?

Methods

Questionnaires and workplace visits.

Discussion

Enforcement of eye protection is a difficult issue. Mine managers have an absolute legal obligation under CMRA and OHSA to enforce safety, and it seems logical that means such as managers' rules or incorporation of

safety into mineworker employment contracts or enterprise bargains is a useful way to meet those obligations. However, as noted above, managerial prerogative by itself is not an effective enforcement approach, as it needs to be integrated with other workplace systems.

Three examples illustrate this point:

- One underground mine introduced a mandatory eye protection policy in the early 1990's. Compliance was good for about two days, but when mineworkers did not put on their eye protection and were not cautioned, levels of noncompliance were so high that deputies and safety personnel abandoned attempts to caution workers, and by the end of about a week the program had failed completely.
- At another underground mine one mineworker noted that he did not see any reason for wearing his eye protection when he saw none being worn by the mine manager when underground.
- At another underground mine, the working group established to develop an eye protection program found that when methods of enforcement were discussed, some mineworkers insisted that they would always disregard instructions to wear eye protection (one mineworker went so far as to obtain a doctor's certificate stating that he could not wear safety glasses for medical reasons). The working group then changed the policy to where workers should have the eye protection on their person, for example on a cord around their necks or in a pocket. This meant that when performing a task which required eye protection, the worker just had to put it on.

  While this approach did not necessarily assist with enforcement directly, it did raise awareness of eye safety and increased compliance with eye protection and safe working. Because of this increase in awareness, mineworkers did not only expect to be prompted by safety officers and deputies, but also by their colleagues. Compliance rates at this mine were high, and continued to increase as workers became aware of the benefits. Project team members felt that at this particular mine, opposition to wearing eye protection was genuinely being changed and the traditional antipathy between management and workers was diminished. Note that the high rates of compliance were achieved because of cooperation across the entire work force and management structure, and not because of disciplinary or punitive measures.

Again, these examples suggest that both management style and a cooperative environment are important factors in encouraging (not enforcing) compliance.

Conclusions

Managerial prerogative alone is not an effective enforcement approach.

While incorporation of safety compliance in employment contracts or enterprise bargains provides a basis for management to insist on and enforce safety compliance, again, these measures will not be effective by themselves.

Emphasis on increasing compliance through non-punitive and cooperative approaches will be more effective than punitive or disciplinary approaches. While this could be interpreted as an abrogation of the managers' statutory responsibility to enforce safety, in fact the manager determines how such obligations are to be met, and there is no reason why a cooperative approach could not be used.

Recommendation: It is recommended that any mine management wishing to improve eye safety should demonstrate commitment to eye protection programs through a formal process of development and implementation and by complying with their requirements .

Recommendation: It is recommended that any mine management wishing to encourage eye protection compliance should implement non-punitive and consultative approaches.

5.2.5 Other problems of eye protection

Question 5

Whether there are any other observable problems due to the wearing of eye protection? (If so, to identify such problems and design suitable alternative workplace strategies and systems).

Methods

Questionnaires and workplace visits.

Results and Observations

Given the problems related to selection and specification of appropriate eye protection, which are dealt with elsewhere in this report, the only major issue encountered was the widely held opinion that wearing non-prescription eye protectors can, in some way, damage or harm eyes. This opinion pervades the mining industry and was even heard expressed at one meeting at the JCB itself. This erroneous opinion is not confined to the coal mining industry.

Discussion

There is no possibility, not even a remote one, that the wearing of lenses, including non-prescription eye protectors, can damage or harm eyes. Even the wearing of incorrect prescription lenses by an adult cannot lead to damage to the eyes. Vision may be blurred and/or uncomfortable and/or double while wearing the lenses, but the eyes are not damaged. There is no physiological mechanism by which any such problem can ever be contemplated. Some complainants point to the lack of longitudinal studies by which to allay their concerns. Few, if any, research funding bodies will grant funds to investigate what they view as blatantly obvious.

There is an unambiguous statement contained in AS/NZS 1336-1982 which is repeated in the draft AS/NZS 1336-1996;

> "*The long term use of eye protectors which meet the requirements of AS/NZS 1337 and AS/NZS 1338 Parts 1, 2 or 3, and which are selected and fitted in accordance with this Standard (AS/NZS 1336), will not harm or weaken the eyes of the wearer.*"

and later

> "*Particular attention should be paid to any reported objections to the wearing of eye protectors. Some employees may believe that the wearing of plano eye protectors for prolonged periods can accelerate the need for vision correction or that they cause headaches. Tradesmen, in particular, may feel that the requirement to wear eye protection constitutes an adverse reflection on their trade judgment. Complaints may be made about restriction of vision, fit, pressure or weight. It is worthy of note that similar complaints are not made about sunglasses , as the requirement for the optical quality of sunglasses (see AS 1067.1) and industrial eye protectors (see AS/NZS 1337) are equivalent. Selection of appropriate eye protectors with pleasing style, comfort and fit may remove some objections.*

The standard also suggests an adjustment period.

Before the wearing of eye protectors is made compulsory for a particular task or risk area an adjustment period should be considered for inclusion in an eye protection program. A person wearing eye protectors for the first time, in particular eye protectors of the spectacle type, may require a period of adjustment and therefore should be informed of what to expect. Vertigo on walking downstairs, "drawing of the eyes" and headaches are typical but usually relatively short-lived symptoms. Attention should be paid to the fit of eye protectors as headaches can be caused by ill-fitting eye equipment.

At no stage has the Research Project Team been made aware of any training available in the coal mining industry on the selection and fitting of occupational eye protection. While the Team was issued with eye

protection when going on to sites, at no time was the fit assessed or checked.

The reluctance to wear eye personal eye protection does underscore the importance of considering control and/or non-PPE procedures first.

Conclusions

The wearing of occupational eye protectors may be resisted. The above objections are spurious and will be reduced by appropriate procedures on selection and fit. There is a need for the selection and issuing of eye protectors to be the subject of some training for mine staff.

Recommendation: The JCB (or any mine manager) can, if it wishes, make the categorical statement that that the wearing of lenses, including non-prescription eye protectors, will not damage nor harm eyes.

5.2.6 Current eye protection practices in the NSW Coal Mining Industry

To describe current eye protection practices and policies in coal mines overseas and in other parts of Australia and to compare such practices with NSW, with the aim of identifying suitable bench marks.

The observation of overseas practice, as part of this particular objective was not funded as part of research award granted by the JCB HST, and therefore a comparison with overseas practices was not conducted. Therefore, the project team modified this objective to:

Question 6

Describe current eye protection practices and policies in coal mines in NSW and Queensland, with the aim of identifying suitable benchmarks.

Methods

The identification and description of current eye safety practices that could be used as benchmarks were carried out by a survey of the published literature, by analysis of questionnaires and through mine site interviews and inspections.

Results and Observations

A benchmark is defined here as a policy or practice which leads to better standards of eye safety in a coal mine. The project team observed a range of benchmarks including:

- Open and expressed commitment of all levels of mine management, as well as head office management, to eye safety.
- Incorporation of eye safety matters into management meeting agendas.
- Incorporation of compliance with eye safety programs in managers' rules.
- Incorporation of compliance with eye safety programs in enterprise bargaining.
- Incorporation of compliance with eye safety programs in employee contracts.
- Development of appropriate consultative mechanisms that allow mineworker input into the design, development, implementation and review of eye safety programs, so that ownership of such a program belongs to all workers and management.
- Establishment of a specific consultative working group or committee of workers and management to develop an eye safety policy and program.
- Audit systems to undertake specific mine site safety assessments to identify eye hazards and risks.
- To adopt the hierarchy of controls in controlling or preventing exposure to eye hazards.
- Training of all mine management and mineworkers to familiarise them with the:
  - range of eye hazards in mines,
  - reasons for eye protection, and
  - selection, fit, use and maintenance of eye protection equipment.
- Designation of locations and tasks where eye protection equipment must be worn.
- Selection of suitable eye protection equipment designed to relevant Australian standards and approvals.
- Availability of a range of safety eyewear of different types that workers can trial and choose, and replacement of safety equipment.
- Availability of specific eye protection for specific eye hazards (goggles, face-shields, airstream helmets, and so on).
- Mineworkers who wear prescription glasses should have eyewear supplied, which have been designed to specific safety performance requirements.

- Availability of cleaning solutions and anti-fogging solutions at locations where they are needed.

Discussion

Benchmarks in safety are those practices which lead to a step increase in safety performance. The project team members obtained a number of useful concepts from the published literature and observed many different approaches to improving eye safety during mine visits.

The benchmarks listed above were common features of programs at a number of mines which were attempting to deal with eye safety issues. However, the scope and content of the eye protection programs that the project team members saw were many and varied. Many of these were not useful on their own, but, as noted above, had a part to play in a total program.

One further rationale for the identification of benchmarks in eye protection and eye protection programs in coal mines was to standardise eye safety practices across the coal mining industry. Therefore, one final benchmark, is the need for standard industry wide eye protection policy, program and practice. Such a program is outlined in Appendix 4.

Conclusions

The steps taken to improve eye safety in coal mines need to be organised into a standard eye protection program.

In the opinion of the Project Team, the major objective of these benchmarks and this program is to create a climate which allows the existing safety culture to change to one that accepts eye safety as part of safe working practices.

As a separate but crucially important and related issue, mine managers obtain their professional expertise through relevant accredited mining engineering qualifications and long experience. The accreditation process also includes a thorough knowledge of the CMRA and mine safety. However, the project team members felt that knowledge was too narrowly focused on enforcing the legislative requirements of coal mine safety, and too little on contemporary concepts of occupational health and safety, and safety management. For example, mine managers have extensive knowledge about the hardware of safety, but are dismissive of such procedures as consultative mechanisms and management styles, or the importance of peer group pressure regarding adoption of safety practices by workers.

Similarly, mineworkers often know the recommended safety procedures, and it is more a matter of identifying key individuals or informal leaders in

the worker network. Such individuals need to be targeted for getting support for safety initiatives. Therefore, compliance with safety systems is both a "top down" (management driven) and "bottom up" (worker supported) process.

Recommendation: The introduction of an eye safety program into a coal mine is best achieved through the steps of management commitment, establishment of management/worker consultative processes, and the development of a eye safety policy with development and implementation of an eye safety program.

Recommendation: Development and implementation of a properly constituted eye safety program is essential to change poor safety practices or inappropriate safety cultures.

5.2.7 Evaluation of eye protection equipment in use in Australia

Question 7

To evaluate eye protection equipment currently in use in Australia and, if necessary, develop eye protection designed specifically for the NSW and Australian coal mining industry.

Methods

The Research Project Team has obtained some samples of eye protectors and have discussed the issues of eye protection in coal mining with most of the companies in Australia. These include (main contact(s) in parenthesis):

Protector Safety	(John Higginson and David Yeomans)
Uvex Safety	(Stephen Streitfield)
MineSight	(John Moore)
Industrial Eye Safety	(Bob Williams)
Alsafe	(Pat Larobina)

The Research Project Team has also observed and discussed work conditions and have the results of the questionnaires. The issues will be addressed as those specifically affecting underground mining, those specifically affecting open cut mining and those which are the same as non mining sector eye protection issues.

Results, Observations and Discussion

Issues in underground mining

As a result of the discussions with mine personnel and eye protection personnel and our own visits, it is clearly the situation that dust is not a major hazard, and is well controlled by the damping down processes, particularly in long wall mining. This fulfills the more important aim of safe working, that of avoiding the hazard by control methods.

What is clear, from the same sources of information, is that fogging is a substantially greater problem and in active need of solving.

Fogging is caused by warm, moist air condensing on the colder surfaces of glasses. In warm environments this will occur on the outside of the lens, but if the micro-environment between the face and the lens is hot and humid (for example during strenuous work) then fogging can also occur on the inside of the lens. Most glasses comprise a single thickness lens. Therefore the propensity for fogging is determined by the thermal conductivity of the lens material, the thermal gradient (from the back to the front of the lens) and conditions such as temperature and humidity.

Fogging is also linked to wearing of dust masks and some respirators. The wearing of the mask, especially if not properly adjusted to the contours of the nose and cheeks, tends to direct warm moist air up the face, which gets in behind the spectacle-type eye protector. This causes much of the fogging reported by mineworkers.

There are a number of matters in progress, initiated or facilitated by the Research Project Team and other matters which deserve consideration.

1. Goggles generally are not a popular option. They have the advantage that, in a double glazed form, with a coating on the inner most surface, fogging can be minimised. The technology is little different from ski goggles which are more readily accepted (albeit by skiers). On the other hand, goggles are considered cumbersome, awkward and claustrophobic.

2. Integrated helmets, respirators and visors have also been considered. The Racal Airstream helmet was seen in use in some mines for selected applications. The combination of a filtered air circulation and visor set further from the face reduces fogging considerably. However, the helmet is bulky and can be cumbersome to wear, and the lifting of the visor is problematic due to the location of the cap lamp. Therefore, such helmets do not have much acceptance for general use. Its cost would also probably preclude multiple purchases. A more modern system has been seen in the UK and the Research Project Team is in the process of purchasing the "Max Miner" integrated helmet from Centurion products in the UK, which combines, eye, respiratory and

noise protection. The team has also seen a helmet made in New Zealand for other purposes which may be easily adapted to mine use including some air circulation. Cost, weight and bulkiness are significant barriers to acceptance and use of such equipment.

3. Face masks and respirators. There are two issues, one of which may assist in reducing fogging due to expired air leaking around the edges of respirators and fogging safety eyewear:

   - masks could be redesigned to facilitate better accommodation with face shape. This includes the use of double valve masks and masks with a looser weave. The possibility of edging with open cell foam could also be considered;
   - while the technical properties of a mask or respirator are in the hands of the manufacturers, the way in which they are worn is in the hands of the user. In some cases, poor or improper fit can cause or aggravate fogging, which can be eliminated by correct use and fit. Therefore, in workplaces where masks are handed out without any instruction, some attention to selection, use and fit in informal "toolbox" training sessions would assist in alleviating this problem.

4. Anti fog coatings. There are a number of problems in this area at present:

   - there is no standard in use in Australia that outlines provisions for reducing fogging. European Standard EN168 contains provisions for fogging, but these are unlikely to be included in Australian standards for eye protection until at least their next revision;
   - there is no facility in Australia to assess the fogging of eye equipment. In European Standard EN168 there is a method of assessing fogging but there is a specific caveat about using the test for comparative work. The reasons for this caveat is not known and the advice of Dr E Sutter of PTB in Germany is being sought. The JCB HST has approved the redirection of funds from the Project's original dust test proposal for the purchase of construction of suitable equipment so that the problem of fogging can be assessed, albeit to an overseas standard;
   - anti-fog surface treatment processes are notoriously temporary. In general the process of anti-fog treatment involves the deposition of a hydrophilic coating on an otherwise hydrophobic lens. Hydrophilic materials are substantially less mechanically stable than the lens surface and are easily removed. In addition to improving anti-fog performance, manufacturers have been trying to make more stable surfaces. Most recently the Research Project Team

observed prototype anti-fog new generation eye protectors from Uvex issued to personnel at Wyee and Ulan collieries. These were pronounced a most marked improvement on anything that had gone before. The production version is now available and appears on initial inspection to be a substantial improvement. However, as yet, there is no Australian standard for fogging, and no testing equipment to measure anti-fog performance to overseas standards;

- anti-fog solutions are even more temporary. Even the solution said to be most effective (supplied by MineSight) is only claimed to be effective for one hour. This is virtually useless in workplace situations, as continual application is time consuming and likely to be abandoned. This is further exacerbated by the non-availability of cleaning materials (solutions and cleaning tissues) underground, or at least, in crib rooms. These materials were observed on or near the surface but were not observed regularly by any of the Research Project Team at the face underground, where they are needed.

5. Mesh spectacles and goggles have been sold into the mining industry (colloquially called "blowfly glasses"). Some claims of compliance with AS/NZS 1337 Occupational Eye Protection have been made by the supplier, but these are false. Mesh eye protectors in the form of face shields with an optical insert are permitted in the standard, no other mesh eye protector is permitted. Since the responsibility of WorkCover NSW and its product acceptance program does extend to the coal mining industry, such eye protectors, which would not be acceptable in other industries, have been allowed to be supplied and worn.

   The concerns with mesh eye protectors may be summarised as follows:

   - while large particles are prevented from reaching the eyes, small particles are not;
   - mesh eye protectors may not provide adequate protection against other hazards. In particular, broken hydraulic lines discharging high pressure fluids constitute a severe risk;
   - there is an impediment to clear vision presented by the mesh;
   - there are no performance standards for mesh eye protectors and there have been no independent validation of claims of performance.

   The advantage of mesh is very obviously that it does not fog. It can be argued that the low light levels of underground mining mean that pupils of the eyes are large and the effects on vision are smaller.

However, the ratio of pupil size to mesh aperture is a reasonable measure of the ability of a mesh to degrade vision. Further, the aging of the mining work force means that the workers will become more and more affected as their pupils become increasingly fixed at smaller and smaller diameters.

A draft European standard on mesh eye protectors has been released for comment. It is also likely that Australian Standards will become progressively more aligned to the European Standards which have become, in the absence of IS0 international standards, *de facto* international standards. There is some pressure from the forest industries for the inclusion of mesh eye protectors in Australian Standards provisions. Standards Australia Committee SF/6 would also appreciate the advice of the coal mining industry in such matters.

In the meantime, it is recommended that if mesh glasses can not be prohibited, the JCB HST issue some kind of guidelines on the acceptability and use of mesh eye protectors (based on the provisions of the draft European Standard). This will also require very clear instructions on the circumstances in which mesh eye protectors are to be permitted (if at all).

6. Alternative designs for eye protection which will not fog are being considered. The most notable is the preparation of a prototype double glazed spectacle. As indicated previously, double glazing in goggles is a successful anti-fog measure and this might be transferable to spectacles. The success of double glazed goggles may be put down to a number of factors:

   - warm moist exhaled air is diverted from the lens area;
   - the major problem of warm moist air separated from cold air by a single thickness lens. The thermal conductivity of the lens material as well as the thermal gradient (from the back to the front of the lens) will determine the propensity for fogging. The effect of double glazing is to interpose a poorly thermal conducting air interlayer so that the inner surface is maintained at a temperature closer to the retained air and, if possible, the temperature is above the dew point of the semi enclosed air behind the lenses;
   - the development or adaptation of a successful method of assessing anti-fog treatments is vital to the evaluation of such a product.

Issues in open cut mining

There are three issues which appear to be particularly evident in the open cut mine sites

1. **Glare:** There are a significant number of problems related to glare during daylight working. These are due to workers driving heavy machinery in cabs. Universal eye protection policies require the drivers to wear eye protection while in the cabs. To a certain extent there are no risks while in the cabs but the requirement to wear them is part of the attempts to ensure wearing outside the cabs. It is suggested that the provision of a selection of sun glare eye protectors complying with AS/NZS 1337 will give a positive inducement since the incentive of glare reduction means that eye protectors will be worn. It is not sufficient to provide sunglasses (which may comply with the Sunglass standard AS 1067) since they may not provide the necessary physical protection.

2. **Fogging:** This occurs when moving from an air conditioned cab to the outside. The Research Project Team is not aware of any method of avoiding this. It is not self evident that anti-fog treatments help in these circumstances. One immediate answer may be to set the air conditioner temperatures to more temperate levels. However, this is regarded as a transient problem, because such condensation usually evaporates quickly.

3. **Glare at night:** The Research Project Team is aware of a number of complaints about glare from lighting installations both related to this study and for some years. The team is also aware of drivers wearing sunglasses in these circumstances, and of difficulties in making the transition from the well lit mine site to the unlit roads outside the site.

   This is clearly due to a lack of design with the lighting installations and the solution lies in the proper design lighting installations and vision tapered requirements in the access roads by a qualified illuminating engineer. Australian Standard 1680.1 provides the general principles on lighting design but there is no guidance for open cut mines. However, an illuminating engineer would be able adapt the principles of AS 1680.1 to this situation. It is imperative that the practice of using sunglasses in these circumstances be discontinued. While they may reduce the glare from the light, they will also significantly lower the visibility of low contrast objects.

Conclusions

1 Eye protectors complying with AS/NZS 1337 and/or AS/NZS 1338 and selected, fitted and maintained in accordance with AS/NZS 1336 appear to be entirely satisfactory solutions in the coal mining industry.

2 While selection is crucial, the use of safety eyewear should be accompanied by appropriate training and instruction to ensure correct fit, use and maintenance of eye protection equipment.

3 Mesh eye protectors, without an optical insert, do not come within the scope of AS/NZS 1337 and the Research Project Team has serious concerns with their use in the coal mining industry.

4 The issue of fogging and fogging treatments is being actively pursued by the Research Project Team.

Recommendation: It is recommended that the selection, use and maintenance of eye protection equipment in coal mines be made in compliance with AS/NZS 1336, 1337 and 1338.

Recommendation: It is strongly recommended that the use of mesh eyewear be prohibited in coal mines. The JCB should take active steps through all avenues at their disposal to prohibit the use of mesh eyewear in coal mines.

Recommendation: If it is not possible to prohibit the use of mesh eyewear in coal mines, it is recommended that stringent guidelines be issued for the situations and locations where mesh eyewear is used.

Recommendation: It is recommended that the use of tinted lenses in safety eyewear underground should be discouraged, especially if lenses are not to AS/NZS 1337.

Recommendation: It is recommended that cleaning materials for safety eyewear (solutions and tissues) should be available in areas at the workplace, for example near the coal face, where they are needed.

Recommendation: It is recommended that instruction be given to mineworkers wearing eye protection on how to ensure a good fit of eyewear, on how it should be used properly, and how it should be maintained in good working order.

Recommendation: It is recommended that instruction be given to mineworkers wearing masks and half-face respirators on how to ensure a good fit, to alleviate the problem of fogging from expired breath.

Recommendation: It is recommended that the provision of a selection of sun glare eye protectors be made in compliance with AS/NZS 1337 (as well as AS 1067).

Recommendation: It is recommended that guidelines be developed by a qualified illuminating engineer for use in open cut mines so that lighting installations in access roads ans workplaces lit a night are subject to proper design features (such as lighting installation and vision tapered

requirements). Such guidelines should be consistent with AS 1680.1 and specific to open cut mines, where illumination of dark rock strata may be different to other types of mines.

5.2.8 Training programs for eye safety in coal mines

The Question

To develop a training program for eye protection in coal mines which could be used as a "train the trainer" program, to ensure standardisation in the implementation of eye protection programs in the coal mining industry. Consideration should be given to directing the training at: (i) the employee who wears the eye protection; (ii) the safety officer/purchaser of eye protection/person who gives out and fits eye protection; and (iii) management (work systems constructors and enforcers).

Methods

Analysis of some questionnaire responses and from mine site inspections. Also, discussions with mine managers, mineworkers, safety professionals, optometrists, optical dispensers and eye protection manufacturers and suppliers.

Results and Observations

The significance of safety training is recognised by the CMRA and in fact there is a requirement upon the mine manager to provide training if approved by the Joint Coal Board (Section 114). Also, the minister may require training and may direct the manager to make training rules (Section 115). The provision of training is also covered under Section 15 of OHSA.

There are three issues related to the development of training programs:

- the issue of who is being trained;
- the issue of the content of training programs;
- the delivery of training programs to target groups.

The Research Project Team identified three main target groups for training:

- mineworkers;
- members of the mine management team; and
- personnel involved with the delivery of eye protection programs within coal mines, including safety officers, staff who purchase safety eyewear, staff who issue and fit safety eyewear.

As noted above, in the mineworker group, it is especially important to identify key individuals or informal leaders in the worker network for training.

To some extent, there are a substantial number of common features to the content of training programs to each of these target groups, and Table 8 outlines a matrix of the components of training programs for the three target groups identified.

Table 8: Contents of Training Programs for Eye Safety in Coal Mines

Type of target group	Mine worker	Mine Manager	Safety staff
Introduction	✓	✓	✓
Module 1: Legislation			
o Relevant extracts from CMRA	✓	✓	✓
o Relevant extracts from OHSA	✓	✓	✓
o Any relevant statutory regulations, rights and obligations, and collective responsibilities	✓	✓	✓
Module 2: Structure of the Eye			
o Structure of the eye	✓	✓	✓
o Hazards to the eye in coal mining	✓	✓	✓
o Processes that give rise to eye hazards	✓	✓	✓
o Effects on the eye	✓	✓	✓
o Examples of eye injuries from JCB workers' compensation reports	✓	✓	✓
Module 3: An Eye Safety Policy			
o The need for eye protection in coal mining	✓	✓	✓
o The risk management approach	✓	✓	✓
• Management commitment to eye safety and to consultation	✓	✓	✓
• Identification of eye hazards (safety audits, practical experience, incident reports, near hit reporting)	✓	✓	✓
• Assessment of eye hazards (significance of risk or past injuries, workers' compensation costs)	✓	✓	✓
• Control of eye hazards (hierarchy of controls, dust suppression, ventilation, other engineering controls, eye protection)	✓	✓	✓
o The need for an eye policy and	✓	✓	✓

	program			
o	Company specific requirements related to eye protection policy	✓	✓	✓
Module 4: An Eye Safety Program				
o	Types of eye protection	✓	✓	✓
o	The eye protection standards		✓	✓
o	Selection of eye protection			✓
o	Issuing eye protection and fit			✓
o	Correct use of eye protection	✓	✓	✓
o	Maintenance of eye protection	✓	✓	✓
o	Company specific requirements related to eye protection program	✓	✓	✓
o	Encouragement and improving compliance	✓	✓	✓
o	Review of eye protection program	✓	✓	✓

A fourth group was also identified, namely, the optometrists, optical dispensers and safety eyewear suppliers to the coal mining industry. However, training of these groups is outside the scope of the coal mining industry, and outside the terms of reference of this project. Nevertheless, the training of such groups could be addressed through professional bodies or associations. Further, the concept of accredited or approved suppliers of safety eyewear (including safety prescription spectacles) is one that should be explored by individual mine managers or preferably, by the industry, through peak industry associations.

Discussion

Providing training to mineworkers about eye hazards and their control is an integral part of a program for eye protection. Training has a number of functions, and is:

1. A means of sharing knowledge.
2. A means of developing skills, abilities and competencies.
3. One way of influencing inappropriate behaviour into more effective patterns to create a better safety culture.
4. An approach to improving workplace performance.

Training has a number of less obvious functions than reinforcing information. It can:

- ensure that legal obligations are met;
- emphasise the best (safest) work methods and procedures;
- clarify the role of mineworkers and managers in the workplace;
- contribute to productivity;

- reduce costs.
- reduce down time due to injuries, machinery breakdown or damage in the mine;
- reduce workers' compensation premiums;
- reduce the need for rehabilitation.

Importantly, training can reduce the human cost of poor safety.

Training should provide employees with the knowledge and skills needed to apply the information provided to them. It should also inform them how to use the control measures, safe working procedures and personal protective equipment provided for their protection. Training and education should also enable participation in decisions about the identification, assessment and control of eye hazards in the workplace.

The model(s) outlined above provide a flexible training program, which can be tailored to the individual needs of target groups and individual mines, and which can be used to develop a training program to be used to:

- introduce eye protection programs in coal mines;
- be integrated into induction training programs;
- be integrated into other safety training programs as components of a consolidated program;
- be used as part of refresher or periodic training programs, perhaps when standards are slipping.

Conclusions

Training programs are an important part of safety in coal mining. If a mine management is considering development of an eye safety program, an accompanying training program is essential. The content of the training program would depend on target group, existing knowledge and competencies, and training needs. There are a range of models which can be used to develop of safety training program. The sample program outlined above is one such model.

Recommendation: It is recommended that specific training on eye safety and eye protection be made part of eye protection policies and programs.

Recommendation: Training should be aimed at the target groups indicated in Table 8, and should contain at least the relevant elements indicated in the Table.

Recommendation: It is recommended that individual mine managers, mine groups or more preferably, peak industry associations, explore the development of a policy for the selection of suppliers of safety eyewear

based on accreditation or demonstrated competencies in occupational eye safety.

5.3 Other Issues

A number of issues were identified by the Research Project Team during its investigations, which impact on safety in coal mining (as well as eye safety) in a general fashion.

5.3.1 Relevance of Legislation

The coal mining industry has a long history of dealing with specific prescriptive legislation, now codified into the Coal Mines Regulation Act (CMRA) 1982. Most mine managers and their staff are familiar with this legislation, and are comfortable with its provisions.

In 1983, NSW enacted the Occupational Health and Safety Act (OHSA), enabling legislation which crystallised a number of important legal precedents relating to workplace health and safety previously residing in common law. This legislation was one of the first performance based statutes, and applied to all workplaces in New South Wales. The competent authority which handles this legislation is the NSW WorkCover Authority, which also maintains an inspectorate to deal with issues and breaches of the Act and associated regulations.

There is some debate within the coal mining industry as to whether this Act applies to coal mines. Section 30 of OHSA states that provisions of the Act with regard to appointment and powers of inspectors does not apply *to "a mine within the meaning of the Mines Inspection Act or the Coal Mines Regulation Act 1982"*. This has produced a perception among managers in the coal mining industry that they are exempt from all provisions of OHSA.

This is not true. With the exception of powers of inspectors, all other provisions of OHSA apply to coal mines. However, OHSA cannot be enforced by its inspectors. Therefore, enforcement of the provisions of OHSA technically falls to the inspectors of the Department of Minerals and Energy.

It is obvious that inspections by coal mines inspectors would be made principally to check compliance with CMRA. The findings of this project established that many inspections were preceded by notification of a visit, although under Section 59 (1) (a) (i) of CMRA, an inspectors has the power to *"at any time (whether by day or by night) to enter a mine and inspect the whole or any part of the mine and anything at the mine"*. This provision implies that at least some visits should be unannounced.

Further, whether Coal Mines inspectors enforce the provisions of OHSA is doubtful. Certainly, no prosecutions under the general issue of "duty of care" have been made by the Coal Mines Inspectorate to date. The Research Project Team is of the view that it would be beneficial for the enforcement of safety in the coal mining industry if there was a stronger emphasis on the competency and risk management based approaches of OHSA.

The Research Project Team is of the view that a duality of interests exists where inspectors have a responsibility for safety under legislation administered by a government department involved in matters other than safety (for example, the Mining Act 1992).

5.3.2 Coal Mining as an Island Industry

Statistics suggest that coal mining is a highly hazardous industry, and certainly a focus on the management of danger is critical. This has produced a widespread perception that the safety problems of the coal mining industry are unique to that industry and that their solutions are specific. Further, because of this special uniqueness, an attitude is prevalent that solutions found in other industries have no application in coal mining.

Similar claims are made by other industries, including the construction industry, the utilities industry, transport, health care, the agricultural sector and so forth.

In reality, these claims are unrealistic. The level of hazard in any industry will have a bearing on its risks. It is not the numbers of deaths or injuries that determine the scope of unsafeness, it is the way in which an industry chooses to deal with hazards, that makes industries dangerous or not. For example, aviation is an industry which is arguably highly hazardous, with a potential for a large number of fatalities. However, through development of technologies and attention to safety, it has a reputation of being extremely safe. Similarly, other industries, such as the chemical industry, handle high volumes of dangerous chemicals with little risk to workers.

Therefore, it is less the uniqueness of the hazards in any particular industry that should be emphasised, rather it is the ways in which hazards are controlled. For example, the eye hazards in coal mining can be controlled using conventional eye protection equipment found in other industries. The use of cap lamps could be eliminated if conventional (flameproof) lighting systems were used to illuminate coal mines.

Consequently, the perception that coal mining is unique is incorrect, and this view may be a barrier to the introduction of proven safety solutions. For example, it is apparent to the Research Project Team that risk

management approaches, now common in many industries, have made only limited entry into coal mining.

5.3.3 The Usefulness of Lost Time Injury Frequency Rates to Safety

Lost time injury frequency rates (LTIFR) are used extensively by the coal mining industry to demonstrate safety performance. In many of the interviews held with mine managers, the LTIFR was used to the exclusion of any other measure to demonstrate how safety performance has improved in coal mines. As can be seen in Figure 1, eye injuries (and indeed, all injuries) have fallen significantly in recent years. These statistics must also be set against decreases in the size of the coal mining workforce, increases in productivity and changes to the methods or reporting lost time injuries.

It is quite probable that improvements in safety occurred during this period, but to cite safety as the only reason for decline in injury rates is misleading (Hopkins, 1995). If safety was a factor, then it would also impact on the numbers of deaths in coal mines, which are very variable, and show no clear trend. Changes in workers' compensation arrangements for injured workers, better claims management and encouragement to injured workers to continue working are more plausible explanations for decreases in LTIFR. Often, mineworkers carry injuries as they are concerned they may loose benefits, and the LTIFR will not measure these. The exclusion of fatalities from LTIFR because no time was lost means that deaths are not recorded in the leading index of health statistics in this injury.

The Joint Coal Board also uses LTIFR and productivity data to show that the more productive mines also have lower LTIFR. However, this is also misleading. Increasing coal production from open cut mines (which are inherently safer) and changes in underground coal extraction technology are more likely reasons of increased production, although it must be acknowledged that there are usually indirect benefits to safety with such changes (Stiller, 1995).

The NSW coal mining industry should seek additional means of assessing safety performance, and not rely on LTI and LTIFR alone.

5.3.4 Risk Management as a Means of Dealing with Safety Issues

In all interviews and discussions with mine managers and mineworkers, the issue of eye safety is seen as one of eye protection. This is viewed from the perspective that there are hazards in the mine environment that affect the eyes, and that the eyes must therefore be protected. All consequent activities stem from this belief, which then limits the number of options that are then available for control of eye hazards. The main option

is to introduce a personal protective barrier, require the worker to use it, and accept the responsibility of its effectiveness. This process is inefficient and often does not work.

One reason for this is the term "eye protection", which is intrinsically associated with safety glasses, goggles, shields and so forth. However, many seemingly unrelated injuries in coal mines may be a result of impaired vision. For example, trips and falls may be due to an inability to see uneven ground because cap lights are pointed in the wrong direction. Indeed, the range of occupational injuries in mines that may be due to impaired vision (for example from poor lighting or inappropriate safety eyewear or badly positioned caplights) is potentially quite large.

Therefore, the process of dealing with risks to the eyes is less about forcing mineworkers to wear safety glasses and more about examining the entirety of the hazards and risks associated with the eyes and vision, and then investigating ways in which they can be controlled. This focus is then not of eye protection, but on management of eye safety risks. As with virtually any other workplace hazard, eye hazards need to be identified, assessed and controlled in a systematic and comprehensive fashion. The process that evaluates these steps can be called *Risk Management: Eye Safety.* Such a program is outlined in AS 1336, which could be modified for the individual risks and requirements of underground or open cut coal mines.

Interestingly, this approach mirrors similar developments in another common coal mine hazard, noise. Noise features as a large cost in workers' compensation statistics. This is not too surprising, as the effects of noise are long term rather than immediate, and in the past, attitudes to hazard control have not been useful in reducing noise exposure. Concepts such as "noise induced hearing loss", and "hearing protection" do not help either. The former of these masks the fact that a noise "injury" has occurred, and the latter suggests that ear muffs and are the only available solution to loud noises in the workplace.

Again, as with eye hazards, noise needs to be identified, assessed and controlled in a systematic and comprehensive fashion. Recently, the emphasis has changed from hearing conservation (forcing mineworkers to wear ear muffs) to management of the risks from noise. The process that evaluates these steps is dealt with as *Noise Management* (Worksafe, 1990).

5.3.5 The "Conspiracy of Complacency"

One enduring aspect of safety in the mining industry, mentioned in numerous interviews with mine managers and some mineworkers, is the concept of a safety culture, specific to individual mines. The origins of safety culture go back many years even to the time when the coalmining

workforce was recruited from virtually enclosed communities, with their own traditions and customs. These practices were based on those of their forebears, mostly from the United Kingdom, and were shaped by local geology and transformed by necessity into a workable Australian derivative. Mining and management expertise methods were adopted in entirety from those operating in the UK, and even job classifications such as check inspector, deputy, undermanager and so forth all were based on traditions and legislation from the UK.

Out of these traditions grew the concept that each mine developed its own way of doing things. These were handed down year by year and generation by generation and became what can now be regarded as the safety culture of a mine or when taken together, of the industry. This culture is more correctly seen as a tacit agreement to perform work in the way it had always been carried out to obtain maximum productivity and production, perhaps with disregard to safety. Further, a workers perception of risk can decrease with familiarity of the work, particularly if there is a feeling that the worker controls the situation (Slovik, 1987).

In this way coal mining, like other industries, normalised its own levels of danger. Organised disregard of safety practices became the norm. Consequently, disregard of safety was perpetuated by coal miners, managers and owners, and was allowed to continue to exist by mines inspectors, who implicitly allowed unsafe practices to continue, by not intervening to stop them (presumably because they were considered appropriate). This development of poor working practices and improper safety culture is more correctly identified as the "conspiracy of complacency" (Dingsdag, 1993).

In a 1987 study of factors that contributed to injuries in coal mines, Hopkins and Palser (1987) noted that management promoted a view that "accidents" were caused by apathy and carelessness, and developed safety programs that affected work activities over which managers had considerable discretion (such as roof support work), but which mineworkers had little input. The programs also emphasised the role of safety officers as "overseers" of work activities. However, breaches of safety standards did not arise from carelessness, but represented a response to managerial pressure to break codes and to assert the mineworkers' own informally agreed safety standards. In essence, mineworkers were resisting efforts to reduce their autonomy and the increase of control by management.

This was plainly seen by the Research Project Team in the introduction of eye protection policies, where no attempt was made to improve compliance. Some managers did not lead by example, or did not informally encourage the wearing of safety glasses by mineworkers that did not have them on. This erodes any impact a new program may have, and quickly reinforces that any provisions in such programs can be ignored. The frustration articulated by safety officers charged with

introducing such programs was very evident at some mines, and some interviewees implied a sense of futility with the statement "Why bother?".

The Research Project Team concludes that introducing programs that improve safety invariably has an immediate effect on safety. However, the success of such programs is a product of:

- the will of management to see the program succeed;
- the awareness of mineworkers to understand the rationale behind the program (this is increased by getting mineworker input into the development of the program);
- the willingness to comply with the provisions of the program (such as carrying and wearing safety glasses); and
- continual vigilance by all parties to encourage compliance with the program;
- systems for dealing with persistent or blatant noncompliance.

Further to these points is that while they are directly aimed at the specific program being introduced, in actuality, they should be aimed at all safety non-conformance: For ignoring such non-conformance encourages and perpetuates an inappropriate safety culture. Therefore, the introduction of a new safety program can be used as tool to address safety culture problems, and to break the conspiracy of complacency.

Postscript

Shortly before finalisation of the Draft Final Report, in November 1996, four coal miners were killed in the Gretley coal mine in the Hunter Region of New South Wales. These miners drowned as they were digging a new shaft and broke through into some old workings which were filled with water. In announcing an inquiry into safety in coal mining, the NSW Minister for Minerals and Resources noted while many improvements in equipment, work practices and manager-mineworker attitudes had been made in recent decades, that most mine fatalities are avoidable, and problems were still due to a lack of emphasis in safety matters - a lack of safety culture, in coal mines.

This research project does not wish to trivialise the need for proper management of catastrophic danger in a highly hazardous industry. However, the findings and conclusions of this research project are echoed by the sentiments expressed by the NSW Minister for Resources.

It is possible to develop an eye safety program (or any other safety program for that matter) in a coal mine which is somehow separate from its style or culture. However, for such a program to be effective, it must have management commitment from all levels of management, and it must have input from mineworkers who have day to day experience or working with hazards. Further, it is the safety culture which should be targeted for improvement, because success in safety is about making safety behaviour an automatic part of, but not making it additional to, normal work activities. Further, by changing the way managers and mineworkers exchange ideas on safety and develop cohesive safety plans will assist in improving the safety culture, including other safety related activities and programs (injury prevention, noise management and hearing conservation, respiratory protection, fire prevention, equipment safety and so on).

SECTION 6

REFERENCES AND BIBLIOGRAPHY

6 REFERENCES AND BIBLIOGRAPHY

ACTU. *Occupational Health and Safety Policy* Australian Council of Trade Unions, Melbourne, 1985.

ACTU. *Chemical Hazards Policy.* Australian Council of Trade Unions, Melbourne, 1989.

Anon. Miner case may see more claims. *Occupational Health and Safety Newsletter* 354, 1, 1995.

Anon. Eye protection fails builders' glamour test. *Occupational Health Magazine* **95:** 4-5, 1996.

Anon. Protected chemical workers look cool. *Occupational Health Magazine* **95:** 8-9, 1996.

Anon. Poorly designed boots: Injury risk for coal miners. *Current Cause* p 16, November, 1996.

Biggins, D., Phillips, M. and O'Sullivan, P. Benefits of worker participation in health and safety. *Labour and Industry* **4:** 138-159, 1991.

Brooks, A. *Occupational Health and Safety Law in Australia*, fourth edition. CCH International, Sydney, 1993.

Butani, S.J. Relative risk analysis of injuries in coal mining by age and experience at present company. *Journal of Occupational Accidents* **10:** 209-216, 1988.

CEN. *Personal Eye Protection - Non-Optical Test Methods.* Comité Européan de Normalisation, Paris, 1992.

Chiappone, D.I. and Kroes, W.H. Fatalism in coal miners. *Psychology Reports* **44:** 1175-1180, 1979.

Cole, H.P., Berger, P.K., Garrity, T.F., Auvenshine, C.D., Szwilski, A.B., Hernandez, M., Blythe, D.K. and Lacefield, W.E. Medical compliance behavior and miner health and safety. *Annals of the American Conference of Government Industrial Hygienists* **14:** 425-433, 1986.

Dannenberg, AL, Parver, LM, Brechner, RJ and Khoo, L. Penetrating eye injuries in the workplace. *Archives of Ophthalmology* **110:** 843-848, 1992.

Dingsdag, D.P. *The Bulli Mining Disaster 1887: Lessons From the Past.* St Louis Press, Sydney, 1993.

Eakin, J.M. Leaving it up to the workers: Sociological perspective on the management of health and safety in small workplaces. *International Journal of Health Services* **22:** 698-704, 1992.

Ewigman, B.G., Kivlahan, C.H., Hosokawa, M.C. and Horman, D. Efficacy of an intervention program to promote use of hearing protectors by firefighters. *Public Health Reports 105*: 53-59, 1990.

Feist, R.M. and Farber, M.D. Ocular trauma epidemiology. *Archives of Ophthalmology* **107:** 503-504, 1989.

Fong, L.P. Ocular trauma in Victoria, Australia. *Medical Journal of Australia* **162:** 64-68, 1995.

Fong, L.P. and Taouk, Y. The role of eye protection in work-related eye injuries. *Australian and New Zealand Journal of Ophthalmology* **23:** 101-106, 1995.

Gunningham, N. *Safeguarding the Worker.* Law Book Company, 1984.

Harrington, J.M. and Gill, F.S. *Occupational Health.* Blackwell Scientific Publications, Oxford, 1983, pp. 205-206.

Hopkins, A. Is productivity related to safety? The case of coal mining. *Journal of Occupational Health and Safety, Australia and New Zealand* **10:** 431-438, 1994.

Hopkins, A. Does safety pay: The case of coal mining. Chapter 10 In: *Making Safety Work: Getting Management Commitment to Occupational Health and Safety.* Allen and Unwin, Sydney, 1995, pp 140-157.

Hull, B.P., Leigh, J., Driscoll, T.R. and Mandryk, J. Factors associaited with occupational injury severity in the New South Wales underground coal mining industry. *Safety Science* **21:** 191-204, 1996.

Industry Commission. *Work Health and Safety. Inquiry into Occupational Health and Safety*, Report No 47. Commonwealth Industry Commission/AGPS, Canberra, 1995

Jackson, K.S., Kuebn, P.L., Cox-Watkins, K. and Gilliam, J. Methodology for measuring compliance and facilitating change. *Journal of the Occupational Nursing Association* **24:** 34-40m 1994.

Jackson, W. *Research Methods: Rules for Survey Design and Analysis.* Prentice Hall, Ontario, 1988.

JCB. *Lost Time Injuries and Fatalities: New South Wales Coal Mines 1995-96.* Joint Coal Board, Sydney, 1996. (Also Reports from previous years.)

Kelly, S.A., Goldberg, S.E. and Banton, T.A. Effect of yellow-tinted lenses as contrast sensitivity. *American Journal of Optometry and Physiological Ophthalmology* **61:** 657-62, 1984.

Kletz, T. Accident data: The need for a new look at the sort of data that are collected and analysed. *Safety Science* **16:** 407-415, 1993.

Krause, T and Finley, R. Safety and continuous improvement: Two sides of the same coin. *Safety and Health Practitioner* pp 11-22, September 1993.

Laflamme, L. and Menckel, E. Aging and occupational accidents: A review of the literature of the last three decades. *Safety Science* **21:** 145-161, 1995.

Macewen, C.J. Eye injuries: A prospective survey of 5671 cases. *British Journal of Ophthalmology* **73:** 888-894, 1989.

McDonald, S., McDermott, D., Theunissen, T., and Crossley, W. Training for safety and productivity in the mining industry: a case study. *Journal of Occupational Health and Safety, Australia and New Zealand* **10:** 137-149, 1994.

Mitchell, T. *Noise Management at Coal Mine Sites.* Noise Induced Hearing Loss Standing Committee/VIOSH, Ballarat, 1996.

MoorSafe. *Tahmoor Mine and Washery: Safety System Training Manual,* Moorsafe, Tahmoor, 1992.

NSW Government. *Coal Mines Regulation Act 1982* and associated regulations.

NSW Government. *Occupational Health and Safety Act 1983* and associated regulations.

Ore, T. Microeconomic reform and occupational health and safety: A study of the Australian coal mining industry. *Journal of Occupational Health and Safety, Australia and New Zealand* .**8:** 155-165, 1992.

Quinlan, M. and Bohle, M. (editors) *Managing Occupational Health and Safety in Australia: A Multidisciplinary Approach.* Macmillan, Melbourne, 1991.

Rhoton, W.W. A procedure to improve compliance with coal mine safety regulations. *Journal of Organisational Behavior and Management* **2:** 243-249, 1980.

Shaw, A. and Blewett, V. Measuring performance in OHS: Using positive performance indicators. *Journal of Occupational Health and Safety, Australia and New Zealand* **11:** 353-358, 1995.

Slovic, P. Perception of risk. *Science* **236:** 280-285, 1987.

Smith, D.S., Harris, R., Pelham, N., Truman, G. and Harris, D. Preliminary *Report from a Survey of Coal Miners Injured 1994/95: Lower Limb and Ankle Injury Project*. University of Sydney, Sydney, 1996.

Standards Australia. Eye Safety Standards:

- AS 1067 *Sunglasses and Fashion Spectacles* (1990)
- AS 1336 *Recommended Practices for Eye Protection in the Industrial Environment* (1992)
- AS 1337 *Eye Protectors for Industrial Applications* (1992)
- AS 1338 *Filters for Eye Protectors* (1992)

Standards Australia, Homebush.

Standards Australia. *AS4360 Risk Management.* Standards Australia, Homebush, 1995.

Standards Australia. *Draft Standard: Recommended Practices for Occupational Eye Protection.* Standards Australia, Homebush, 1996.

Stiller, L. Letter: Is productivity related to safety? *Journal of Occupational Health and Safety, Australia and New Zealand* **11:** 13-14, 1995.

Tielsch, J.M., Parver, L. and Shankar, B. Time trends in the incidence of hospitalised ocular trauma. *Archives of Ophthalmology* **107:** 519-523, 1989.

Veale, J.H. The incidence of eye injuries in New Zealand. *Australian Journal of Optometry* **55:** 275-282, 1972.

VIOSH. *Study of Occupational Health and Safety in the Australian Coal Industry*. Victorian Institute of Occupational Safety and Health, University of Ballarat, Victoria, 1994.

Worksafe Australia. *Noise Management at Work*. National Occupational Health and Safety Commission, Sydney, 1990.

Worksafe Australia. *Camberwell Coial: OHS and Productivity, Hand in Hand - OHS: Building Best Practice Series.* National Occupational Health and Safety Commission, Sydney, 1994.

Worksafe Australia. *OHS: Good for Business.* National Occupational Health and Safety Commission, Sydney, 1995.

Worksafe Australia. *Organising Health and Safety Training for Your Workplace.* National Occupational Health and Safety Commission, Sydney, 1996.

APPENDICES

APPENDIX 1: THE USE OF AS/NZS 1336 IN EYE SAFETY PROGRAMS - A COMMENTARY

At this stage AS/NZS 1336 is in final draft form and confidential to the drafting committee. However, its principal components remain the same as the 1992 edition. At this stage a "walk through" AS 1336-1982 will be set out with the promise that an undated version will be provided once AS/NZS 1336 becomes available.

Eye protection programs cannot be conducted in isolation. They must be part of a generalised system of safe working. As such, reference to AS/NZS 1336 must be supplemented by reference to other standards which include:

AS1470	Health and Safety at work - Principles and Practice.
AS1269	Acoustics - Hearing Conservation
AS1800	The Selection, Care and Use of Industrial Safety Helmets
AS2211	Laser Safety
AS2508	Safe Storage and Handling Information Cards for Hazardous Materials
AS4204	Safeguarding of Machinery
AS/NZS1715	Selection, Use and Maintenance of Respiratory Protective Devices

1. The basic principles in occupational eye protection set out in AS1336-1992 should incorporate the following:

   (a) A written policy expressing commitment by management to an eye safety program. This program should be freely available to employees and their representatives to ensure widest possible acceptance.

   (b) The elimination of hazards by careful design and layout of plant, considerations of the total work environment, formal development of working methods and their supervision and, where practicable, the improvement of processes.

   (c) The control of hazards at or near their sources.

   (d) Detailing of the arrangements made for the supply of eye protection equipment and the requirement for employees to wear such equipment when required to do so.

   (e) The continual auditing and monitoring of these principles.

   Whether or not workplaces adapt a universal eye protector wearing policy, there is a need to identify risk areas (Clause 1.4) and to evaluate the appropriate eye protection, which should be more than low impact spectacle-like eye protectors.

3. Clause 2 encourages the elimination of hazards by replacement with non-hazardous materials, processes and practices.

4. Clause 3 encourages the control of eye hazards in order to minimise the risk by limiting hazardous areas or by limiting the extent of exposure to the hazard.

5. Clause 4 deals with personal eye protectors. The need for personal eye protection should only be considered after all possibilities in elimination or control have been exhausted. The use of personal eye protection places too much of the onus of protection with the user. It is vital that the "It can't happen to me," attitude is eliminated. In addition, too much reliance on the protective capacity of eye protection may result in overconfidence, leading to the possibility of workers being unprotected or inadequately protected.

Clause 4.2 sets out advice on the selection of eye protectors. There are extensive tables detailing possible hazards, typical processes, appropriate control measures and suitable eye protectors.

Clause 4.3 deals with issue and fitting. Perhaps the most important subclause is the advice about selection and fitting being by a "competent" person. That same "competent" person is also needed in considering clause 4.6 dealing with the care, inspection and replacement of eye protectors.

Clause 4.7 and 4.8 deal with issues related to promoting the use of eye protectors including educational programs.

Section 5 deals with protection against ultraviolet and infrared radiation. This is of significance more in workshops where welding processes are used. The selection of appropriate welding filters depending on the welding process and current usage is dealt with in this section.

The new AS/NZS 1336 will also include sections on laser safety and prescription eye protectors. They will be dealt with as they become available.

AS/NZS 1336 is intended to be a comprehensive document dealing with issues of eye safety. The wider the audience for the provisions of AS/NZS 1336, the more a successful eye safety regime is possible. At the very least the provisions should be well understood in detail by those involved in decisions relating to the selection, issue, care and maintenance of eye protectors.

The central principle in eye safety is echoed in a number of documents including WorkCover guidelines, including that Eye Protectors shall comply with AS1337 and AS1338 and be selected and used as set out in AS1336.

Selection of Eye Protectors for Use in Coal Mining

Eye protection equipment must be selected according to Australian Standards. It is important to realise that the presence of an Australian standards mark on the frame of a pair of safety spectacles does not necessarily cover the lenses, which will have their own marks. There are a range of marks used on eye protection, some of which relate to different types and properties.

Low Impact

These may be spectacles (with or without side shields), goggles, eye shields or face shields. They are intended to provide protection against flying fragments with low velocity as low mass from processes such as chipping, hammering, riveting. The frames will be marked with the manufacturer's identifier, the Australian Standard mark and a licence number. The lenses will carry the manufacturer's identifier.

In theory, the spectacle type can have glass (heat or chemically tempered) lenses but in practice there is no source of supply in Australia. Spectacle lenses will typically be hard resin (also known as CR39) or polycarbonate. Polycarbonate is the much superior impact resistant material. Goggles, eye shields or face shields may have polycarbonate, cellulose, acetate, triacetate or cellulose acetate butyrate lenses. Polycarbonate is the much superior impact resistant material.

Medium impact

These may be wide vision spectacles (larger and with permanently attached side shields), goggles, eye shields or face shields. They are intended to provide protection against small flying particles with medium velocity or medium mass from processes such as disc cutting, grinding, machining and stone dressing. The frame will carry a manufacturer's identifier the Australian Standards mark, a licence number and the letter "I" to indicate medium impact. The lens will carry a manufacturer's identifier and the letter "I".

Spectacle lenses will be polycarbonate and goggles, eye shield and face shield lenses will be polycarbonate or acetate.

Note: Goggles, eye shields and face shields may comply with only low impact requirements. Medium impact eyewear is always stamped for the letter "I". This indicates medium impact protection.

High Impact

These will be face shields only. They are intended to provide eye and face protection against high velocity particles from such processes as explosive powered tools. The frame will carry a manufacturer's identifier, the Australian Standards mark, a licence number and the letter "V" to indicate high impact protection. Lenses will carry a manufacturer's identifier and the letter "V". Lenses will be polycarbonate.

Note: Face shields may comply with low or medium impact only. Look for the letter "V" to indicate high impact protection.

Dust resistance

These will be unventilated goggles with a good seal against the face. They are intended to protect against air borne dust. In addition to any marking detailed with reference to impact protection, they will also be marked with a "D". Dust resistance testing is available from the NSW WorkCover Authority.

Gas Resistance

These will be unventilated goggles with a particularly close seal against the face. They are intended to provide protection against gases and vapours from such processes as chemicals and spray painting. They are also effective against dust. In addition to markings detailed with reference to impact protection they will also be marked with a "G".

Splash Resistance

These will be unventilated or indirectly ventilated goggles, eye shields and face shields. They are intended to provide protection against liquid splashes from things like chemical processes. In addition to any markings detailed with reference to impact protection they will also be marked with a "C".

Molten Metal and Hot Solids Resistance

These will be face shields and wire mesh screens with plastic lenses. They are intended to provide protection against metal splashes from such processes as metal casting, molten metal handling, galvanising and lead joining. In addition to any markings detailed with reference to impact protection they will also be marked with an "M". Welding hand shields and helmets will meet the hot solids resistance requirements as a matter of course.

Protection From Radiation Generated In Welding Processes

These will be goggles for gas welding and hoods helmets and hand shields for electric welding.

The radiation developed in welding processes varies with the process (gas or electric), the technique (for example, MIG, TIG or plasma arc), the current and the shielding gas (for example, Argon or Carbon Dioxide). AS/NZS 1336 and 1337.1 provide guidelines for selection of filters for the various processes and currents used. There is also provision for spectacles for welders assistants who work in the vicinity of fire arc but who do not need view the arc.

In addition guidance will be given on safe working distances and safest time exposures.

Ultraviolet and Infrared protection

The only relevant situation for mining appears to be the need to protect outdoor workers against solar ultraviolet. Eye protectors marked (on the lens) with an "O" have been classified as 'outdoor untinted' and provide adequate ultraviolet protection. If glare is also a problem, any of the eye protectors which are tinted and comply with AS1337 are suitable.

Note: Tinted eye protectors complying with AS1338.1, 2 or 3 are not necessarily suitable for driving.

APPENDIX 2: MANAGEMENT QUESTIONNAIRE

Eye Safety and Personal Protection in the Coal Mining Industry

Management Survey Questionnaire

Date		
Mine		
Type of Mine	Open Cut	❒
	Underground	❒

The purpose of this questionnaire is to get views on eye protection and personal protective equipment which concern you as a manager in the coal mining industry.

❒ There are no right or wrong answers - this is an opinion survey.

❒ Only summary data will be presented when the study is completed.

What You Say In This Interview Will Remain Confidential

Please return this questionnaire in the envelope provided, or to:

Assoc Prof Chris Winder
Eye Safety in Coal Mining Project
Department of Safety Science
University of New South Wales
Sydney NSW 2052

Section 1 - OHS Responsibilities

This first section is about Occupational Health and Safety duties in this mine.

1. SAFETY ISSUES

1.1 Does your company have:	Yes	No	Don't Know
o A written Occupational Health and Safety (OHS) Policy			
o A written Occupational Health and Safety Program			
o A Worker Rehabilitation Program			
o Written Emergency Response Procedures			
o Do you think the OHS program is actually followed?			
o Is safety written into your job description?			

1.2 What are your direct health and safety responsibilities here as part of the management team?

✍

1.3 How important is eye safety in comparison with other health and safety issues?

Not important	Slightly important	Quite important	Important	Very important	Critical to safety

✍

1.4 Do you have any statistics on eye safety in this mine? If yes, provide details

✍

1.5 Which do you think are the main health and safety issues in this mine?

✍

1.6 What difficulties do you have when dealing with health and safety?

✍

1.7 Any other thoughts? ✍	Yes	No	Don't know
o Do you know when an inspector is visiting the mine?			
o Is your management sensitive to safety needs?			
o Do the site unions assist in the improvement of safety?			

Section 2: Eye Protection and Personal Protection Practices

Next, some practical questions about the reality of implementing health and safety in this coal mine with regards to eye protection.

2.1 PERSONAL PROTECTION PRACTICES

On a scale of one to ten, how significant is personal protection in coal mines? (1= low, 10 = highly significant)	① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨ ⑩		
	Yes	**No**	**Don't know**
Have there been any accidents involving personal protective equipment (PPE) in this mine?	❒	❒	❒
If yes, provide details and examples of the PPE concerned. ✍			❒
Does the mine have an personal protection policy?	❒	❒	❒
Does the mine have any written instructions on the use of personal protection?	❒	❒	❒
Does the mine have an personal protection program?	❒	❒	❒

2.2 EYE PROTECTION PRACTICES

On a scale of one to ten, how significant is eye safety in coal mines? (1= low, 10 = highly significant)		① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨ ⑩		
Have there been any accidents involving eye safety in this mine?		❒	❒	❒
If yes, provide details ✍				❒
Is a range of eye protection equipment available in this mine?		❒	❒	❒
If yes	What is the procedure for selecting eye protection?			❒
	Provide details: ✍			
	Is the selection of eye protection equipment made to standards?	❒	❒	❒
	Which standards? ✍			❒
Were workers consulted in the selection of the eye protection used at this mine?		❒	❒	❒
Is eye protection issued individually to workers?		❒	❒	❒
Is use of eye protection actively encouraged?		❒	❒	❒
If yes	How is it encouraged? ✍			❒
Are there jobs/locations where eye protection must be worn?		❒	❒	❒
If yes, provide details: ✍				❒
Does the mine have an eye protection policy?		❒	❒	❒
Does the mine have any written instructions on eye protection?		❒	❒	❒
If yes	What do the instructions specify? Is it possible to obtain a copy? ✍			❒
Does the mine have an eye protection program?		❒	❒	❒

		Yes	No	Don't know
If yes	Does a particular person or group take full responsibility for the eye protection program?	❒	❒	❒
If yes	Who? (title) ✍			❒
	Do you have a nominated supplier of eye protection equipment?	❒	❒	❒
	Who? ✍			❒
	Do you have a nominated supplier of eye protection equipment for people who wear prescription spectacles?	❒	❒	❒
	Who? ✍			❒
Does the mine have an optometrist that it sends workers to?		❒	❒	❒
If yes	Do you know his/her name and the organisation they work for? ✍			❒
Are people who wear prescription spectacles given specific training about when and how to wear eye protection?		❒	❒	❒
If yes	By whom? (name) ✍			❒
Has an assessment been conducted to assess whether eye protection is needed?		❒	❒	❒
Is the hazard(s) that caused the eye problem(s) monitored?		❒	❒	❒
Do workers receive training in the use of eye protection?		❒	❒	❒
If yes	Does the training include: How to use the eye protection?	❒	❒	❒
	The nature of the risks the eye protection is supposed to reduce?	❒	❒	❒
	When the eye protection should be worn?	❒	❒	❒
	Are the needs of prescription glasses wearers addressed in training programs?	❒	❒	❒
	Who does the training? ✍			❒
	How long is the training? How often? Is it part of induction or separate? ✍			❒
Are procedures in place if workers do not wear their eye protection?		❒	❒	❒
If yes	Are these procedures written down?	❒	❒	❒
	Were they developed in consultation with workers?	❒	❒	❒
	Do they include counseling?	❒	❒	❒
	Do they include disciplinary measures?	❒	❒	❒
	Is it possible for a worker to be sacked for persistent noncompliance?	❒	❒	❒
	If yes, has this ever happened?	❒	❒	❒
Are measures in place to assess the eye protection program?		❒	❒	❒
If yes	How often? ✍			❒

Section 3: Other Issues

Just a few final questions

3.1 Do these factors affect your ability to deal with health and safety issues?
Rank these factors, from 1 (lowest) to 7 (highest).

Reasons	Yes	No	Don't know	Rank (1-7)
Production				
Time				
Access to relevant information				
Understanding technical information				
Financial restraints				
Worker reluctance to comply with safety rules				
Shortage of staff				

3.2 If you were in a situation where you were on your way to do something. Say you are going through the mine and you see one of the miners doing something a bit risky with a piece of mining equipment. He's not wearing his safety glasses. He's been with you for years, he's good at his job. Which of the following would you do?

Reasons	Yes	No	Don't know
I'd be obliged to put a sign on the equipment saying that safety glasses must be worn when in use			
I wouldn't be obliged to do or say anything to him because he's trained and is good at his job and knows the risks involved.			
I'd be obliged to tell him to wear safety glasses.			
I'd be obliged to tell him to be careful not to get chips in his eyes when using the equipment.			

3.3 Just say you asked the guy to put the safety glasses on and he said he didn't find them comfortable. You'd already bought a few different types of glasses and none of them he liked. Which of the following would you do?

Reasons	Yes	No	Don't know
I'd be obliged to make him wear the safety glasses even though he thought they were uncomfortable			
I wouldn't be obliged to do or say anything. I'd fulfilled my responsibility and got him a variety of different safety glasses.			
I'd be obliged to ask him to buy his own safety glasses at his own expense. I'd fulfilled my responsibility and tried to find him safety glasses.			

3.4 Would you circumvent safety if production targets need to be met?

3.5	Finally, just some general information about you:
Gender:	❑ Male ❑ Female
Age *(years)*:	❑ under 20 ❑ 20-29 ❑ 30-39 ❑ 40-49 ❑ 50-60 ❑ above 60
What is your job title: ✍	
Please give a brief outline of what you do, such as your main jobs and tasks at work here: ✍	
How long have you been working here (in years)? ✍	

Thanks for your time and cooperation.

If you want to add any comments or opinions, please use the box below.

✍ **Any further comments?**

APPENDIX 3: WORKER QUESTIONNAIRE

Eye Safety and Personal Protection in the Coal Mining Industry

Worker Survey Questionnaire

Date		
Mine		
Type of Mine	Open Cut	❒
	Underground	❒

The purpose of this questionnaire is to get views on eye protection and personal protective equipment in the coal mining industry.

- ❒ Do not put your name on any of these forms.
- ❒ There are no right or wrong answers - this is an opinion survey.
- ❒ Your employer will NOT be allowed to see these forms once they have been completed.
- ❒ Only summary data will be presented when the study is completed.
- ❒ Please tick the box that best represents your choice.
- ❒ Please feel free to make written comments in your answers, especially if this is easier than ticking boxes.

WHAT YOU SAY IN THIS QUESTIONNAIRE WILL REMAIN CONFIDENTIAL

Please return this questionnaire in the envelope provided, or to:

Assoc Prof Chris Winder
Eye Safety in Coal Mining Project
Department of Safety Science
University of New South Wales
Sydney NSW 2052

Eye Safety in Coal Mining Survey: Questionnaire

Date:	

1. Your normal eye wear is:

Please tick as many as applicable	Eye wear
Nothing	❑
Your own prescription spectacles/bifocals ✍ *(please specify)*	❑
Prescription spectacles supplied by your employer	❑
Contact lenses	❑
Your own sunglasses	❑
Sunglasses supplied by your employer	❑

To Question 2 ↓

2. What eye protection is available, and what do you use?

Please tick as many as applicable	What eye protection is available?	What do you actually use?
Safety glasses	❑	❑
Safety clip-ons to be attached to normal spectacles	❑	❑
Eye cup goggles with or without ventilation and/or filters	❑	❑
Coverall goggles with or without ventilation and or filters	❑	❑
Faceshields	❑	❑
Welding eye protection	❑	❑
Combinations (such as respirators with eye protection) ✍ *(please specify)*	❑	❑

To Question 3 ↓

3. On an average shift, how often do you wear eye protection?

Not at all	❑	
↓	*If Not at all, go to Question 5* →	
Rarely	❑	*Please specify what eye protection you wear*
Less than an hour	❑	
A few hours	❑	
About half a shift	❑	
Most of the shift	❑	
All of the shift	❑	

To Question 4 ↓

From Question 3

4. Are there any problems with the eye protection you wear?

This is for eye protection at work. Tick the box which best indicates the symptoms and their severity

Symptom	None	Very mild	Mild	Moderate	Intense	Very intense
Tired eyes	❑	❑	❑	❑	❑	❑
Watery eyes	❑	❑	❑	❑	❑	❑
Eye strain	❑	❑	❑	❑	❑	❑
Headaches	❑	❑	❑	❑	❑	❑
Blurred vision	❑	❑	❑	❑	❑	❑
Glare	❑	❑	❑	❑	❑	❑
Other	❑	❑	❑	❑	❑	❑

Please specify the eye protection you're talking about, which brand, and the problems you have.

To Question 5

5a. Are there any rules regarding eye protection in this mine?

Don't know ❑ — *If Don't know, go to Question 6*

No ❑ — *If No, go to Question 6*

Yes ❑ — *If Yes, go to Question 5b*

5b. Are the rules regarding eye protection written down?

That is, are there specific written rules about eye protection?

Don't know ❑ — *If Don't know, go to Question 6*

I can't remember ❑ — *If so, go to Question 6*

No, they are informal ❑ — *If No, go to Question 5c*

Yes, they are written down ❑ — *If Yes, go to Question 5c*

5c. Do these rules refer to:

	Informal rules	Written Rules
Which eye protection is to be worn *(which types and brands)*	❑	❑
When eye protection should be worn *(which jobs)*	❑	❑
Where eye protection should be worn *(which locations)*	❑	❑
Particular situations where eye protection should be worn *(for example, when roof-bolting or during emergencies)*	❑	❑
I can't remember the rules, so I can't answer the question	❑	❑

Go to Question 5d

From Question 5c

5d. In what specific situations do these rules apply?

Please specify type of eye protection you're talking about, and the situation in which it is used.

✍

Go to Question 6

6. Finally, just some general information about you:

Gender: ❑ Male ❑ Female

Age *(years)*: ❑ under 20 ❑ 20-29 ❑ 30-39 ❑ 40-49 ❑ 50-60 ❑ above 60

What is your job title:

✍

Please give a brief outline of what you do, such as your main jobs and tasks at work here:

✍

How long have you been working here (in years)?

✍

Thanks for your time and cooperation.

If you want to add any comments or opinions, please use the box below.

✍ **Any further comments?**

APPENDIX 4: A MODEL PROGRAM FOR EYE SAFETY IN COAL MINES

The information in this Appendix is not intended to replicate general information on eye hazards at work and their control.

This appendix outlines a framework which is designed to increase the level of current awareness of eye safety in coal mines and provides an outline on how an effective eye protection policy and program can be developed, implemented and reviewed. The articulation of this framework should be such that it is sufficiently flexible to be adapted to the individual needs and conditions of each mine.

Background

Coal mining organisations have recognised a need to deal with the risks from eye hazards. Whereas in the past the responsibility for preventing damage to eyes and sight in coal mines is indirectly prescribed in legislation, a more contemporary approach places greater emphasis on risk management methods. This approach aims to have those exposed to risks to be involved in the development of strategies, plans and actions to eliminate, control or prevent exposure to the risk.

A number of findings became apparent in this project which are sufficiently common to suggest a framework for the coal mining industry to deal with eye safety issues. For example, it is quite apparent that mandatory programs will fail, that enforcement of non-compliance is extremely problematic, and that the more successful programs are developed by the workers in the mines once a strong commitment is given by mine management.

Therefore, the project team proposes a model approach for developing an eye safety program, outlining key characteristics and the steps in building the eye safety program.

Objectives of a Model Program for Developing an Eye Safety Program in Coal Mines

The objectives of this program are to:

- Promote the adoption of a systematic approach to managing the risks of eye hazards.
- Encourage established or to promote new consultative processes to develop and implement eye protection policies.
- Minimise the risks from eye hazards through risk management by:
  - identification of hazards to eyes and to eyesight;

- assessment of identified risks to evaluate their significance;
- control of any risks assessed as significant using the hierarchy of controls (elimination, substitution, isolation, engineering controls adminstrative procedures; and personnel protective equipment).

- Promote better training and education strategies dealing with eye hazards and the means for their control.
- Encourage the NSW coal mining industry to adopt a common approach for the management of eye safety.

Finally, it should be appreciated that risk management of eye hazards is only one issue related to improving health and safety in coal mines. Therefore, the development of any eye safety program should be conducted in such a way that it is capable of integration with other management structures and procedures.

Focus on Attitudes and Safety Culture

Current worker attitudes and resistance to eye safety are really no different to the introduction of the hard hat policy in the NSW coal mining industry in the 1950s. Perhaps in fifty years time wearing of eye protection will be as automatic as hard hats are in the 1990's.

There is much discussion of management and worker "attitudes" and "safety culture" particular to the coal mining industry. This may even be expressed as a view that the mining industry is "different" from other industries, with its own norms and values. Irrespective of these views, the project team found that managers' and workers' attitudes as well as mine culture are suprisingly similar to those in other industries (such as construction or manufacturing).

Even so, the prevailing safety culture in a particular mine may be poor because it is based on unsuitable perceptions of risk and incorrectly held assumptions about control. Further, if management approaches to attitudes or culture are inappropriate, they may exacerbate attitudes and entrench the culture.

Consequently, the consultative approach, which is enshrined in the NSW Occupational Health and Safety Act and which is used to some success in other industries, is an approach which could have more widespread application in the coal mining industry to address inappropriate attitudes (held by management or workers) and to improve safety culture.

Key characteristics of effective eye protection policy and practice in NSW coal mines

A focus on improving attitudes to safety should concentrate on cooperative approaches:

- first, by commitment to development of a suitable policy, which should be announced;
- second, if not available, appropriate consultative mechanisms should be developed, for example a safety committee or eye safety committee should be constituted;
- third, this safety committee should call for ideas on how to address the issue of eye safety. This can be further facilitated by a questionnaire circulated among workers. Ideas and answers can be used to develop a draft policy;
- fourth, a draft eye safety policy should be developed for comment.

Strong management commitment to eye safety

- Initially (and ultimately) eye safety should be viewed as management responsibility.
- Compliance with relevant legislation and standards should be a minimum.
- Strong open management commitment is essential. All levels of management - from head office to deputies and examiners - should be committed to and actively involved in eye safety.
- Where relevant, eye safety matters should be regularly included on management meeting agendas.

Management/worker commitment to consultation

- As well as being a management responsibility, eye safety is a joint responsibility of the entire workforce. This includes empowerment of non-management workers relative to the duty of care provisions of the NSW OHS Act.
- Supportive and open consultative relationships between management and workers are also essential.
- Frequent, easy, two-way communication among workers, deputies/examiners, safety officers and managers and the appropriate union representatives will facilitate consultation.

Management/worker action in planning for eye safety

- Development of a organisational culture which supports working both safely and efficiently.

- Voluntary participation by all workers is essential. Imposed programs will probably be resisted by workers who will feel they have no control/ownership.

- Expression of management commitment can be asserted though expression in development of an eye safety policy. The policy should be developed through a suitable consultative arrangement, such as a safety committee, or an eye safety working group.

- Voluntary eye protection policy, not based on policing, but on voluntarily participation.

Management/worker action in development of an eye safety policy

- The policy should also contain an express commitment to develop a eye safety program.

- Important components of a draft policy are:
  - no mandatory compliance with wearing of eye protection;
  - all workers are required to carry, not wear, eye protection, preferably around their necks, or in a pocket or belt pouch (if available);
  - acceptance that there will be some situations where workers not wear their glasses in situations where perhaps they should;
  - no policing of the policy, but encouragement of compliance through "you've forgotten your glasses" or "don't be daft, this is a safety glasses job".

Management/worker action in implementation of an eye safety policy

- Head office managers/district check inspectors/head office union representatives to encourage widespread preventive/corrective eye safety activity and themselves actively involved, wearing appropriate eye protection in designated areas.

- Mine managers/under managers/deputies/examiners/local check inspectors and workers involved in daily observation of eye protection practice, hazard detection/encouragement/corrections.

- Little or reduced reliance upon a central safety officer for the day to day implementation of eye protection practice, but;
  - all members of the workforce should be responsible for maintaining a safe work environment and observing correct eye protection policy and practice voluntarily;
  - diffusion of responsibility from management to workers and;
  - the designated safety officer to coordinate standard policy, to encourage and promote good practice, to provide information and to coordinate training.

- Procedures for safe task performance and eye safety practice should be clearly specified.

- Regular communication of eye safety procedures and safe job performance procedures on every shift by several means including:
  - Informal meetings/dialogue at the panel/section; toolbox talks, section/panel talks by deputy/examiner/local check inspector/OHS committee members;
  - Formal safety meetings at regular intervals to be determined collectively; probably weekly/fortnightly at first and less frequently once the safety culture produces demonstrable benefits, such as falling rates or frequency; then the optimum interval might be once a month to maintain the safety culture;
  - Correctly designed and displayed posters showing eye protection washing stations, safety policy, procedures, reminders, and so on.

- Formal investigation of injuries and near injuries/incidents; the investigation of near hits are as important as seeking the cause after an injury because understanding, recording and discussing the circumstances of near hits can have a significant role in the prevention of injury and the promotion of working safely.

- Constant re-enforcement and reminders of safety procedures.

Steps in Developing an Effective Eye Safety Program

Step I - Preparation

- Target specific high risk areas and jobs that are:
  - linked to past eye injuries;
  - culturally (that is, behaviourally) defined.

Step II - Introducing the new culture

- Hold 30 to 40 minute meetings with workers and safety coordinators/ deputies/examiners by sections/panels once a week or fortnight initially where:
  - large charts with graphs of injury rates and frequency are shown;
  - advantages of working safely with eye protection are discussed;
  - each specific safety procedure is demonstrated, for instance the appropriate task procedure and the appropriate eye protection equipment, procedure and correct fitting.
- Participation in eye safety practice is reinforced by safety coordinators/deputies/ examiners with verbal praise and recognition, and so on.
- Workers and safety coordinators/deputies/examiners are encouraged to affirm their active participation publicly.

Step III - Introducing the new program

- Elements of the eye safety program would include:
  - **hazard identification** - identification of eye safety hazards, especially underground (or in open cut areas) and in maintenance activities. Sometimes these need careful consideration (such as the problems of glare from low level lamps, or bifocals and fixed helmet lamps). Review of eye safety hazards should be included in any regular safety audits;
  - **safety glasses** - availability of a range of safety glasses and equipment that workers can select for their own use. Correct fitting is essential and should only be carried out by properly trained personnel. Consideration should also be given to allowing personal use of glasses to reinforce eye safety outside the workplace;
  - **designated areas** - should be chosen where safety glasses must be worn. These areas can be generic (for example all areas underground or past the bathhouse) or specific (for example, in maintenance workshops);
  - **warning signs** - used to be designate those areas of the mine where safety glasses must be worn;
  - **information** - availability of information on eye hazards and eye safety precautions at home for tasks such as car

maintenance, lawn mowing or wood chopping, which reinforces eye protection activities;

- **training** - in selection, use, fit and maintenance of eye safety glasses and equipment. These training sessions should be given by workers at the mine to reinforce ownership of the policy. Features of the sessions should include: the relevant legislation; the possible hazards in the mine that can damage the eyes; the reduction in compensation payments if an injury occurred because a worker was not wearing his protection (which may have raised a doubt in his mind about not wearing eye protection);
- **good housekeeping** - such as regularly maintained lighting on underground transports, uncluttered roadways, lighting wherever feasible and orderly pit-tops in underground mines (neatly kept roads and well ordered work areas (well lit at night) in open cuts); unobstructed vision in machinery and vehicles; correctly designed, positioned and well lit signs and so on;
- **compliance** - while there is no policing of the policy, workers are encouraged at least to wear glasses around the neck or in a pocket or belt pouch, because when they keep eye protection away from the body (such as in crib tins) they are less likely to put them on. Workers not wearing protection should be prepared to be challenged;
- **safety glasses maintenance** - such as well identified and easily accessible lens washing stations, availability of tissues, replacement lenses and so on;
- **knowledge sharing** - well coordinated, standard eye safety activities among sections/panels, workers, deputies/examiners/safety coordinators and managers;
- **record-keeping** - showing the correlation between production, efficiency, safe job performance, the correct use of eye safety equipment and widespread sharing of this information relative to the eye safety program;
- **incident and near hit reporting and investigation** - with an emphasis on finding causes, not ascribing blame. Should also include accountability measures to ensure incidents, near hits and injuries do not recur;
- frequent use of information and joint decision making in planning eye safety policy and practice.

Step IV - Implementation and reinforcement of the voluntary eye protection program

- Continue observing, recording, and charting performance of targeted tasks and high risk areas on every shift at least twice a week, three to four times would be better.

- Display graphs of performance in the panel/section/crib-room at least twice a week.

- Continue holding weekly or fortnightly safety meetings by sections/panels where:
  - graphs are discussed;
  - modifying safe work procedures to overcome barriers with participation is planned;
  - new or potential hazards are identified.

Procedures for Creating, Fostering and Maintaining Participation

1) Foster the active participation of the entire workforce in creating a participative culture based on a joint voluntary agreement on eye safety policy and practice. The culture should be reinforced through a learning philosophy not through education and training (that is, education and training are the methods for learning).

   The workforce includes any person on the mine site from Feds to the manager and head office management who proceed into designated areas in underground mines and in open cuts.

2) Eye protection zones should correlate with hard hat zones, however:
   - appropriate eye protection should be worn at all times only in agreed specified high risk areas or for high risk procedures;
   - in all other eye protection/hardhat zones appropriate eye protection should be carried on the person, say around the neck or in a pocket or pouch, ready to be worn if necessary;
   - if office staff or visitors go to eye protection zones they should observe the appropriate eye protection policy.

3) Identify specific eye injury and health hazards requiring specific risk-reducing procedures

4) It is desirable to involve workers' social groups, family and friends as part of a pro-active health promotion policy to help achieve

increased levels of participation with the agreed eye safety practice and policy; re-issue lost or damaged eye safety equipment on request and encourage its use at home, for example while whipper-snipping or using electrical power tools. Safe practices in the home will permeate the work culture in the same manner as other facets of non-work culture have an influence at the workplace.

5) Identify and discuss at meetings and target high risk procedures that are linked to eye injury, cooperation with the agreed safe practice will have the most impact on reducing risk.

6) Define each targeted risk situation and procedure in specific and directly observable terms.

7) Focus the educational and training activities and the monitoring of the workers' performance in training sessions directly upon specific targeted risk situations, not on the long term goal of reducing incidence or frequency. Voluntary participation in correct eye protection and task procedures will reduce the latter, but focusing training and education on reducing incidence or frequency will not have a significant impact on reducing injury.

8) Provide frequent cues to the entire workforce to help them remember to participate with agreed procedures. Good record-keeping, frequent feedback and support from peers and supervisors are good sources of cues.

9) Provide frequent feedback and knowledge of results to employees concerning the safe and efficient performance of a procedure. Effective means for feedback and reinforcement include:

- charting of safe performance and regular examination of this information by employees;
- verbal praise and recognition by safety coordinators/deputies/examiners and peers for safe performance.

10) Incorporate attempts to reduce barriers to co-operation by employees by modifying procedures and eye protection to fit better with the personal requirements and the particular needs of the section/panel.

11) Include incentives for the appropriate social and community celebrations of the achievement of long-term goals by individuals and groups, but do not confuse these with the monitoring of variables.

APPENDIX 5: PRODUCT DATABASE

Supplier	Product Name	HSR?	Product Use	Ingredients
Adchem	Ramset 9316 lubricating and releasing oil	?	Lubricant for power tools	Mineral oil >60% Lubricant additive <10% Anti corrosive additive <10%
Adchem	Ramset chem masonry anchors	✓	Chemical fastener for masonry	Component A consisting of: 88% styrene monomer 10-60% epoxy acrylate resin 10-60% inorganic materials 10-60% Component B consisiting of: 12% benzoyl peroxide <30% inorganic materials (including glass and quartz) 10-60%
Adchem	Ramset Fomofill PFL	✓	Sealant, gap filler	polyol 10-60 % polymericdiisocyanate (PMPPI) 10-60% diphenyl methane diisocyanate (MDI) <1% hydrocarbon propellant 10-60%
Adhesive Engineering	Armagrout AP/ Dry pack epoxy grout	✓	Mortar	Not specified.
Adhesive Engineering	P110/General purpose epoxy paste.	✓	Bonding concrete elements.	Not specified.
Ajax Chemicals	Gripcrete	✓	Adhesive	plasticsed vinyl acetate homopolymer >60% formaldehyde< 0.1% dibutyl phthalate< 10%
Ajax Chemicals	Hydrochloric Acid	✓	Acid. General purpose food additive, pickling and metals	Hydrochloric acid 36% water to make 100%
Ajax Chemicals	Bycol Clear		Detergent, surfactant	water to make 100% Surfactant <10%
Ajax Chemicals	General purpose thinners	✓	Paint and workshop cleanup	Xylene> 60% Mineral turpentine 10-30% Petroleum spirit 10-30%
Ampol	Distillate	✓	Fuel, process oil, mould oil	distillate >60%
Ampol	Unleaded petrol	✓	Fuel	petroleum hydrocarbons > 60% benzene < 10%
BOC Gases	Carbon dioxide, compressed gas and liquid withdrawal	✓	Welding shielding gas	carbon dioxide 99.8 %
BOC Gases	Nitrogen	✓	Energising pneumatic equipment	Nitrogen 99.9%
BOC Gases	Acetylene	✓	Welding gas, fuel	Industrial acetylene 98% min.

Supplier	Product Name	HSR?	Product Use	Ingredients
Bostik Australia	Bostik 1830	✓	Spray adhesive for bonding insulation materials	hexane 60-100% resins 10-30% rosins ester 1-10% additives < 1% antioxidant < 1%
BP Chemicals	Solvent E95% IMS	✓	Solvent, cleaning chemical	ethanol 95% methyl isobutyl ketone (MIBK) 0.25% bitrex 6.6 ppm % fluorescein 1.0ppm%
BP Chemicals	Mineral Turpentine	✓	Mineral turpentine general purpose solvent	aromatic hydrocarbon compounds 45% lhd 98% benzene< 0.5%
Bracton Chemical	para-Dichlorobenzene	✓		para-Dichlorobenzene 99.4%
Croda coatings	Acidol	✓	Protect surfaces from acid fumes	high boiling aromatics petroleum hydrocarbons >60% ether alcohol solvents< 10% chlorinated rubber resin 10- 30% chlorinated wax plasticiser < 10%
CSR Building Materials	Plasterboard Stud Adhesives	?	Adhesive to fix board sheets to steel with minimum nails	calcium carbonate 20-60% acrylic copolymer 0-40% water 0-35% acrylic copolymmer 0-10% polyvinyl acetate resin 0-25% clay 0-15% ethoxylated nonylphenol 0-5 % toluene 0-5% sodium polyacrylate 0-5 % cellulose thickener 0-2 % petroeum hydrocarbon 0-2 % blue dye/ pigment trace
CSR Building Materials	Plaster Accelerator 1011	?	Plaster accelerator and setting agent	calcium sulphate dihydrate 60-100% starch 0-40% sodium salt of naphthalene 0-10% quartz < 0.1 %not contain asbestos

Supplier	Product Name	HSR?	Product Use	Ingredients
CSR Building Materials	Plasterbased Cements and Adhesives 0220	✓	Cement for fixing plasterboard and concrete	calcium sulphate dihydrate 65-98% calcium carbonate 0-31% calcium monocarbonate (whiting) 0-30% mica 0-10% talc 0-3 % calcium oxide (hydrated lime) ?% polyvinyl alcohol 0-2% ethylene vinyl acetate(eva) 0-2% starch 0-2%
Dulux	Dulux Epoxy Thinner	✓	Thinner for Dulux enamel	Solvesso 100 30-60% Propylene glycol-monomethyl ether 30-60%
Dulux	Dulon AAA Normal Thinner	✓	Thinner for Dulon lacquers	Acetone 30-60% Toluene 10-29% Xylene 10-29% Ethyl alcohol 1-9% n-Butyl alcohol 1-9 % Propylene glycol monomethyl ether acetate 1-9% Cyclohexanone 1-9% Benzene (impurity) <1%
Dulux	Chromate free one -pack etch primer	✓	Etch primer	Pigments 10-29% Polyvinylbutyral resin 10-29% Phenol formaldehde resin 1-9% Additive 1-9% n-Butyl acetate 10-29% Xylene 10-29% n- Propyl alcohol 10-29% n- Butyl alcohol 1-9% other solvents <1%
Dulux	Acra Primer 501 /1 Water based	✓	Architectural coating	White spirit 1-9% Ammonia< 1%
Dulux	Acra-Shield	✓	Semi gloss top coat for internal or exrenal use	Acrylic emulsion resin 30-60% Pigment 10-29% Additives (surfactant, coalescent, antifoam, preservatives, thickeners) 1-9% Water 30-60% Propylene glycol 1-9% Ammonia< 1%
EH Munro	Eucalyptus Disinfectant		Cleaning and disinfectant	Benzalkonium Chloride 2%
Emery Chemicals	Emer-Clad	✓	Water resistant protective coating.	Acrylic Copolymer 10-60% Fillers and Pigments 10-60% Additives <10%

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Fyreguard	Nullifire M701	✓	Fire rated joint sealant for walls and floors	Acrylic polymer latex including residual 10-30% Antimony trioxide 10-30% Butyl acrylate -traces Calcium alumino silicate 10-30% Water 30-60% Proxel 1%
Fyreguard	Fyre Mortar		Cement powder fire rating openings	portland cement 30% Silica Alumina filler 60% Celluose thickener minor Wetting agent -minor Gypsum -minor
Galmet Paints	Industrial primer (roac,goac,yoac)	✓	Anticorrosive paint for steel	modified alkyd resin 10-30% pigment, coloured and filler 10-30%% aroamtics hydrocarbon 10-30% pigment magnesium silicate-talc 10-30% aliphatic hydrocarbon 10-30% ethylene glycol monobutyl ether <2%
Galmet Paints	Rustpaint aerosol	✓	Anticorrosive paint for steel as aerosol	dichloromethane 10-30% modified alkyd resin 10-30% pigment, coloured and filler 10-30% liquid epoxy resins <10% acetone < 10% toluene < 10 % methoxy propyl acetate < 5% cobalt octoate < 1 % manganese octoate <1%
Galmet Paints	Rustpaint	✓	Anticorrosive	alkyd resin 10-30% aliphatic hydrocarbons 10-30% pigment, coloured and filler 10-30% liquid epoxy resins <10% cobalt octoate <10% manganese octoate <1% methyl ethyl ketoxime < 1%
Galmet Paints	Fluoro aerosol	✓	Anticorrosive	aliphatic hydrocarbon 30-60 propane 10-30% dichloromethane 10-30% ethanol 10-30% butane 10-30% thermoplastic acrylic resin < 10% pigment, coloured and filler <10%

Supplier	Product Name	HSR?	Product Use	Ingredients
Galmet Paints	Fluoro paint	✓	Paint	acrylic polymer 30-60% pigment coloured and filler 10-30% monoetylene glycol <10% ethylene glycol monobutyl ether <5% pine oil < 2% triethanolamine < 2 % ammonia <1%
Galmet Paints	Thinner-200b	✓	Paint thinner	1- methoxy 2- proyl acetate 30-60% toluene 30-60%
Galmet Paints	Thinner 300c	✓	Paint thinner	aliphatic hydrocarbon 30-60% aromatic hydrocarbon 30-60%
Galmet Paints	Thinner 400d	✓	Thinner	petroleum distillate > 60%
Galmet Paints	Thinner 500e	✓	Paint thinner	methyl ethyl ketone > 60%
Galmet Paints	Thinner 600f	✓	Paint thinner	1- methoxy 2- propyl acetate 30-< 60% toluene 30<60%
GE Silicones Australia	Silglaze N10 silicone sealant	?	Sealant-silicone mixture based on poly-dimethylsioxane silanol	mainly silicone polymers did not say what other substances are that they classify as hazardous.
Goodby Graffitti	Goodbye graffiti no.1	✓	Removal of graffiti from non porous surfaces.	No.1 Denatured alcohol 30-60% Caustic potash< 10% Hyroxy Amine <10% Glycol Ether <10% Butyl ester 10-30% Aromatic Hydrocarbons 30-60%
Goodby Graffitti	Goodbye graffiti no. 2.	✓	Removal of graffiti from porous surfaces.	Caustic Soda< 10% Water 10-30% Denatured alcohol/ Butylester mix 30-60% HydroxyAmine 10-30% Glycol Ether 10-30% Aromatic Hydrocarbons 10-30%
Hilti	Hilti CA273 Medium Setting Adhesive Paste	✓	Bonding, repairing major construction materials like concrete	PART A resin DGBA 0.1N 10-30% resin DGBA 0.1N <10% Reactive Diluent BDDGE <10% Resin DGBF0.1N <10% PART B Silica Flour 50-70% Polyamine Adduct 25-40% Phenol 0-5%

Supplier	Product Name	HSR?	Product Use	Ingredients
Holdfasts Adhesives (Australia)	Polychloroprene solvent cement	✓	Adhesive	polychloroprene 16% phonolic resin 5% magnesium oxide 0.5% toluol 40% mek 25% naphtha 13.5 %
ICI	Hydrochloric Acid	✓	General Chemical	hydrogen chloride 33% water 67%
Laporte	Duraseal	✓	Sealing leaks in guttering	bitumen > 60% kerosene 10-< 30% mineral turps 10<30% synthetic fibre < 10% calcium carbonate <10%
National Starch and Chemical	Aussie Grip Spray Adhesives	✓	Mounting paper and other such materials-permanently	hexane andhexane isomers 40% aliphatic hydrocarbon solvent 40% methylene chloride 10-30% hydrocarbon solvent 10-30% hydrocarbon propellent 30-60 % non hazardous ingredients make 100%
National Starch and Chemical	Aussie Grip Powder Sugar Soap		Redecorating and general purpose cleaner	sodium tripolyphosphate >90% water to make 100%
National Starch and Chemical	Vinyl Tile Adhesive		Bond vinyl, lino, timber, hardboard floors	rubber 10-30 % casein < 10% clay < 10% white spirit 9% hydrocarbon resin <10% ammonia .66% water to make 100%
National Starch and Chemical	Solvent Based Adhesive	✓	Adhesive for bonding wall panels	petroleum spirit 30-60% tolulene 30-60% methyl ethyl ketone 10-30%
National Starch and Chemical	Aussie Grip Seal a-gap or Water Based Emulsion Adhesive		Sealant for exterior and interior use	preservative 1% non hazardous emulsion polymer 30-60% other ingredients and water to make up 100%
National Starch and Chemical	Aussie Grip Pool Liner Repair Kit	✓	Adhesive for pool liners	acetone 30-60% tetra hydrofuran 10-30% polyurethane 10-30%
National Starch and Chemical	Aussie Grip Plastibond	?	General Purpose Polyester Putty	unsaturated polyester resin in monomer 30-60% talc <10% di- methyl aniline 0.25% surfactant <10%

Supplier	Product Name	HSR?	Product Use	Ingredients
National Starch and Chemical	Pipe Bond PVC Solvent Cement	✓	PVC pipe bonding cement	cyclohexanone 30-60% methyl ethyl ketone 30-60% stabiliser <10% poly vinyl chloride resin 10-30%(coloured blue)
National Starch and Chemical	Multi Contact Cement Aussie Grip Multi Contact Adhesive	✓	Adhesive for bonding variety of building materials	solvent x4 (hexane and hexane isomers) 10-30% acetone 10-30% toluol 10-30% rubber 10-30% hydrocarbon resin 10-30% filler < 10% non harzardous ingredients tomake 100%
National Starch and Chemical	Aussie Grip Fill n Fix.		High strength filler	calcium carbonate 30- 60% styrene acrylic emulsion polymer 10-30% fumed silica < 10% antifoam <10% talc < 10% surfactants < 10% titanium dioxide <10% preservatives < 1% water to make up 100%
National Starch and Chemical	Aussie Grip or Construction Adhesive 2646	✓	Flooring adhesive	calcium carbonate 30-60% hexane 20-30% synthetic rubber 10-30% resins 10-30% acetone < 10% white spirit <10% mineral oil <10%
National Starch and Chemical	Staybond Ceramic Tile Adhesive 7119		Ceramic tile adhesive	calcium carbonate 30-60% dbm vinyl acetate copolymer 10-30% rubber 10-20% antiffoam 10% preservatives 10% water to make up 100%
National Starch and Chemical	Aussie Grip Carpenters Woodworking Glue	✓	General purpose woodworking glue	vinyl acetate 30-60 surfactant < 10% antifoam < 10% poly vinyl alcohol< 10% preservatives<10% water to make up 100%

Supplier	Product Name	HSR?	Product Use	Ingredients
Norton Abrasives	Contact cement	✓	Adhesives for bonding laminated plastics, metal and other materials	polychloroprene rubber 10-60% w/w magnesium salt of phenolic resin 10-60% w/w toluol 10-60% methyl ethyl ketone < 10% heptane 10-60% antioxidant < 10%
Phoenix	501 Multi purpose thinner	✓	Coat thinners	Toluene 35-45% Methyl ethyl ketone 25-35% Hydrocarbon Solvent 25-35%
Reckitt and Colman	Pine-o-cleen		Disinfectant	water > 60% quaternary ammonium compound 1.5 % ethoxylated nonyl phenol < 1% sodium tripolyphosphate <1% ethylene diamine tetra acetic acid-tetra sodium salt <1% sodium carbonate <1% fragrance < 1% dye <1%
Recochem	Thinners	✓	Thinners	Mixture of hydrocarbons, alcohols, ketones
Selleys	Kwik Grip contact adhesive or solvent borne polychloroprene/resin based adhesive	✓	Bonding laminated plastics and other materials	Toluene 39% Liquid hydrocarbons (mostly paraffins and napthenes) 27% Methl ethyl ketones 9% Polychloroprene rubber/resin solid - non hazardous 25%
Selleys	Liquid Nails/Solvent Borne Synthetic Rubber Based Adhesive		High strength building adhesive	Hydrocarbons, predominently c6-c9 (including n-hexane 2.5%) 32% Synthetic rubbers 10-29% Clay 10-29% calcium carbonate <1%
Selleys	Plasti -Fix/Two Part Polyester Resin Putty	✓	Filler for holes or cracks in metal and other materials	Resin: inert inorganic fillers 30-60% polyester resin 10-29% styrene 17% Hardener: Cyclohexanone peroxide 50% Dibutyl phthalate 50%
Selleys	Roof and Guttering Sealant/ Neutral Cure Silicone Sealant		Metal to metal sealant	Polydimethyl siloxane >60% Inert fillers and pigments 10-29% Oximino silane 1-9% Alkoxy silane 1-9% Organometallic cure catalysts <1%
Selleys	Window and Glass Sealant/Acid Cure Silicone Sealant		Silicone sealant on windows and frames	Polydimethyl siloxane ?% Fillers ?% Methyl triacetoxy silane <5%

Supplier	Product Name	HSR?	Product Use	Ingredients
Selleys	All Clear/Solvent Thinner Copolymer Sealant	✓	Sealant on most building materials like roofs and gutters	Toluene 25% Hydrocarbons Liquid, Isoparraffin 9% Non-hazardous synthetic copolymers fillers, plasticisers 66%
Selleys	Bathroom and Kitchen Sealant/ White Mildew Resistant Silicone Sealant	?	Sealing around baths, showers and sinks	Methyltriacetoxysilane <5% - Slowly releases acetic acid during curing. 10ppm, 10,10-Oxybisphenoxarsine<1%
Galmet	Galmet cold galvanizing	✓	Surface coating to protect iron and steel against corrosion	Zinc dust 30-60% Aromatic hydrocarbons 10-30% Polystyrene resin <10% Chloroinated parrafin <1% Organo clay <1% Moisture solvent < 1% Ketone solvent< 1%
Taubmans	Top Gun Acrylic Sealant		Aacrylic sealant for inside and outsideuse	Acrylic polymer 10-30% Calcite 30-60% Paint Additive <10% Water 10-30%
Taubmans	Series750 Universal Thinner	✓	Universal thinner	Xylene 30-60% Methyl Ethyl Ketone 30-60%
Tremco	Heavy grade hydroseal or bitumen cut-back	✓	Waterproofing and sealant	bitumen (blown) 30-60% mineral fillers 10-30% cellulose <10% amines < 1% mineral turpentine 10- 30%
Vespol	Brushable bitumen paint		paint	non given
Vessey	Acidol	✓	Protect surfaces from acid attack	High boiling Aromatic Petroleum Hydrocarbon >60% Ether Alcohol Solvents <10% ChlorinatedRubberResin 10-30% Chlorinated Wax Plasticiser <10%
Vessey	Special Thinner FR/X	✓	Thinner for industrial coating	Xylene 60-100%
Vessey	Polymet 600 base	✓	Enamel base	Xylene 10-30% Methyl ethyl ketone 10% Methyl iso butyl ketone 10% Methyl propyl acetate 10% Polyester polyol 10-30% Pigment and other additives to make up 100%
Vessey	Polymet 600 Hardener	✓	with Polymet 600 base to make protective coating .	Methoxy propyl acetate 10-30% Xylol 10-30% Desmodur N polymerised hexamethyl di-isocyanate 75 %
Vivacity Engineering	Megapoxy H part A Megapoxy H part B	✓		No ingredients

Supplier	Product Name	HSR?	Product Use	Ingredients
WD-40	WD-40 Aerosol /Organic Mixtures	✓	Lubricant,inhibits corrosion	Aliphatic Petroleum Distillates 30-60% Hydrocarbon Propellant 10-30% Petroleum Base oil 10-30% Corrosion Inhibitor <10% Wetting Agent <10% Fragrance <10%
WD-40	WD-40 Bulk/Organic Mixture	✓	Lubricant	Aliphatic petroleum distillates > 60% Petroleum base oil 10-30% Corrosion Inhibitor <10% WettingAgent<10% Fragrance< 10%
White Knight Paints	High Gloss Enamel	✓	Gloss finish coat for internal and external use	alkyd resin 10-60% mineral turpentine 10-60% aromatic hydrocarbons 10-60% methyl ethyl ketoxine<10
White Knight Paints	Metal Primer Brush-on	✓	Anti corrosive primer	long oil /soya alkyd resin 30-60% mineral turpentine 10-30% pigments and extenders, non hazardous 30-60% driers <10% additives and surfactants<10%
White Knight Paints	Rustguard Sovent	✓	Solvent	aromatic hydrocarbons 10-60% methyl ethyl ketone 10-20% iso butanol < 10%