



# INDIAN SAFETY ENGINEER

QUARTERLY JOURNAL OF SAFETY ENGINEERS ASSOCIATION

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## NEW WEBSITE FOR INDIAN SAFETY ENGINEERS LAUNCHED



SEA (India) has hosted their website [www.seaindia.org](http://www.seaindia.org) which was a long-felt need of Indian Safety Engineers. The website was designed and developed by M/s. Dynamic Software Solutions, Chennai.

The site is designed to provide useful information, events, references and links which will be of interest to the SEA (India) members, health, safety and environment engineers, industries, service providers and others. The site will give direct link access to different websites which will be good sources of information and knowledge to safety professionals.

The site will help the safety professionals in India and abroad know about the activities of the Association and become members and be part of it. SEA (India)'s quarterly journal "Indian Safety Engineer" which is found to be useful to individuals, industries, technical libraries, colleges and universities, can also be subscribed through the site. Details on various Technical Meets conducted by SEA (India) and the previous issues of "Indian Safety Engineer" are stored under Archives to provide useful reference to the viewers of the site.

The site also gives an opportunity for safety equipment manufacturers and service providers to publicise their products

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## ISO STANDARD ON ERGONOMICS

Each day, many workers are continuously exposed to work-related risks resulting in repetitive motion and strain with injury, illness, and lost work time. Industries are challenged with designing strategies to mitigate these risk factors so that injuries and illnesses are reduced within a cost-managed framework. ISO/FDIS 6385, Ergonomic principles in the design of work systems is expected to increase user satisfaction and productivity, decrease support and training costs and improve user health and well being.

Guidelines to improve, design, redesign and modify working situations to make the workplace safer, more comfortable, and more productive are contained in this International Standard ISO 6385, the core ergonomic standard which serves as a reference for many other ergonomic standards.

### The importance

Since the publication of the first version of ISO 6385, Ergonomic principles in the design of work systems in 1981, working situations have become more technical and complex and they change more quickly.

The ergonomic working field has become an area with a great variety of subjects. There are specific standards on human characteristics (anthropometrics, metabolism and postures), but also on the design of specific types of working situations, such as office workplaces, control rooms or mobile machinery. There are specifications and guidelines for physical and for mental workload. The enormous growth in the number of standards and the general validity of ergonomic standards has led to some overlap and inconsistencies in ergonomic standards. In order to solve these problems and to make ergonomic standards more accessible for the users, it is important to go back to the fundamental ergonomic standard, ISO 6385.

In the "new" revised ISO 6385, all the basic ergonomic terms and principles can be found. This has strengthened the basis of the ergonomic working field.

This new revised standard gives guidance to the integrated design of human-centered solutions with the help of ergonomic principles and specifications for the design of tasks, jobs, the work environment, work organization, equipment and workplaces.

This new standard promotes the use of ergonomic knowledge and experience in an early stage of the design process, e.g. also in the preparation of decisions on investment in buildings, machines and automation.

The revised ISO 6385 is applicable to a variety of working situations, regardless of industry or profession. It is relevant to all sectors, not only heavy industry, but also the growing service industries (office organizations) and the health care sector. This standard is going to help professionals in the creation of durable solutions when facing the challenge of human-centered technical innovation in a quickly challenging world.

This second edition has been updated to take into account the definition of ergonomics as well as the principles and processes involved in the design of work systems. It also gives an account of all the components which together form the designed work system, including the work organization, tasks, jobs, environment, and work equipment, both hardware and software, as well as the workspace and workstation. ■

## New Website....

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and services so that the safety professionals will get to know and avail of them when they need. Safety products and services are classified into different categories such as Safety / Environment Equipment, Personal Protective Equipment, Fire-fighting equipments, Industrial Hygiene and Audits and other safety services.

Mr. R. Thiruvengadam, Chief Inspector of

Factories, Govt. of Tamilnadu, formally launched the website on 1st April 2004 during the inaugural function of a specialised training programme organised by National Safety Council (TN Chapter) and Inspector of Factories, Govt. of Tamilnadu. He appreciated that the site was very much user-friendly and would contribute to the cause of safety promotion in industries. He praised the efforts taken by the Safety Engineers Association in bringing out the site. ■

# STRESS

Have you been having frequent headaches? Bouts of upset stomach? Difficulty concentrating or feelings of inadequacy? Do you feel overwhelmed and unable to cope with tasks you are asked to do? Before you run to the medicine cabinet for antacids and pain relievers, it might be a good idea to evaluate conditions at work. The symptoms named often indicate work-related stress. Especially during times of economic uncertainty, with news reports about layoffs at major corporations, stress may be sneaking up on you.

Here are some additional signs that work-related stress may be taking a toll:

- An increase in the number of sick days or time taken off
- Increased feelings of fatigue
- Difficulty in sleeping
- Low moral at work
- Feelings of isolation from co-workers

These symptoms may seem minor when compared to serious health problems or some other major disruption in your life, but if left untreated, they can accumulate and cause damage to your health and well-being. Workers suffering from stress are more prone to work-related accidents and injury. Studies have shown that high

stress jobs increase the incidences of cardiovascular disease and suicide. Stress can push workers into depressions severe enough to require medical attention or lead to aggressive behaviour in the workplace, and that can lead to workplace violence.

What are the specific workplace conditions that can lead to stress? Here are some examples:

- Long hours
- Infrequent rest breaks
- Poor communication
- Lack of support from co-workers and management
- Lack of opportunity to participate in decision-making that affects your job
- Unrealistic deadlines
- Unclear job expectations
- Being assigned to tasks beneath your level of training and skill
- Being assigned to tasks beyond your education or training
- Lack of opportunity for growth, advancement or promotion
- Job uncertainty

If any of these conditions sound familiar, you may be headed for work-related stress. Or may be you are already there. If you already have symptoms of work-related stress, help yourself by looking for ways to reduce it. Here are a few:

- Make an honest appraisal of your own work style, looking for

ways to streamline tasks or organize your work space more efficiently.

- Seek guidance from counsellors or stress-management courses.
- Find enjoyable activities outside of work that take your mind off work.
- Start a program of regular exercise; it can lower your level of stress and improve your health at the same time.

Stress is not all in your mind; it can have very real psychological effects. If symptoms persist or worsen, see your doctor. Medication, such as antidepressants, may be what you need to get through trying times.

Dealing with work-related stress should not be the sole responsibility of individual employees. Management should be aware of the causes and effects of work-related stress. Again, honest self-appraisal may be in order. Is management behaving in ways that exacerbate worker stress? Are organizational changes needed to help stressed employee cope? If any one of the working conditions listed above are present in your workplace, management would be well advised to develop strategies and practices to minimize them. Less stress makes any workplace safer and more productive. ■

## WORK-RELATED MUSCULOSKELETAL DISORDERS (WMSD) – PART-I

### What are work-related musculoskeletal disorders (WMSD)?

Work-related musculoskeletal disorders (WMSD) are a group of painful disorders of muscles, tendons and nerves. Carpal tunnel syndrome, tendonitis, thoracic outlet syndrome and tension neck syndrome are examples. Work activities which are frequent and repetitive or activities with awkward postures cause these disorders which may be painful during work or at rest.

Almost all work requires the use of the arms and hands. Therefore, most WMSD affect the hands, wrists, elbows, neck and shoulders. Work, using the legs can lead to WMSD of the legs, hips, ankles and feet. Some back problems also result from repetitive activities.

### Are there other names for WMSD?

WMSD are very difficult to define within traditional disease classifications. These disorders have received many names, such as:

- Repetitive motion injuries
- Repetitive strain injuries
- Cumulative trauma disorders
- Occupational cervicobrachial disorders
- Overuse syndrome
- Regional musculoskeletal disorders
- Soft tissue disorders

Most of the names do not accurately describe the disorders. For example, the term “repetitive strain injuries” suggests that repetition causes these disorders, but awkward postures also contribute. These terms are used synonymously, and in the absence of agreement, WMSD is used in this document.

### How common are WMSDs?

WMSDs are recognized as leading causes of significant human suffering, loss of productivity, and economic burdens on society. However, reliable estimates of the number of WMSD is not available. The data available is limited and does not represent the magnitude of the problem because there is a great deal of under-reporting of these types of injuries. For example, over 20,000 Canadian workers received compensation in 1987 for new cases of WMSD, accounting for about 600,000 days of lost work. In British Columbia, over half the industrial disease claims are due to WMSD. A survey of cashiers throughout B.C., performed by Simon Fraser University and the United Food and Commercial Workers in 1982, indicated that over 30% of the work force surveyed suffered from a form of WMSD.

### What are the risk factors for WMSD?

WMSDs arise from ordinary arm and hand movements such as bending, straightening, gripping, holding, twisting, clenching and reaching. These common movements are not particularly harmful in the ordinary activities of daily life. What makes them hazardous in work situations is the continual repetition, often in a forceful manner, and most of all, the speed of the movements and the lack of time for recovery between them. WMSD are associated with work patterns that include:

- Fixed or constrained body positions
- Continual repetition of movements
- Force concentrated on small parts of the body, such as the hand or wrist

- A pace of work that does not allow sufficient recovery between movements

Generally, none of these factors acts separately to cause WMSD. WMSD commonly occur as a result of a combination and interaction among them.

Heat, cold and vibration also contribute to the development of WMSD.

### Body Position

There are two aspects of body position (posture) that contribute to injuries in jobs involving repetitive tasks.

The first relates to the position of the part of the body that performs the actual task, usually the upper limb. For example, tasks that require repetitive movements to the extreme ranges of the joint in the wrist, elbow or shoulder contribute to the occurrence of a painful condition in those areas. Table 1 gives examples of such movements. Poor layout of the workstation and improper selection of equipment and tools can lead to these hazardous body movements.

The other postural aspect that contributes to WMSD is a fixed position of the neck and the shoulders. To perform any controlled movement of an upper limb, the worker must stabilize the shoulder-neck region. Muscles in the shoulder and the neck contract and stay contracted to hold the position stable for as long as the task requires. The contracted muscles squeeze the blood vessels. This restricts the flow of blood all the way down to the working muscles of the hand where the blood, because of the intense muscular effort, is needed the most. The result is

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## Work-related musculoskeletal...

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twofold. The neck-shoulder muscles become fatigued, even though there is no movement. This contributes to pain in the neck area. At the same time, the reduced blood supply to the remaining parts of the upper limb accelerates fatigue in the moving

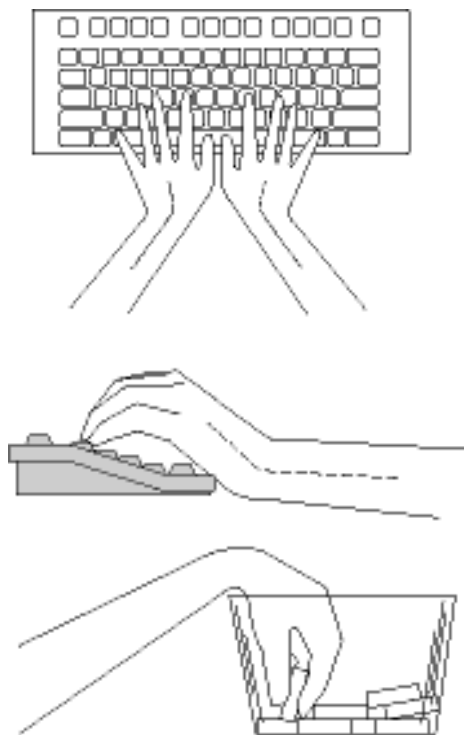


Figure 1A, 1B & 1C - Hazardous movements of the hand

muscles, making them more susceptible to injury.

### Repetition

Workers performing highly repetitive tasks are at the highest risk for WMSD. This shows that repetition of movements, although it never acts separately, is most likely the strongest risk factor. Tasks requiring repetitive movements always involve other risk factors for WMSD such as fixed body position and force: the worker, in order to perform the task, has to maintain the shoulder and neck in a fixed position and to exert some force.

Work involving movement repeated over and over again is very tiring. This is because the worker cannot fully recover in the short periods of time that are given between tasks. With

time, the effort to maintain the repetitive movements, even if they involve minimal forces, steadily increases. When the work activity is continued in spite of the developing fatigue, injuries occur.

### Force

The force required to do the task also plays an important role in the onset of WMSD. More force equals more muscular effort, and consequently, a longer time is needed to recover between tasks. Since in repetitive work, as a rule, there is not sufficient time for recovery, the more forceful movements develop fatigue much faster. Exerting force in certain hand positions is particularly hazardous (Fig. 1A-4F). The amount of force needed depends on the weight of the tools and objects that the worker is required to operate or move, and their placement in relation to the worker's body. More strength has to be used, the farther away from the body the force has to be applied. The shape of the tool plays an important role, also. Tools that do not allow the best position of the wrist, elbow and shoulder substantially increase the force required. Worn and poorly maintained tools are very important as well, yet often overlooked. For example, a worn screwdriver, pliers with worn jaws, or dull scissors can increase the operating force as much as tenfold.

### Pace of Work

Pace of work determines the amount of time available for rest and recovery of the body between cycles of a particular task. The faster the pace, the less time is available and the higher the risk for WMSD.

When the worker has no control over timing and speed of work because of external factors like



Figure 2 - Exerting force while extending forearm



Figure 3A - Hazardous reaching movements - reaching forward

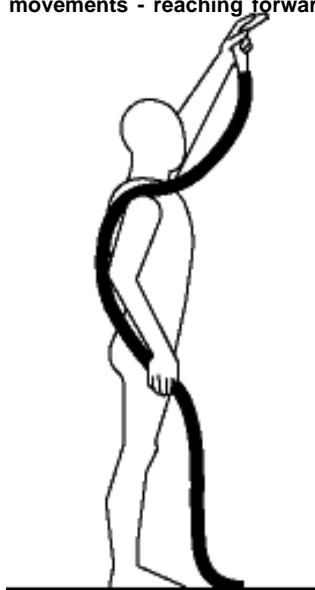


Figure 3B - Hazardous reaching - reaching above shoulder

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# SAFE OPERATION OF HEAVY EQUIPMENT

Operation of heavy equipment such as excavators, loaders, graders, rollers and bulldozers, should always be done by highly-skilled operators who have demonstrated the ability and necessary skills to operate safely. Ground-based workers should be trained in how to work safely around the equipment and how to stay clear. Unsafe practices by either the operator or those around the equipment can create very dangerous situations. Serious injuries can occur if the equipment strikes a worker or if the equipment is rolled over.

Here are a few common safety rules for operators and ground based workers to consider:

**1) Good communication is essential.** A standardized set of hand signals should be used by the operator and signal person. Operators should always know exactly where all ground based workers are located, and the wearing of high visibility vests will help the operator locate

them quickly. The equipment should have a back up warning alarm that can be heard by all nearby workers. Two-way radios are also valuable communication tools.

**2) Heavy equipment must have a rollover protective structure (ROPS)** meeting the requirements. The ROPS is designed to protect the operator if the machine tips over. A seat belt must be worn so that the operator will not be thrown out of the seat during a rollover or upset situation. If working on slopes, try to avoid moving across the face of the slope. Try to operate up and down the slope face if possible. Use extreme caution when operating near open excavations.

**3) Wear hearing protection when required.** If it has been determined that noise levels around the equipment could potentially cause hearing loss, always use protective plugs or muffs when working on or around the equipment.

**4) Never jump onto or off the**

**equipment.** Operators should always use the three-point contact rule when climbing onto or off heavy equipment. The three-point rule means having both feet and one hand, or one foot and both hands in contact with the ladder access at all times.

**5) Inspect and service the equipment regularly.** Complete equipment service in accordance with the manufacturer's recommendation. Periodic safety inspections on all components of the equipment should be done regularly by qualified personnel. Inspect the steering system and brake systems carefully. A pre-shift walk around inspection by the operator is highly recommended.

Injury accidents involving heavy equipment on construction sites have a higher probability of resulting in a fatality than many other types of accidents. It is critical to follow all of your company's safety rules and procedures when operating or working around heavy equipment.

## Work-related musculoskeletal...

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assembly line speed or quota systems then stress level increases. With higher stress level comes muscle tension causing fatigue and again increased risk for WMSD. Controlling the pace of work externally denies the worker the flexibility to determine their own work speed. It is a human characteristic to work at varying rates at different times of the day.

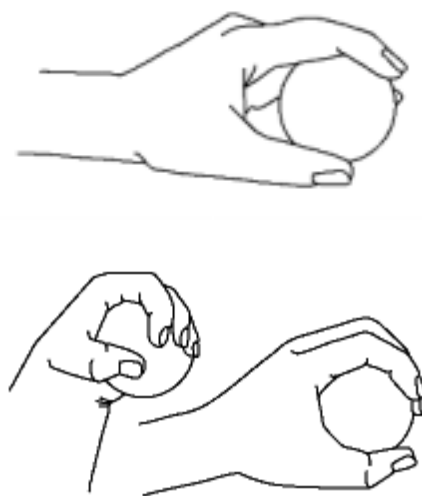


Figure 4 - Exerting force in various hand positions

## Temperature and Vibration

Temperature and humidity affect the worker performing repetitive work. When it is too hot and too humid, the workers tire more quickly and thereby become more susceptible to injury. On the other hand, cold temperatures decrease the flexibility of muscles and joints, increasing the likelihood of injury of any kind.

Vibration affects tendons, muscles, joints, and nerves. Workers using vibrating tools may experience numbness of the fingers, loss of touch and grip, and pain.

(To be continued in the next issue)

## CONSULTANCY SERVICES BY OSHA

Using a free consultation service funded by the Occupational Safety and Health Administration (OSHA), employers can find out about potential hazards at their worksites, improve their occupational safety and health management systems and even qualify for a one-year exemption from routine OSHA inspection.

The service is delivered by state governments using well-trained professional staff. Consultations take place on-site, though limited services away from the worksite are available. However, consultations cannot take place during an enforcement inspection and may not take place until citations, if any, have been issued and become final orders.

Primarily targeted for smaller, high-hazard businesses, OSHA's safety and health consultation program is completely separate from the OSHA inspection effort. In addition, no citations are issued or penalties proposed.

Confidentiality will be strictly maintained during the consultation process. The consultant will only report hazard information to OSHA if the employer fails to correct an imminent danger or serious hazards.

The employer's only obligation will be to commit to correcting serious job safety and health hazards – a commitment which is expected to be made prior to the actual visit and carried out in a timely manner.

### Getting Started

Since consultation is a voluntary activity, employers must request for it. A telephone call or letter sets the consulting machinery in motion.

The consultant will discuss specific needs with the employer and set up a visit based on the priority assigned to the request, the employer's work schedule and the time needed for the consultant to prepare for the visit. OSHA encourages a complete review of a firm's safety and health situation; however, an employer may limit the visit to specific problems.

Certain obligations must be met, including agreeing to correct all serious hazards, found during the visit in an agreed-upon time frame.

### The On-Site Consultants Will

- Meet with the employer and, at times, employees or employee representatives;
- Walk-through the worksite with the employer and employees;
- Review company injury and illness rates;
- Help identify hazards in the workplace;
- Identify kinds of help available for further assistance;
- Give detailed findings in a closing conference;
- Provide a written report summarizing findings;
- Assist the development or maintenance of an effective safety and health program;
- Provide training and education for the employer and employees;
- Recommend the site for a one-year exemption from OSHA programmed inspections, when SHARP criteria are met.

In rare instances, the consultant may find an "imminent danger" situation during the walkthrough. If so, the employer must take immediate action to protect all

employees. Other situations – those which would be judged a serious violation under OSHA criteria – require the employer and the consultant to develop a plan and schedule to eliminate or control the hazard.

### The On-Site Consultants Will Not

- Issue citations or propose penalties for violations of OSHA standards;
- Report possible violations to OSHA enforcement staff;
- Guarantee that your workplace will "pass" an OSHA inspection.

### Hazard Correction and Follow-Through

The consultant will send to the company a detailed written report about 20 days after the closing conference that explains the findings and confirms agreed upon correction periods. A list of hazards is included in the report and must be posted electronically or in an easily observable area by employees for three days or until the listed hazards are corrected. Consultants may also contact the business from time to time to check progress, and employers may always contact them for assistance. Employers using the consultation service are deferred from OSHA's scheduled inspections while the consultation remains "in progress." This period encompasses the time between the onset of the consultation and the final correction dates, including any extensions.

Ultimately, OSHA does require hazard correction so that each consultation visit achieves its

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## EXTENSION CORD – TAKE NO CHANCES!

We use extension cords almost every day both at work and at home. These are very useful devices, but they can present a fire or shock hazard when either worn out or used improperly.

### Types of extension cords

Extension cords come in either two or three-wire types. Two-wire extension cords should only be used to operate one or two small appliances. Three-wire cords are used for outdoor appliances and electric power tools. The third wire on this cord is a ground and this type of cord should never be plugged into any ungrounded electrical outlet. Only grounded extension cords are to be used with power tools unless the tool is double insulated.

Construction sites require extension cords which are specified by the National Electric Code for hard usage or extra hard usage. Approved cords

may be identified by the word “outdoor” or the letters “WA” on the jacket.

### Care and inspection of extension cords

Extension cords must be treated with care and checked regularly for damage or deterioration. The cord itself should *never* be *pulled* to disconnect it from an electrical source; remove it by the plug. They should not be placed under rugs or furniture and should never be strung through doorways, windows, walls, ceilings, or floors. Damaged cords present a potential fire or shock hazard and should be destroyed and replaced immediately.

An extension cord should never be used as a substitute for permanent wiring. They should not be fastened to a building or structure, even though staples are sold for this

purpose at many hardware stores. Avoid plugging two cords together to make a longer one. It's best to use one cord in a continuous length from the receptacle to the appliance or tool. Extension cords which are either connected together or are too long will reduce operating voltage and operating efficiency of tools or appliances and may cause motor damage.

Extension cords are convenient devices which we often take for granted in our everyday activities, but which need proper care and attention. Use good housekeeping practices at home and at work, to keep extension cords from being a tripping hazards or becoming damaged. Inspect them regularly for wear and replace defective units.

**Prevent potential electrical hazards that may lead to someone's injury!**

## Consultancy Services....

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objective – effective employee protection. If there is a failure to eliminate or control identified serious hazards (or an imminent danger) according to the plan and within the limits agreed upon, the situation is referred from consultation to an OSHA enforcement office for appropriate action.

### Benefits

Knowledge of workplace hazards and ways to eliminate them can only improve the company's operations – and the management of the firm. Employers receive professional advice and assistance on eliminating or preventing workplace hazards via the on-site

hazard survey or the on-site training from the consultant. The consultant can help establish or strengthen an employee safety and health program, making safety and health activities routine considerations rather than crisis-oriented responses. Improving workplace safety and health also brings fewer accidents, lower injury and illness rates, decreased workers' compensation costs, and limits product losses. Consultations will also help the entire company comply with OSHA standards.

### SHARP

Employers may participate in OSHA's Safety and Health Achievement Recognition Program (SHARP) or a similar state program. This program is designed to provide incentives and support to employers to develop,

implement and continuously improve effective safety and health programs at their worksite(s). SHARP provides for recognition of employers who have demonstrated exemplary achievements in workplace safety and health by receiving a comprehensive safety and health consultation visit, correcting all workplace safety and health hazards, adopting and implementing effective safety and health management systems and agreeing to request further consultative visits if major changes in working conditions or processes occur which may introduce new hazards.

Employers who meet these specific SHARP requirements may be exempted from OSHA programmed inspections for a period not less than one year. ■



## IN THE NEWS...

### ISO offers free-of-charge ISO 9001:2000 'auditing kit' online

Guidance modules on specific aspects of auditing ISO 9001:2000 quality management systems (QMS) are available free of charge from ISO and others are being developed. (*The modules are available online only*).

Short, easy to read and understand, the guidance modules that make up the "auditing kit" adopt a practical, "how to" approach. They have been developed mainly for certification body personnel carrying out audits of quality systems for organizations seeking an ISO 9001:2000 certificate as independent confirmation of their implementation of ISO's well-known standard.

However, they may also be useful to staff carrying out in-house audits to provide assurance to management about the performance of their organization's quality system, as well as to consultants,

trainers and anyone with an interest in quality.

The guidance modules are not endorsed by ISO and are not a product of its standards-development processes. The documents are intended to provide additional assistance to ISO 9001:2000 users, without modifying any of the requirements of the standard.

The documents are being developed by the ISO 9001:2000 Auditing Practices Group (APG) established by ISO (International Organization for Standardization) and the IAF (International Accreditation Forum - [www.iaf.nu](http://www.iaf.nu)) - the grouping of national accreditation bodies that verify the competence of certification bodies. The documents are available on the APG Web site at: [http://isotc176sc2.elysium-ltd.net/APG\\_index.html](http://isotc176sc2.elysium-ltd.net/APG_index.html).

### WORKERS MEMORIAL DAY

Each year, April 27 is commemorated in the U.S. and internationally as Workers Memorial Day. This day honors the memory of men and women who have been killed or injured on the job.

Although efforts by many partners over the years have resulted in significant reduction in work-related injuries, illnesses, and deaths, much more remains to be done. On estimate, an average of 6,834 people sustain disabling occupational injuries. 15 die from a job-related injury, and 134 die from work-related illnesses in the United States each day.

The National Institute for Occupational Safety and Health (NIOSH) provides national and world leadership to prevent work-related illnesses, injury, disability, and death by gathering data, conducting scientific research, and translating the knowledge gained into products and services that will improve worker safety and health. NIOSH has pledged to meet this commitment by:

1. Developing and evaluating effective tools and methods for

preventing work-related injuries and illnesses, and finding new ways to quickly move those results of NIOSH research into everyday practice.

2. Leveraging the capabilities and resources of many diverse agencies and organizations through partnerships under the National Occupational Research Agenda (NORA).
3. Building new collaborative relationships internationally, such as those highlighted recently on World Health Day 2004 to reduce the risk of work-related motor vehicle fatalities (the leading cause of work-related deaths in the U.S.).

Workers Memorial Day is an occasion to reflect on the importance of our mission, in the memory of the men and workmen who have suffered injury, illness, and death on the job. It is also an occasion to rededicate ourselves to the goal of the 1970 Occupational Safety and Health Act, "to assure so far as possible every working man and woman in the Nation safe and healthy working conditions".

### EARTH DAY – 2004 (22<sup>nd</sup> APRIL)

On April 22, people around the world joined to recognize how far we've come and keep working on what still needs to be done.

Earth Day is a time to celebrate. The Americans have accomplished so much. Gone are the days when air pollution could turn noon to night, when rivers caught fire, and toxic waste was poured down drains.

Earth Day is a time to unite. The environment knows no boundaries. We all breathe the same air, drink the same water. We all cause pollution – every one of us. And working together, we can find the

solutions and effect the changes needed to protect our planet.

Earth Day is a time to act. To turn off a light, compost yard waste, join a car pool, clean a stream or plant a tree. We know there are common sense actions that will serve our common interests.

Earth Day is a time to anticipate. To anticipate a future where we can clean the environment and affirm our nation's economic competitiveness. A future where accelerating the velocity of environmental progress should be our vision.

### U.S. ADMINISTRATION MAKES STRONG COMMITMENT TO CLEAN BEACHES

The administration announced its commitment to further protect the water quality of the nation's beaches, ensuring compliance with the BEACH Act of 2000. The Act requires coastal states, including those

bordering the Great Lakes, to adopt updated pathogen criteria by April 10, 2004. By June 30, EPA will propose federal revised standards for the states and territories that have not yet done so.

# SAFETY IN WELDING & CUTTING

## Types of Welding

- Manual Metal Arc (MMA)
- Metal-Inert Gas (MIG)
- Tungsten-Inert Gas (TIG)
- Friction
- Spot (resistance)
- Plasma
- Brazing and “Silver” soldering

## Cutting & Gouging

- Gas Cutting
- Arc and Airfeed
- Oxygen lance
- Laser Cutting
- Spark Erosion

## Hazards (depending on type)

– Arc-eye (welding flash) a gritty feeling in the eye and skin burning can result from invisible ultraviolet radiation from the arc (or from oxygen flames). The effect is delayed. It is particularly intense with TIG welding of aluminium alloy. Damage to the retina and blindness can also occur.

– Fluoride. From the coating on low hydrogen rods. This can damage the lungs and cause general poisoning.

– Iron oxide, manganese, nickel and chromium fume. These can all cause lung disorders. Zinc fume from galvanised steel can result in chills and fever. The effect is delayed. In some applications a cadmium coating has been used. Cadmium fumes poison the lungs and kidneys. Copper coatings on rods and materials can also cause fume fever.

– Zinc, lead and chromium fume from paints on coatings.

– Toxic gases such as ozone, dioxide formed by the arc (the oxygen flame also forms nitrogen dioxide), and carbon monoxide.

The first two attack the lungs (delayed action), carbon monoxide prevents oxygen reaching the body cells. Ozone will rot rubber gas tubing.

– Toxic substances from heated coatings and paints e.g. cyanide, formaldehyde and isocyanates. Isocyanates can cause chemical asthma.

– Hot metal injury to eyes, skin.

– Brazing uses brass or ‘silver’ solder. Brass can give off zinc and copper fume, some silver solder can give off cadmium fumes.

– Gouging gives off large quantities of fume and is extremely noisy. Plasma cutting is also noisy.

## Protection

– Prevent burn hazards with proper gloves, overalls and footwear. Remember, metal can be hot even though the glow has gone.

– Protect eyes with helmet and grade of visor and designed for the type of welding.

– Prevent fire with welding blanket, by removing or covering flammable materials and proper distance from flammable substance.

– Prevent explosion by checking that tanks and drums are free of substances which are flammable or give off flammable substances when heated, before welding or cutting.

– Use proper supports

– Ensure that you are comfortable

– Ensure protection from fume and gases by (depending on circumstances) one or a combination of:

- (i) good general ventilation
- (ii) use of booth
- (iii) local exhaust ventilation on the handpiece

- (iv) air supply to the helmet, and
- (v) suitable respirator which fits inside the helmet

– Protect bystanders by use of screens or proper welding curtains and blankets.

– Wear hearing protection if necessary

– Do not weld near cleaning tanks containing chlorinated solvents - the heat breaks down the vapours into very toxic gases

– Laser cutting requires protection from accidental eye contact with the beam or beam reflections and proper capture of fumes.

– Properly mount cylinders

– Use correct cylinder regulators

– Clean cylinder threads (oil-free for oxygen)

– Store oxygen and gas separately

– Clean blowpieces

– Ensure no leaks

– Fire extinguisher on hand

– Proper lighting

– Proper earthing of arc-welding equipment

– Protect gas supply tubes from hot metal and abrasion

– Choose gas tubing which is not rotted by ozone

– Eye protection during slag removal (chipping)

– Avoid radiation exposure from weld checking equipment

– Ensure that ‘O’ rings in Oxygen Acetylene retractable hose units are regularly replaced to prevent leakage.

**NOTE:** Not all the hazards of all types of welding, cutting and brazing and the precautions are given here. ■

# CHEMICAL CLEANERS

A variety of chemicals are used for cleaning purposes. These may be acid-based e.g. hydrochloric acid (HCl), hydrofluoric acid (HF), phosphoric acid (H<sub>3</sub>PO<sub>4</sub>), nitric acid (HNO<sub>3</sub>), or alkali-based, for example caustic soda (sodium hydroxide - NaOH) or caustic potash (potassium hydroxide - KOH).

## Health effects

Chemical cleaners can cause serious ill health mainly by:

- **skin contact:** acids and alkalis cause burns which are often slow to heal; and
- **inhaling fumes or mist:** concentrated solutions of acids and alkalis may give off toxic and corrosive fumes. Spray application produces a mist which may also be toxic and corrosive.

Concentrated solutions from which the dilute working solutions are made up pose the greatest risk but even dilute solutions can cause serious injury. This is particularly true of HF where skin contact with diluted solution can cause very serious and extremely painful burns which may not be felt until up to 24 hours after contact.

## Using chemical cleaners

Work with chemical cleaners require the health risk to be assessed and then prevented or controlled. Users should get information on risks and precautions from the manufacturers or suppliers who have a legal duty to provide it. Acids and alkalis will attack and corrode a wide variety of materials and a material resistant to one may not be resistant to another. Consult manufacturers or suppliers of any equipment used on whether it is suitable for use with chemical cleaners, with concentrated acids or alkalis written advice should be obtained from the manufacturers or

suppliers.

## Precautionary measures

### Preventing exposure

Consider whether corrosive chemicals need to be used at all. If yes, check with the supplier for the least hazardous products which will perform to an acceptable standard.

If corrosive acids or alkalis have to be used, choose the most dilute solution which is effective. Use proprietary brands or cleaner which are diluted by the manufacturer or supplier rather than handle concentrated chemicals yourself.

### Controlling exposure

If you have to handle and dilute concentrated acids or alkalis, dilution should take place in a well ventilated area off-site (e.g. under controlled conditions in the depot) and concentrated acid or alkali transferred using sealed equipment such as a self-priming syphon or pump. When diluting, always add acid or alkali to water, **never** water to acid or alkali. Transfer the dilute material to site in properly labelled, sealed containers. If dilution on site cannot be avoided, it should always be done at ground level. Avoid spray application. Apply the cleaner with a brush or roller, fitted with a splash guard.

### Personal Protective Equipment (PPE)

Wear appropriate protective clothing to protect your skin, face, eyes, etc. from the corrosive material, including:

- eye protection;
- gauntlet gloves which have been properly selected and are suitable for the task;
- protective, chemical proof and waterproof boots;
- protective overall and, when handling concentrated acid or alkalis, a protective apron (to below top of boots);

- approved respiratory protective equipment (RPE) which could be necessary when handling concentrated acids or alkalis, cleaning by spraying or in confined areas.

Check with the manufacturer or supplier of the PPE to ensure that it is suitable for the corrosive material being used and for the working conditions. Those who need to wear PPE should be trained in its proper use and its limitations. Store the equipment in clean, dry conditions away from chemicals - a locker would be suitable. PPE should be maintained and kept clean.

## Hygiene

Ensure that protective equipment is thoroughly cleaned with water after use and checked for any wear, e.g. pinholes or cuts in the gloves, especially the fingertips. All contaminated clothing should be laundered professionally by fully briefed staff before it is reworn.

Heavily contaminated clothing should be removed at once and washed separately. Clothing contaminated with HF or other concentrated acids should be neutralised with sodium bicarbonate (NaHCO<sub>3</sub>) before washing (keep solution readily available if HF is being used). Workers should avoid contact with contaminated equipment, e.g. they should not raise their face protection with soiled gloves as this can result in facial burns.

Welfare facilities should be available on site and workers should wash their hands and face at the end of each job and before eating, drinking or smoking and wash their hands before going to the toilet. Where possible, showers should be available at the end of the day.

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# EMERGENCY EXIT ROUTES

How would you escape from your workplace in an emergency? Do you know where all the exits are in case your first choice is too crowded? Are you sure the doors will be unlocked and that the exit access, such as a hallway, will not be blocked during a fire, explosion or other crisis? Knowing the answers to these questions could keep you safe during an emergency.

## What is an exit route?

An *exit route* is a continuous and unobstructed path of exit travel from any point within a workplace to a place of safety. An *exit route* consists of three parts:

- *Exit access* – portion of an *exit route* that leads to an exit.
- *Exit* – portion of an exit route that

is generally separated from other areas to provide a protected way of travel to the *exit discharge*.

- *Exit discharge* – part of the *exit route* that leads directly outside or to a street, walkway, refuge area, public way, or open space with access to the outside.

## How many exit routes must a workplace have?

Normally, a workplace must have at least two *exit routes* to permit prompt evacuation of employees and other building occupants during an emergency. More than two exits are required, however, if the number of employees, size of the building or arrangement of the workplace will not allow employees to evacuate safely. *Exit routes* must be located as far away

as practical from each other in case one is blocked by fire or smoke.

*Exception:* If the number of employees, the size of the building, its occupancy, or the arrangement of the workplace allows all employees to evacuate safely during an emergency, one *exit route* is permitted.

## What are some other design and construction requirements for exit routes?

- Exit routes must be permanent parts of the workplace
- Exit discharges must lead directly outside or to a street, walkway, refuge area, public way or open space with access to the outside. These *exit discharge* areas must be large enough to accommodate the

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## Chemical Cleaners....

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### Protecting the co-workers

Workers who are not involved in cleaning need to be protected against exposure to the chemicals. The following steps should be taken:

- (a) check all windows, doors, etc., in facades are closed to protect the building's occupants;
- (b) avoid applying or rinsing with a spray or working in windy conditions as this may give rise to fine droplets which could be carried as a mist by the wind;
- (c) create a 'no-go' area with barriers around the base of the facade, statue, etc, at the same time ensuring pedestrians have a safe, alternative path to use. Suitable warning signs should be posted (the local highways authority will need to be consulted if the public pavement or roadway are involved). Drainage gulleys should be covered or fenced off;
- (d) scaffolding should be close-boarded and sheeted to contain

splashes, etc. Extra ties may be needed to counter the increased wind loading on the scaffold;

- (e) open ends of scaffold poles should be capped before beginning work;
- (f) overspilt liquid should be directed so that it does not flow over the pavement (the Environment Agency, local authority and local water company should be consulted over any likely or actual pollution of water courses);
- (g) store chemical cleaners in a secure area to prevent them being accessible to persons not related to the job. Always store acids away from alkalis;
- (h) these chemicals need to be disposed of carefully and should not be put down the drain. Make arrangements with the local authority for the safe disposal of them.

### Spillages

Dilute spillages of the acid or alkali cleaners with water unless HF or concentrated acids are involved. In this case neutralise spillages with

slaked lime (calcium hydroxide - Ca(OH)<sub>2</sub>). Tools and equipment which may be contaminated should be treated similarly. Porous materials such as wood or packaging should be burned or buried in a safe place if contaminated with concentrated acids or alkalis or HF.

### First Aid

Anyone appearing to be affected by the chemical cleaners should be taken at once into the fresh air to be given first aid and referred to medical care. In most cases, first aid will involve drenching the affected parts, e.g. skin, eyes, etc. with plenty of cool, clean water. A drench shower should be available. HF burns require special first-aid treatment which involves applying an antidote to the burn. Contractors should inform the accident and emergency department of the local hospital that they are using HF on site. The hospital will then arrange to have the antidote available in case of an emergency. ■



## Emergency Exit....

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- building occupants likely to use the exit route.
- Exit stairs that continue beyond the level on which the exit discharge is located must be interrupted at that level by doors, partitions, or other effective means that clearly indicate the direction of travel leading to the exit discharge.
- Exit doors must be unlocked from the inside. They must be free of devices or alarms that could restrict use of the exit route if the device or alarm fails.
- Side-hinged exit doors must be used to connect rooms to exit routes. These doors must swing out in the direction of exit travel if the room is to be occupied by more than 50 people or if the room is a high-hazard area.
- Exit-routes must support the maximum permitted occupant load for each floor served, and the capacity of an exit route may not decrease in the direction of exit route travel to the exit discharge.
- Ceilings of exit routes must be at least 7 feet 6 inches high.
- An exit access must be at least 28 inches wide at all points. Where there is only one exit access leading to an exit or exit discharge, the width of the exit and exit discharge must be at least equal to the width of the exit access. Objects that project into the exit must not reduce its width.
- Outdoor exit routes are permitted but must meet the minimum height and width requirement for indoor exit routes and must
  - have guardrails to protect unenclosed sides if a fall hazard exists;
  - be covered if snow or ice is likely to accumulate, unless the employer can demonstrate accumulations will be removed

- before a slipping hazard exists;
- be reasonably straight and have smooth, solid, substantially level walkways; and
- not have a dead-end longer than 20 feet.

### What are the requirements for exits?

- Exits must be separated by fire resistant materials – that is, one-hour fire-resistance rating if the exit connects three or fewer stories and two-hour fire-resistance rating if the exit connects more than three floors.
- Exits are permitted to have only those openings necessary to allow access to the exit from occupied areas of the workplace or to the exit discharge. Openings must be protected by a self-closing, approved fire door that remains closed or automatically closes in an emergency.

### What are the maintenance safeguarding, and operational features for exit routes?

- Keep exit routes free of explosive or highly flammable furnishings and other decorations.
- Arrange exit routes so employees will not have to travel toward a high-hazard area unless the path of travel is effectively shielded from the high-hazard area.
- Ensure that exit routes are unobstructed such as by materials, equipment, locked doors, or dead-end corridors.
- Ensure that safeguards designed to protect employees during an emergency remain in good working orders.
- Provide lighting for exit routes adequate for employees with normal vision.
- Keep exit route doors free of decorations or signs that obscure the visibility of exit route doors.
- Post signs along the exit access indicating the direction of travel to the nearest exit and exit discharge if that direction is not

immediately apparent. Also, the line-of-sight to an exit sign must be clearly visible at all times.

- Make doors or passages along an exit access that could be mistaken for an exit “Not an Exit” or with a sign identifying its use (such as “Closet”).
- Install “EXIT” signs in plainly legible letters.
- Renew fire-retardant paints or solutions often enough to maintain their fire-retardant properties.
- Maintain exit routes during construction, repairs, or alterations.
- Provide an emergency alarm system to alert employees, unless employees can promptly see or smell a fire or other hazard in time to provide adequate warning to them.

### What are the minimum elements of an emergency action plan?

- Procedures for reporting fires and other emergencies.
- Procedures for emergency evacuation including the type of evacuation and exit route assignments.
- Procedures to account for all employees after evacuation.
- Procedures for employees performing rescue or medical duties.
- Name or job title of employees to contact for detailed plan information.
- Alarm system to alert workers.

In addition, you must designate and train employees to assist in a safe and orderly evacuation of other employees. You must also review the emergency action plan with each employee covered when the following occur:

- Plan is developed or an employee is assigned initially a job.
- Employee’s responsibilities under the plan changes.
- Plan is changed. ■

## SILICA – DATA SHEET

Silica occurs as a natural component of many materials used or encountered in construction activities. This information sheet deals with crystalline silica which can cause lung disease.

Crystalline silica is present in substantial quantities in sand, sandstone and granite, and often forms a significant proportion of clay, shale and slate. It can also be found in chalk, limestone and other rock and soil though this is unusual. Products such as concrete and mortar also contain crystalline silica.

### Exposure to silica

The health hazards of silica come from breathing in the dust. Activities which can expose workers or members of the public to the dust include:

- stone masonry;
- facade renovation;
- blast cleaning of buildings; especially using sand;
- many demolition processes;
- concrete scabbing; cutting or drilling;
- tunnelling

The use of power tools to cut or dress stone will lead to high exposures throughout the work. For other activities, exposure will often depend upon how confined the working space is, the presence or absence of ventilation and how near the worker's breathing zone is to the

source of the dust. Tunnelling through dry, silica-bearing rock will always lead to high exposures for workers at or near the cutting face.

### Health effects

Breathing in the very fine dust of crystalline silica can lead to the development of silicosis. This involves scarring of the lung tissue and can lead to breathing difficulties. Exposure to very high concentrations over a relatively short period of time can cause acute silicosis, resulting in rapidly progressive breathlessness and death within a few months of onset. Similarly, accelerated silicosis, which can progress to death within a decade, has been associated with high exposures to silica in sand blasting.

More common is progressive silicosis, usually because of exposure over a longer period. This causes fibrosis (hardening or scarring) of the lung tissue with a consequent loss of lung function. Victims are likely to suffer severe shortness of breath and will find it difficult or impossible to walk even short distances or upstairs. The effect continues to develop after exposure has stopped and is irreversible. Sufferers usually become house- or bed-bound and often die prematurely due to heart failure.

Silica may be linked to lung cancer. If this is the case it is most likely that it occurs as a progression of

lung fibrosis. Precautions taken to control the risk of fibrosis will serve to control the risk of lung cancer.

### Legal requirements

Silica has been assigned a maximum exposure limit (MEL) of 0.3 mg/m<sup>3</sup>, expressed as an 8-hour time weighted average (TWA). This means that exposure to respirable crystalline silica should be reduced so far as is reasonably practicable and, in any case, below the MEL.

### Precautions

#### Assessment

Activities which may expose workers to silica will require the health risk to be assessed and then prevented or controlled. In most cases, when it is reasonable to expect dust levels to be significant, you should consider the need for atmospheric sampling of respirable dust and respirable silica.

As a general rule, levels greater than 0.1 mg/m<sup>3</sup> can be regarded as significant. In cases of doubt it should be usually assumed that levels will be significant unless sampling from very similar work has shown otherwise. Results of sampling may be needed to find out the control measures that will be appropriate for a particular activity as well as evaluating the risk and describing the precautions. The assessment should set out in detail the way in which the control

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## AIR FRESHENERS CAN PROVE DANGEROUS

Air fresheners may smell good, but they can prove dangerous and create respiratory problems, researchers said.

A potentially harmful smog can form inside homes through reactions between air fresheners and ozone, researchers at the US Environmental Protection Agency (EPA) revealed.

The reactions generate formaldehyde, classed as a probable carcinogen and related compounds that many experts

believe are responsible for respiratory problems, 'Nature' magazine quoted them as saying.

They studied the reactions between ozone gas and fragrance molecules such as pinene and limonene which are emitted by air fresheners that plug into electrical outlets. Ozone produced when vehicle emissions react with sunlight, is a common urban pollutant and environmental bodies have set limits on outdoor levels of it, "Nature" said.

If you open a window on a high ozone day, you could trigger these reactions, says an environmental scientist at the EPA's National Risk Management Research Laboratory.

Director of the EPA's air pollution prevention and control division adds: "If you are concerned about the indoor air, you should not introduce any extra chemical sources to your home and that includes volatile organic compounds and ozone". ■

### Silica Dust....

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measures are to be monitored, supervised and maintained.

#### Prevention and control

##### *Elimination and substitution*

First of all, try to get rid of silica dust from your work. Sometimes silica can be eliminated by substituting other materials, for instance, using non-silica grits for blasting. It may be possible to get rid of or reduce operations that can generate silica dust by adopting to safer design criteria.

##### *Control of dust*

If you cannot get rid of silica dust, you should reduce exposure. In most cases it is feasible to control respirable silica by dust suppression techniques or local exhaust ventilation. Exhaust ventilated tools

which remove the dust at source, and tools fitted with a water supply for dust suppression, are widely available. Capturing or controlling the dust at source is nearly always better than attempting to control exposure by ventilating the whole area.

##### *Personal Protective Equipment (PPE)*

These control techniques may not always be appropriate or they might not reduce exposure sufficiently, so respiratory protective equipment (RPE) often has to be provided as well. You will need to select RPE very carefully as different types can give widely varying standards of protection. Surveys of respirable dust and respirable silica levels are usually necessary to ensure correct selection. For the dustiest processes,

positive pressure or airline breathing apparatus will probably be necessary. Remember that filtering facepiece or half-mask respirators give little or no protection to men with beards and that even a minor growth of stubble can severely reduce the effectiveness of RPE. Those who need to wear RPE should be trained in its proper use and in its limitations. Store the equipment in clean, dry conditions away from chemicals.

##### *Health Surveillance*

Where workers are regularly exposed to respirable crystalline silica levels greater than 0.1 mg/m<sup>3</sup>, 8-hour TWA, then health surveillance which includes all respiratory tests including lung function test and chest X-ray should be provided. ■

## HEARING PROTECTION vs. AUDIBLE LEVELS

We live in a noisy world. Some of us work in the middle of some of the noisiest places. In many high-noise industrial environments, the only option to using hearing protection is deafness. But hearing protection can be overdone.

Hearing naturally varies from one person to the next and exposure to different kinds of noises over time increases that variation. Like hearing, not all earplugs are equal. All hearing protection devices (HPDs) come with a noise reduction rating (NRR), and HPDs are attenuated differently, resulting in variations in the reduction of sound power and pressure levels. For HPDs to be effective they should be selected with consideration to the volume and character of the noise present, and to the situation in which the work is taking place.

Speech and most emergency signals are comprised of higher frequencies. If an HPD is attenuating out too many of these higher frequencies, workers may be missing important verbal instructions or warning signals. Too much hearing protection, especially in the 1000 Hz range, can make hearing a co-worker difficult, and that can encourage removal of hearing protection. This is bad. No hearing protection in a high-noise environment can quickly lead to hearing loss. The best protection

is only as good as the amount of time it is worn.

Warning signals are typically in the 1000 to 4000 Hz range, but these can be masked by ambient noise, especially if the background noise is at the same frequency and decibel level. It is important to choose a signal that stands out from background noise. Noise is made up more than one characteristic. A spectrum analyzer can detect which attenuation characteristics are needed to match the spectral characteristics of specific noises. Over-protection is most often a problem for workers with some degree of hearing loss. Industrial workers commonly suffer hearing loss with exposure to noise over time. Moderate attenuation of sounds in the middle and high frequencies is the simple answer, but hearing impaired workers may require special purpose HPDs or communication headsets.

While flat or uniform attenuation allows hearing of conversation or signals, at exposures of 100 dB and higher, protection is more important than hearing conversation or signals. In these situations, if communication is important, radio headsets may be the answer. These provide hearing protection, typically limiting sounds to 82 dB, but include two-way radios. Wherever hearing impaired workers are present, visual alarms, such as color-coded light or text-based displays, should be added to

auditory alarms. In special cases, vibrating alarms may be an alternative.

Wherever noise levels are persistently high, detecting audible alarms and warnings will remain a problem. Limiting the number of discrete signals will help. The more signals, the harder to distinguish between them. Signals that contrast well against the character of the background noise present are best. Signals should be at least 15 dB above the level at which the signal is just audible above background noise, but at 20 to 25 dB above this level, the signals risk the danger of startling workers.

Behaviour and habits in a high-noise work environment work hand in hand with hearing protection. Workers can help themselves simply by decreasing the distance between speaker and listener as much as possible. They can also use hand and facial cues to reinforce speech. Because wearing HPDs can increase a tendency to lower the voice, workers should consciously speak more forcefully when wearing hearing protection. Emphasis on these techniques should be included in training programs but to find the best means of ensuring communication and recognition of signals in the workplace, input and feedback from workers is essential. ■