Stress and Fatigue

Their impact on health and safety in the WORKPLACE

Information for occupational health professionals, human resource practitioners and others
Foreword

This document is for occupational safety and health professionals in medical, safety, ergonomics and managerial roles. It provides a scientific overview of the various theories of stress and fatigue. It will allow reasonable and practical advice to be given to employers and employees and is accompanied by shorter, more practical documents that give useable “rules of thumb”.

Stress is one of the many causes of fatigue in the workplace. Everyone would accept stress as having a potentially negative influence on product quality and on personal health and safety. Depending on the nature of the workplace the effects of fatigue on the worker’s performance may influence public safety (for example, where the workplace is an aircraft cockpit).

Fatigue should be considered as one of the many causes that may lead to impairment in an employee. Whatever the cause of such impairment (fatigue, medication, illness, recreational drugs and life events) employers need to implement a system to recognise this impairment and its causes, and to assess its possible consequences. Such a system will ensure that they have fulfilled their obligations under the Health and Safety in Employment Act 1992 to provide (as far as is reasonable and practicable) a workplace that is healthy and safe.

Internationally, no firm recommendations exist about what is or what is not an acceptable level of physical or mental fatigue in the workplace. This is because of the complexity of the subject, the difficulty of translating laboratory measures to the everyday workplace, and the specific interaction between each individual’s work and the rest of their life.

Shift-work is viewed by experts — and by those who do it — as a powerful provoker of fatigue, and as a constant source of stress for individuals and their families. This booklet mentions shift-work in outline, and its observations will be amplified in an accompanying publication.

OSH recommends that no employer view stress and fatigue as an isolated problem. Human resource policies should acknowledge the various problems in this field that can arise at work. Most of all, managers should have a basic idea of how to recognise and deal with the early signs that one of the people in their care is beginning to be exposed to health and safety problems related to fatigue — from whatever source.

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Occupational Safety and Health Service
January 1998
## Contents

1. About this booklet
   1.1 Purpose 6
   1.2 Defining stress and fatigue 7
   1.3 The authors 8
   1.4 Acknowledgements 8


3. The interrelationship between work, stress and fatigue
   3.1 Stressors 18
   3.2 Stress 23
   3.3 Fatigue 28

4. A suggested approach for the workplace
   4.1 Managing stress 36
   4.2 Managing fatigue 39
   4.3 Assessing an employee’s safety to carry on working 41

5. Additional information
   5.1 Shiftwork 44
   5.2 References 48
1.1 Purpose
1.2 Defining stress and fatigue
1.3 The authors
1.4 Acknowledgements
1.1 Purpose

This document is a review of some of the literature concerning stress and fatigue, and attempts to apply what is known or postulated to the New Zealand workplace.

It is not a code of practice, nor even a guideline for employers and employees, but one of the OSH series of scientific and medical briefing documents designed to give “best practice” advice to professionals in the field.

In such a contentious and opaque subject there will be several models and interactions which will have equal validity. This document explores one such model and applies it to the Health and Safety in Employment Act 1992. Other OSH publications offer more direct advice — for both employers and employees — about stress, fatigue, and shift-work.

Because shift-work is seen as an important stressor, brief summary information about it is included in part 5, Additional information.

A number of related issues such as post-traumatic stress debriefing, “burnout” and the role of employee assistance programmes are not covered in this document, but may be the subject of future OSH publications if interested parties find that this material is needed.

Managing violence in the workplace is discussed in an existing OSH publication, while an ACC publication covers return-to-work programmes for stress claimants.

The purpose of this document is to stimulate employers and employees into thinking about stress, fatigue and impairment as they apply to their workplaces, and to their own personal lives, and to suggest some mechanisms to help interested parties make reasonable and practical decisions about workplace health and safety.

Because this is a literature survey, references are marked in the text and listed at the end of the booklet.

This publication will be revised in 18 months to two years time, as experience is gathered in the New Zealand context.
1.2 Defining stress and fatigue

A central aim of this document is to provide clear definitions which can serve as a basis for constructive prevention strategies.

**Stress**

For the purposes of this booklet, stress is defined in terms of the interaction between a person and their (work) environment and is:

(i) The awareness of not being able to cope with the demands of one’s environment, when

(ii) This realisation is of concern to the person, in that both are associated with a negative emotional response.

This definition indicates that stress management is but one of the several strategies available to reduce the extent, effects and causes of occupational stress and fatigue. Attention to workplace stressors and fitting people to their jobs by prudent selection and proper training are two obvious strategies that can be used in addition to the traditional “stress management” approach.

**Fatigue**

Fatigue is defined as:

The temporary inability, or decrease in ability, or strong disinclination to respond to a situation, because of previous over-activity, either mental, emotional or physical.

Fatigue can compromise health and safety at work, and is a common outcome of stress and shift-work. It is almost impossible to measure except in specialised situations. General methods for preventing fatigue are outlined.

People at work can be at increased risk of harm because of impaired health and fitness. This impairment can arise from a number of causes, including fatigue — the subject of this publication. The practical result for employers is that they need to ask themselves about an employee’s ability to work safely. This document outlines the minimum questions that OSH believes should be asked.

**Shift-work**, a potent cause of fatigue, is increasingly common. Shift-work is also a cause of short- and long-term health and safety problems.

As well as a thrust towards reducing stressors at source, there is a growing consensus that appropriate information programmes are necessary for people who do shift-work. People need to be educated about the problems it may cause and provided with strategies to assist them to cope with its demands. General methods of assessing shift-work are presented to this end.
1.3 The authors

The authors of this booklet were:

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**Dr Sandy Dawson**, Medical Officer, Air New Zealand, contributed to section 3.3 on the measurement of fatigue.

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Paul Jarvie  Auckland Employers’ Association.
Dr Stephen Legg  Senior Lecturer, Department of Management Systems, Massey University.
Deborah McMahon  Business Adviser, Ministerial Support, OSH.
Hugh Oliver  New Zealand Nurses’ Association.
David Wutzler  Wellington Employers’ Association.
Requirements of the Health and Safety in Employment Act 1992

Relevant sections of the Act are summarised as they apply to the management of stress and fatigue in the workplace.
The Health and Safety in Employment Act 1992 places various obligations on employers and on employees. These requirements are contained in several sections of the Act.

In essence, the Act requires employers to design for safety and to adopt a systematic approach to identifying hazards, assessing which are significant hazards, and controlling these hazards by means of a hierarchy of measures as outlined below.

Included in the Act is the requirement of communication with employees (concerning the identified hazards and the appropriate control measures) and of ongoing monitoring (of the hazards, the control measures and the employees). The sections that are particularly relevant to stress and fatigue are described below.

**Section 6**

This section requires that employers design for safety to prevent harm occurring to employees. (“Harm”, for the purposes of the Act, is defined as “illness or injury or both”). Section 6(d) requires employers to take all practicable steps to prevent harm occurring to employees from the way work is organised, and has implications for the design of shift-working.

**Section 7**

This section requires employers to use systematic and effective methods to identify hazards and then to assess each hazard to see if it is a significant hazard or not.

Employers must identify “significant hazards”, i.e. those hazards that can result in “serious harm” and those hazards that can result in harm, being more than harm which is trivial, the severity of whose effects on any person depend (entirely, or among other things) on the extent or frequency of exposure to the hazard.

**Serious harm** is defined in a schedule to the Act. In some circumstances the health consequences of extreme stress could be classified as serious harm, for example:

- A teller in a bank where an armed robbery takes place is hospitalised for two days because of a stress reaction.
- A manager of an understaffed health agency experiencing an ongoing increase in caseload, with no additional staff provided, experiences a mental breakdown that prevents him from working for several weeks.
- An employee works several double night-shifts in a row, falls to sleep at the wheel of his car on the way home, and suffers significant injury in the resulting crash.
- For three years a surgeon is refused leave because of difficulties in finding a locum replacement. She continues to be on call and suffers a heart attack. This is partly attributed to the stress of her profession and the lack of recuperative time away from its demands.

**Sections 8, 9 and 10**

These three sections outline a hierarchy of controls that must be used when a significant hazard is identified. The hierarchy consists of the three steps: eliminate, isolate or minimise the hazard. If employers cannot eliminate or isolate hazards (because it is not reasonable or practicable to do so) they must, in addition to minimising it, monitor the exposure of the employee to the hazard and, with each employee’s consent, monitor the employee’s health.

Stress can, in some circumstances, be a significant hazard which can lead to “serious harm”.

**Section 11**

Where monitoring is carried out, employees should be given the results of monitoring.

**Section 12**

Employees should be given information about all the hazards that are inherent in the work they do and the steps taken to minimise the likelihood that these hazards will be a source of harm.

**Section 13**

Employees must be trained in the safe use of equipment, plant, etc.

**Section 14**

All employees should be given the opportunity to be fully involved in the development of procedures developed for the purpose of complying with sections 7 to 10 of the Act, and for reacting to an emergency or imminent danger.

**Section 19**

Employees should take all practicable steps to ensure their own safety while at work and the safety of any other person while at work.
3 The interrelationship between work, stressors, stress, shiftwork and fatigue

3.1 Stressors
3.2 Stress
3.3 Fatigue
The topics covered in this part are inevitably intertwined, and each has the potential to affect health and safety at work. Shift-work and stress are treated here as two potent contributors to fatigue which, in turn, may pose health and safety consequences for the workplace. This document links and defines them as set out in figure 1.

Figure 1: A diagrammatic representation of stress

The model set out in figure 1 shows a possible sequence of events that starts with an employee’s need to respond to the demands of work and culminates in physical, mental and emotional fatigue. This state may lead, in turn, to symptoms of both personal and organisational ill-health.

The ergonomist Grandjean developed a “bucket” model of fatigue, a variation of which is shown in figure 2. It shows the filling of the bucket as the restorative processes, and is complementary to the diagram in figure 1.

This model describes common experience in that people recover from the demands of life and work through sleeping, exercising, relaxing, enjoying friendships, achieving
goals and finding fulfilment at work, through sporting activities, hobbies and social events.

Work-related restorative processes occur as well, and may include:

- The completion of tasks;
- The resolution of problems;
- Supportive relationships;
- Progress towards worthwhile goals;
- The opportunity to do high-quality work; or
- The prospect of advancement and training.

All these events and circumstances can restore reserves of capacity, stamina, enthusiasm and endurance. Wellbeing requires a balance in the tension between the opposing draining and recuperative forces.

*Figure 2: The “bucket” model of fatigue*

![Diagram of the “bucket” model of fatigue](image1.png)
This means that continued exposure to the draining forces (when the ability to cope has been exceeded and when coping is important to the person), may lead to a state called “stress” that will affect health and wellbeing. It is then possible to regard the draining forces as “stressors”.

Life outside the workplace — and almost always outside the control of the employer — bears on this question also.

**Definitions**

Capsule definitions of these terms are given below. They are expanded in sections 3.1 to 3.3.

**Stressors**  Events or circumstances which may lead to the perception that physical or psychological demands are about to be exceeded.

**Stress**  The awareness of not being able to cope with the demands of one’s environment; and When this realisation is of concern to the person, in that both are associated with a negative emotional response. (Adapted from Cox1.)

This view is termed the “psychological model” and it defines stress in terms of the interaction between a person and their (work) environment.

In this way stress can be inferred from the existence of problems in the person-environment interaction, or measured in terms of health problems, cognitive processes, and emotional reactions. This is largely consistent with approaches advocated by the International Labour Organisation and the World Health Organisation3.

**Fatigue**  The temporary inability, or decrease in ability, or strong disinclination to respond to a situation, because of inadequate recuperation from previous over-activity, either mental, emotional or physical.

### 3.1 Stressors

The particular stressors that will cause most difficulty in a particular instance, and the effectiveness of an individual’s coping mechanisms are, of course, different from situation to situation and person to person. Both of these are impossible to predict in advance, but may become predictable with experience of that individual and the situation.

Five broad types of work-related sources of fatigue — or potential stressors — were identified in figure 2. They are described more fully below.
The intensity and duration of physical and mental effort

Physical effort

It is obvious that a long, physically demanding job will tire people more quickly than a sedentary job. This has been confirmed by research which shows that extended work days of 12 hours increase fatigue and that sustained working over several days with sleep loss cause a decrease in performance.

Cox quotes the upper level of human performance for working intensively and continuously as 2 to 3 days. It appears that physical performance is more resistant to impairment than mental performance, particularly if the physical effort is of moderate intensity.

Mental effort

It is also obvious that sustained mental effort is more fatiguing than work which is not so mentally demanding. When assessing an employee’s ability to carry on working safely, the intensity and duration of the physical and mental effort required by the job are major factors to consider.

It should be noted that jobs with low mental (and physical) activity can act as stressors. Cox describes “work underload” — including insufficient physical activity — as a “stressful characteristic of work”, while an ILO publication points out some of the physical consequences of an under-stimulating job.

The environment: climate, light, noise, workstation design

Environmental factors can place obvious (and at times extreme) demands on people.

For example, being in very cold or very hot work environments, being exposed to draughts, or handling vibrating tools can all lead to well recognised health problems. Poor lighting — often critical for safety — can also cause more subtle problems that increase mental and physical effort (such as discerning poorly lit text or craning the neck to avoid reflections in VDU screens).

Noise, when very loud or when it has a particular quality (high-pitched or throbbing, for example), can be damaging or distressing. Apart from the obvious effect of noise-induced hearing loss, Smith has concluded that there is considerable evidence that acute noise exposure produces physiological responses which, if prolonged, may have harmful effects on health. Cohen found that workers in high noise areas exhibited a high incidence of problems on all measures, and especially prevalent were allergies, respiratory and gastro-intestinal disorders and complaints associated with musculoskeletal and cardiovascular conditions.
Workstation design (based on ergonomic principles) is an important factor in physical comfort. When the designs of workstations, tools and equipment are inappropriate, the level of effort required to complete tasks may become excessive, leading to musculoskeletal problems. Static muscle effort to conform to poorly designed workstations can rapidly lead to “static” muscle fatigue, with occupational overuse syndrome an unfortunately common outcome.

**Mental and emotional well-being, responsibilities, worries, conflict, social interactions**

Sometimes the pressure of non-work events can be a direct cause of distress, and is often engendered by life’s events. For example, as a person faces the loss of a loved one, assumes onerous responsibilities at work or at home, or tries to resolve personal conflicts. At times, the perception of distress may be more real than the events themselves, but the perception itself will nevertheless act as a stressor for the individual.

Good social relationships are important for personal health and, it has been argued, for the health of an organisation. People who experience supportive relationships in work (and presumably all) aspects of their lives cope better with exposure to adverse or demanding events.

**A lack of physical wellbeing: illness, pain, disrupted circadian rhythm, sleep loss, inadequate nutrition and exercise**

The increased difficulties that a sick employee has in coping with stressors, compared with those of a completely healthy employee are obvious. It is also accepted that people who have a balanced diet and take adequate and regular exercise suffer less in the way of physical illness, and that people who take moderate (rather than intense) physical activity have better mental health and mood.

**The organisational characteristics of work**

Organisational characteristics in workplaces include:

- The psychological stressors involved in getting the work done;
- The individual’s control over his/her own conduct during the day; and
- Support for the individual in the organisation.

Table 1 lists a selection of these characteristics in detail, dividing them into the two broad categories of “job context” and “job content”. This list should be interpreted to
mean that each of these factors has been found linked to the presence of stress under certain conditions. It does not mean that they will produce stress every time they are present.

Table 1: A selection of potentially demanding characteristics of the way work is organised (adapted from Cox).

<table>
<thead>
<tr>
<th>Work characteristic</th>
<th>Conditions predisposing to stress</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Factors describing the context in which the work takes place</strong></td>
<td></td>
</tr>
</tbody>
</table>
| Organisational function and culture | • Rigid work practices — people can’t work out their own solutions to the day-to-day problems they encounter.  
• Poor communication within the workplace.  
• A non-supportive work culture — concerns and requests are dismissed without consideration. |
| Role in organisation | • Role or task ambiguity and uncertainty — people are unsure about what they are meant to be doing.  
• Role conflict engendered by imprecise or conflicting job descriptions. Responsibility for people beyond the individual’s capacity. |
| Career development | • Career uncertainty or stagnation.  
• Poor status or status incongruity (a mismatch between qualifications and job demands).  
• Poor pay.  
• Job insecurity and fear of redundancy.  
• A low social value of the employee’s work. |
| Decision latitude/control | • Low participation in decisionmaking.  
• Lack of control over the speed and scheduling of work. |
| Relationships at work | • Physical isolation.  
• Poor relationships with supervisors and fellow workers.  
• Interpersonal conflict and violence at work (or at home).  
• A lack of social support at work or at home. |
| Home/work interface | • Conflicting demands of work and home life.  
• Low social or practical support at home.  
• Dual career problems. (Having two jobs or juggling schedules with a working partner.) |
| **Factors describing the content of the work** | |
| Task design | • Lack of variety and/or short work cycles.  
• Fragmented or meaningless work.  
• Under-utilisation of skill.  
• Continual dealing with customers. |
| Workload/work pace | • Lack of control over work rate/pacing.  
• Work over-load or under-load.  
• High levels of pacing or time pressure. |
| Work schedule | • Shift-working.  
• Inflexible work schedules.  
• Unpredictable working hours.  
• Long or unsociable working hours. |
**Shift-work and health**

Shift-work is a necessary part of modern society, but this may come with a price. The opportunity to work shifts is valued by many employees for a variety of reasons, including social and domestic. In some industries (e.g. hospitals, police) work must cover 24 hours. In other situations, the imperative for 24-hour shifts is economic.

Different people display different tolerances for shift-work\(^{14}\), but there is clear evidence that shift-work can have long-term health consequences.

Shift-workers, particularly those on rotating shifts, have a higher incidence of sick leave, a higher rate of visits to clinics at the work site, and poorer scores on a variety of indices of health\(^{15}\). In one study, 62 percent of shift-workers complained of sleep problems, compared with 20 percent of day-workers\(^{16}\). Shift-workers, and particularly night-workers, have a higher incidence of gastro-intestinal disorders than day-workers\(^{1}\), and a number of studies have indicated that they also have a slightly higher incidence of cardiovascular disease\(^{1}\). Shift-work may also be a risk factor in such pregnancy outcomes as low birth weight and pre-term births\(^{15}\).

**Other factors**

Other factors such as gender, age, ethnicity and occupation may moderate the experience of stress\(^{17}\). In today’s working environment the fear of redundancy, the lack of job security, diminished career prospects, and a preoccupation with restructuring are all potential stressors not necessarily present in previous generations’ experience of work. It has long been felt plausible that all these factors may diminish health status as well as increase feelings of personal insecurity and the enjoyment of work. A recent study supports this view\(^{18}\).

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**Case study**

**Junior house surgeons**

Junior house surgeons working in hospitals have a job that can be extremely demanding physically, mentally and emotionally. As they commence this new role they must cope with the change from student life to the realities of long hours, intense mental activity and the emotional ups and downs that are a consequence of the sickness and death they encounter in hospital practice. Researchers Spurgeon and Harrington\(^{19}\) concluded that a significant proportion of newly qualified doctors develop some degree of psychological ill health. They argue that this may be related to sleep loss, which probably increases doctors’ vulnerability to other, already considerable demands of the job.
3.2 Stress

What is occupational stress and how does it arise?

Like most theories, the theory of stress has developed and changed since Hans Selye wrote on stress between the 1930s and the 1950s. Many different and useful theories of stress have been advanced but these are difficult to cover in a few paragraphs. Useful summaries are available.

The way people talk about stress is ambiguous and confusing. Common usage includes phrases such as “I thrive on stress”, “I’m feeling stressed”, “she’s under a lot of stress” and “he’s stressed out”. These phrases can be interpreted to refer to “stress” as an external agent, a state of fatigue or a health problem, but their actual intended meanings remain unclear.

This document uses the word “stress” to refer to a psychological state, as shown and defined in figure 1. Occupational stress is described in terms of the interaction (or transaction) between an employee and their work environment. The presence of stress can be inferred from the existence of problems in the employee/environment interaction, or measured in terms of health problems, cognitive processes, emotional reactions and organisational outcomes such as absenteeism or presenteeism (where employees may be described as being physically present at work, but “mentally absent”), staff turnover and injuries.

The model demonstrates that:

- Stress does not reside solely in a situation or in a response.
- Stress is a process — it is a transaction between the individual and the environment.
- Coping and adaptation are explicit parts of that transaction and thus help to shape the stressful experience.

The occurrence of stress therefore depends on the interaction of the individual and the circumstances they are in — it is not a result of an absolute property of either the individual or the circumstances.

Cox further developed the transactional model and said:

*The experience of stress at work is therefore associated with exposure to particular conditions of work, both physical and psycho-social, and workers’ realisations that they are having difficulty in coping with important aspects of their work situation. The experience of stress is usually accompanied by attempts to deal with the underlying problem (coping) and by changes in cognition, behaviour and physiological function. Although adaptive in the short term, in the long term such changes may threaten health.*
Individual factors and stress

Individual factors obviously exert a large effect on the way that people both respond to the demands of work and react to a perceived inability to meet those demands. Different people may perform very differently in seemingly identical tasks. This arises from variations in innate capabilities, fitness, capacity, aptitude, experience, skill and many other factors.

Employers may find it useful to think of the “goodness of fit” between each employee and the work. If the fit between the employee and their work is poor, then problems are more likely. The tall, standing worker who gets back pain because a workbench is too low, or the process worker unable to keep up with the speed of the line are examples of a poor physical fit between the worker and the work. Other examples abound in relation to a poor fit between the cognitive demands of the work and the worker’s abilities.

The concept of “fit” can be extended to cover personal attributes such as aptitude, capacity, training and physical and emotional fitness for the task, for example:

An aspiring air traffic controller is eliminated during selection procedures because he cannot “carry more than two aircraft” (in his head). He later discovers an affinity with social work.

This example illustrates the common experience that different people are suited to different tasks, and that employers will achieve greatest productivity by recognising that people display a wide range of intelligences and by marrying the appropriate people to suitable tasks23.

The concept of “poor fit”, as it applies to workplace stress, can be summarised by the set of measures developed by French, Caplan and van Harrison24. They identified two basic aspects of the employee/environment fit:

1. The degree to which the employee’s attitudes and abilities meet the demands of the job.
2. The extent to which the job environment meets the workers’ needs and, in particular, the extent to which the individuals are permitted and encouraged to use their knowledge and skills in the job.

What are the symptoms and signs of stress?

A symptom may refer to something that a person feels, while a sign is visible to an outside observer.

Organisations or individuals may “experience” symptoms and signs of stress25,26. Personal symptoms and signs of stress can be classified as physiological, behavioural, cognitive and emotional, as shown in table 2, along with a selection of organisational signs.
Table 2: Some common signs and symptoms of stress

<table>
<thead>
<tr>
<th></th>
<th>Physiological</th>
<th>Behavioural</th>
<th>Cognitive</th>
<th>Emotional</th>
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<tbody>
<tr>
<td>Personal symptoms and</td>
<td>Raised blood pressure</td>
<td>Poor sleep patterns</td>
<td>Difficulties in concentrating and with</td>
<td>Depressed mood states</td>
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<tr>
<td>signs</td>
<td>Chest pains</td>
<td>Reduced reaction times</td>
<td>memory</td>
<td>Anxiety</td>
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<td></td>
<td>Palpitations</td>
<td>Erratic behaviour</td>
<td>Inability to make decisions</td>
<td>Irritability</td>
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<td>Hyperventilation</td>
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<td>Loss of confidence</td>
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<td>Gastro-intestinal disorders</td>
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<td>Fatigue</td>
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<td>Organisation symptoms</td>
<td>Changing organisational factors may be more</td>
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<td>productive than concentrating on personal factors</td>
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<td>Physiological</td>
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<td>Not applicable</td>
<td>High absenteeism/sick leave</td>
<td>Not applicable</td>
<td>Low morale</td>
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<td>High staff turnover</td>
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<td>Poor industrial relations</td>
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<td>Loss of employee contribution to planning</td>
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<td>Poor quality and productivity</td>
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<td>and process improvement</td>
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<td>Increased accident and illness rates</td>
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<td>Increased stress claims, retirement rates,</td>
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<td>utilisation of EAP services and</td>
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<td>grievance procedures</td>
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Stress is related to the “whole of the person in the whole of life”

Individuals can never be viewed in isolated boxes. Our lives are influenced by events that occur at home, at work, during recreation or by factors far outside our individual control. The health professional should consider a wide range of factors when assessing and treating the person with stress-related health problems.

What other factors can contribute to occupational stress?

Life events

Everyone is familiar with the idea that certain life events and experiences can be distressing. Extensive research has been carried out, for example, to develop scales that attempt to rank life events such as getting married, changing or losing a job, or the death of a spouse.
This research has shown that seemingly “pleasant” experiences can be stressful. Getting married and the death of a spouse, for example, are given similar rankings. Reacting to events is a normal occurrence that motivates us to control them or to remove the perception of adverse consequences. Stress may become a problem when a person is unable to positively resolve the circumstances inducing the reaction.

Stress also results from less dramatic and less identifiable experiences that have their effect over time. Ongoing poor relationships with colleagues at work or in one’s personal life, chronic pain or the chronic illness of a loved one are examples.

**Personal factors**

It is clear that no one is immune to stress and that people may react, in different ways and at different stages. The employee’s personality, age, educational level, degree of training, health status and social status in the organisation combine with factors from outside the workplace to affect peoples’ reactions and coping abilities. The three case studies on the facing page illustrate some of these points.

**Potential interventions**

There are several opportunities to reduce the extent and effect of workplace stressors, One way is to use the hierarchy of controls outlined in the Health and Safety in Employment Act 1992 — elimination, isolation or minimisation.

The traditional “stress management” approach aims to give individuals an increased repertoire of coping skills. However, as Dewe points out, this approach deals with the issue at the secondary or tertiary prevention stages i.e, after the stress has occurred. If the traditional “stress management” is the only strategy used, the onus of coping lies only with the individual, whereas the power to alter the situation usually lies with the organisation. Primary prevention should incorporate strategies which involve adaptation by the organisation as well as the individual. There is, therefore a shared responsibility for controlling stress.

Dewe further says:

> Little long-term benefit will be gained from a programme that fails to recognise that stress is an individual-environment transaction, and that providing individuals with a widened repertoire of coping activities is of little use unless suitable environmental support and resources are provided for them. . . . Developing supports and providing resources is just as important as removing potential sources of stress.

Dewe goes on to point out that individuals are frequently relatively powerless within large organisations and that, by default, the responsibility for adaptation lies wholly
Case study 1: A young doctor

A doctor in training for a speciality (a young person with an excellent educational level, good training and a successful coping personality) became profoundly depressed after failing the speciality exam. Her problems were compounded by the high work demands of her job, the lack of time for study that these demands created and interpersonal relationship difficulties that arose because she and her partner (also a doctor) seldom managed time off together.

Many would have interpreted her career as extremely successful, but the combination of a lack of social support, high work demands, an impending crisis (the examination) and a lack of time to address the study requirements led to a deep personal sense of failure that precipitated an illness.

Case study 2: A typist with a heavy workload

A young typist who was just coping with a high workload experienced minor muscle aches and pains. An occupational overuse syndrome was precipitated by a further increase in workload (entering data for the Christmas sales) and by an emotional crisis in her personal life. This developed suddenly when the son of a family she was boarding with became schizophrenic and believed that she was an essential part of his delusions. The young woman had to immediately change her living arrangements but, at the family’s request, still had some contact with the young man, in a therapeutic context, which she found highly distressing.

Case study 3: A manager of a business with trading difficulties

The manager of a business in a provincial town that is experiencing trading difficulties was required, by the directors of the company in another city, to make a third of the staff redundant, with almost no notice and without any support.

He did so but, being friends with most of the staff he had to make redundant and being well known in the community, he found he could not cope. He visited a local pub and became drunk. He met one of his now ex-employees there and got into a violent argument with him. In driving home, he caused an accident that was nearly fatal to the driver of another vehicle.

with the individual rather than being a shared responsibility. This is obviously undesirable. If work stress has arisen because of organisational problems, no amount of adaptation by an individual can resolve the stress in the long term if the problem is organisational.
3.3 Fatigue

What is fatigue?

This document defines fatigue as a temporary inability or a decrease in ability or a strong disinclination to respond to a situation, because of inadequate recuperation from previous over-activity, either mental, emotional or physical.

Fatigue is a catch-all term for a variety of symptoms, ranging from muscle pain to difficulty in concentrating, or sleepiness.

Traditionally, fatigue was viewed as resulting primarily from the duration of a task\textsuperscript{29}, which was a key consideration in the establishment of hours-of-work regulations, particularly in industries where public safety was an important factor\textsuperscript{15}. More recently, with the expansion of shift-work and jet air travel, it has been recognised that most occupational fatigue symptoms now result from disturbances of sleep and the circadian biological clock\textsuperscript{15,30,31}. Reports of fatigue are higher among shift-workers than among day-workers, and highest during night work\textsuperscript{15, 31}.

Given the multiplicity of causes, employers should take complaints of fatigue seriously, particularly in an employee with an established, acceptable work pattern. The employee’s general state of health should be considered as well as his or her work practices and hours of work. It is acknowledged that this may be difficult for an employer to do.

Fatigue can be considered as local or general, acute or chronic, as described by Pheasant\textsuperscript{32}. Acute fatigue is the result of sudden and/or severe exposure or onset, while chronic fatigue usually develops after longer exposures, often of a significantly smaller intensity than present in acute fatigue. Chronic fatigue develops slowly.

A common symptom of fatigue is an unpleasant, general sensation of weariness. This sensation has a purpose, as Grandjean\textsuperscript{2} says:

\begin{quote}
It has long been realised as a matter of simple observation that weariness like thirst, hunger and similar sensations is one of nature’s protective devices. Weariness discourages us from overstraining ourselves and allows time for recuperative processes to take place.
\end{quote}

Other outcomes of fatigue include a general disinclination for effort, sluggish thinking, reduced alertness and a reduced ability to perform both physical and mental tasks. They have been listed as\textsuperscript{33}:

- Forgetfulness
- A state of apathy
- Reduced vigilance
- Poor communication
- Slowed reaction time
- Reduced decisionmaking
- Poor decisionmaking
- Lethargy
- Bad mood
The physiological basis of fatigue

**Physical exertion**

Physical exertion is a familiar source of fatigue. Its degree depends on the frequency and length of application of the muscle forces that must be applied, together with the nature of the work — static or dynamic. Physical exertion can be measured in a number of ways such as electromyography, counting heartbeats or measuring oxygen consumption, and limits for continuous work can be derived accordingly\(^2\). An alternative is to measure the amount of work done on external objects, such as the total weight lifted during the day.

A distinction needs to be drawn between dynamic and static muscle activity, because dynamic muscle activity is less fatiguing than static. Higher levels of dynamic work can therefore be sustained for longer periods. Physiological limits have been researched intensively and much advice is available for both types of muscle work\(^2,3^4\).

The fitness of the employee for the work plays an obvious role in the degree of fatigue that is experienced for a given amount of work accomplished.

**Sleep disruption**

To maintain alertness and performance, each individual requires a specific amount of sleep. The factors contributing to individual differences in sleep need are not well understood\(^3^5\). However, reducing sleep by one hour per night is sufficient to cause increased sleepiness, which becomes progressively more severe with each additional night of restricted sleep\(^3^6\).

Reducing sleep in the laboratory by two hours on one night produces symptoms of insufficient sleep\(^3^5\). These include increased “sleep drive”, seen as shorter sleep latencies, a reduction in light sleep (stages 1-2) non-REM sleep, fewer awakenings during sleep, and degraded alertness and performance while awake. The quality of sleep, particularly its continuity, is also an important factor affecting subsequent alertness and performance\(^3^7\).

Reduced sleep is common during shift-work, particularly during work at night\(^1^5,3^1,3^8,3^9,4^0\). It is estimated that 75 percent of all nightworkers experience sleepiness on every shift and, for an estimated 20 percent, it is severe enough to cause them to fall asleep\(^3^1\). Three aspects of work schedules exert a strongly disruptive effect on sleep:

- Prolonged hours of work;
- Irregular hours of work; and
- Schedules that require people to work when they would normally be asleep.
Circadian disruption

The circadian biological clock is located in a small part of the brain called the suprachiasmatic nucleus of the hypothalamus. This centre effectively programmes people to sleep at night and to be awake during the day. It co-ordinates the daily rhythms that exist in the diversity of physiological and behavioural functions of the body and is itself synchronised by time cues from the environment, notably sunlight, work schedules, and social factors. The quality and duration of sleep depend on when in the circadian cycle sleep takes place.

Any industry that involves 24-hour operations will require part of its workforce to try to override the basic diurnal orientation dictated by the circadian clock. This sets up a situation where the circadian clock receives conflicting time cues from the environment.

Night work, for example, tends to draw the clock round to a reversed schedule (the need to sleep in the daytime). However, the night worker is still aware of the day/night cycle and the daylight orientation of the rest of the world, and these cues tend to draw his/her circadian clock back to its preferred orientation for night-time sleep. In addition, most shift-workers revert to night-time sleep on their days off, and those working rotating shifts change their work schedules every few days to weeks. For some shift-workers, therefore, their circadian clock never adapts fully to any one schedule.

Incomplete adaptation of the circadian clock to a work schedule can degrade productivity and safety in two ways. First, sleep quality and quantity can be compromised if sleep is displaced to part of the circadian cycle when, physiologically, the individual is programmed to be awake. Shorter, more disturbed sleep increases the likelihood of making errors at work. Second, there are marked fluctuations in the capacity for physical and mental performance across the circadian cycle.

While the time of peak performance varies with the nature of the task, poorest performance consistently occurs around the time of maximal sleepiness, which coincides with the low-point in the circadian temperature cycle which is between 3-5 am for people on a stable 24-hour routine with sleep at night. Trying to work through this circadian trough also increases the likelihood of making errors.

Domestic and social factors

In addition to the physiological challenges inherent in altered work schedules, shift-workers also face challenges integrating their work patterns with domestic and social activities. When a shift-worker’s sleep times overlap the wake-times of family and friends, there can be considerable pressures to cut sleep. Shift-workers may also be
trying to sleep when environmental factors disruptive to sleep (for example, light, heat, noise) are greatest. Permanent night work can mean that there is little opportunity to take part in some activities. Attending school report evenings and shopping are but two examples.

**Shift-work, fatigue and health**

Shift-work is a necessary part of modern society and the opportunity to work shifts is valued by many employees for a variety of reasons. Different people display different tolerances for shift-work, and shift-work itself has many different forms.

For example, a particular form of shift-work is being “on call”. The rural general practitioner or the service engineer may work extended awkward hours in a manner that disrupts sleep (often in addition to the normal hours worked during the day) and may experience sleep disruption as a consequence.

The extent to which these health consequences are the result of chronic sleep loss and circadian disruption is not known. The contribution of other stresses associated with shift-work cannot be excluded. On the other hand, a recent report by the National Commission for Sleep Disorders Research in the United States found that habitual short sleepers are at risk of increased morbidity and mortality. One study has compared the longevity of mice exposed to regular day/night cycles, or to day/night cycles that were reversed once a week. The mice on the stable schedule lived 6 percent longer (the human equivalent of 5 years) than the mice on the changing schedule.

**Shift-work and ageing**

As a normal part of the ageing process, sleep at night becomes shorter, lighter and more fragmented, and people become sleepier during the day. A number of common sleep disorders also become more prevalent and older people are more likely to be affected by other medical problems that interfere with sleep. In addition, the circadian clock becomes less flexible in adapting to schedule changes across the decades from 20 to 60, which can lead to greater sleep loss among older shift-workers. Increasing difficulty with shift-work is often experienced as people approach 50 years of age. The ILO has recommended that shift-workers should have the possibility of transferring to day work at age 55.

**Nutrition and fatigue**

In addition to the physiological causes outlined above, fatigue may stem from a lack of appropriate food. For example, two studies reported evidence that foundry workers
and workers making tennis shoes who ate little or no breakfast experienced more accidents during the morning at work\(^{51}\), or had lower production rates\(^{52}\), respectively. The foundry workers who were given a high energy drink of glucose and salts before starting work had fewer accidents than workers who received a drink containing salts alone. Cox reported that blood sugar levels in motorway crash victims were commonly abnormally low\(^{53}\).

A brochure dealing with proper nutrition for manual workers in the forestry industry has been produced by the Logging Industry Research Organisation\(^{54}\).

**Medical causes of fatigue**

There are many medical causes of fatigue. Some viral illnesses leave a prolonged and profound fatigue. This may be debilitating to the extent that some people cannot work, while others may fatigue quickly and be only able to work part of the day. These sorts of fatigue are “easily” recognised as being abnormal and usually the employee is encouraged to seek medical advice.

Greater difficulty arises when a chronic or occult illness gradually causes the employee to become fatigued and lethargic. (An occult illness is one that is hidden in that it has not yet revealed itself.) Similarly, sleep apnoea and other sleep disturbances are becoming more widely recognised causes of profound fatigue, particularly in men. These “medical” causes are often difficult to differentiate from other causes of fatigue that are the major theme of this booklet.

**Difficulties in the measurement of fatigue**

A major obstacle to the more rational management of fatigue and work schedules has been the relative scarcity of valid quantitative data on which to base decisions about fatigue and work schedules. In the absence of any objective data, the issues tend to be resolved industrially — with negotiated compromises between safety, productivity, and pay.

Initially it may be appropriate for management to establish the perceptions that the workforce has about the problem and its causes, and to identify their preferred solutions. This may require an appropriate survey questionnaire, and/or interviews and meetings. Consultation with similar workforces, or sleep/shift-work specialists, may also be useful.

However, what people want to do is not necessarily influenced by health or safety. Unfortunately, people in various industrial workforces may opt for unsafe work practices if overtime payments, night rates or time off in lieu are attractive. If the
problem is health and safety then negotiating more generous overtime payments is little more than collusion between employer and employee to permit unsafe work practices, and the Occupational Safety and Health Service would view these practices unfavourably. In these situations, the ideal approach quantifies fatigue and/or health and safety risks directly — and is independent of reward in the industrial negotiation setting.

Several overseas scientific studies have used a variety of techniques to measure fatigue objectively, but they have typically been commissioned in safety-critical work situations such as in aviation, in military settings, and in the nuclear power industry. In these industries the significance of fatigue is large enough to justify major expenditure in scientific data collection. It is important to note that the methods have not generally been robust enough to use as an operational tool without appropriately chosen groups of subjects and a careful attention to detail in the study design.

The following issues need to be addressed before commencing these studies:

- Specialist assistance is essential for a valid result, and the specialist should have had experience in investigating similar industrial problems. There are few specialists with this expertise in New Zealand.

- Fatigue is not a uni-dimensional variable: the word “fatigue” may refer to sleepiness, subjective feelings, performance decrements for different types of task, or other components of the fatigue “syndrome”. A single measure of fatigue is not plausible.

- It is therefore important to assess the functional work requirement, and then to identify the component of “fatigue” which is of most concern: In a routine monitoring task on a night shift, falling asleep may be the most important risk. In such a case, measures to assess sleepiness are required. For production tasks, psychomotor performance may be most important for safety, and different measurement methods will be appropriate. More than one test method is almost invariably required to assess the range of significant fatigue components.

- The measurement method usually requires some validation for a given occupational setting, and must be capable of discriminating in the appropriate range. Many tests will indicate extreme fatigue or sleep, but in most practical situations tests are required which will discriminate between mild, moderate and extreme fatigue.

- The tests typically require consent and active participation from the workforce, which must accept the test methods and their analysis and interpretation as fair and impartial.
The test itself must not interfere with the “fatigue” component being measured. The very presence of a study team, with or without the extra workload of tests, may be enough to change the fatigue associated with the normal work environment.

A benchmark or standard will usually be helpful, because none of these methods will give absolute answers to the key question: “Is this safe?” This is because there are other important criteria to consider — not least the operational setting and the consequences of a failure. The benchmark may be from other comparable work situations which have been established as “safe”. Alternatively, objective measurements may be used to compare different options for scheduling work or procedures and for monitoring trends.

None of these measurement techniques comes close to being usable as a pass/fail test for individual assessment before starting work because they all require groups of subjects and a statistical analysis.

In summary, the technology for objective measurement of fatigue is becoming available, and is being more widely used to address specific areas of high risk. In future, these technologies, and their interpretation, may be further developed and become available for use as operational tools in industry.

In spite of these limitations, various empirical methods of assessing fatigue are available. When used as decision support aids — rather than hard and fast limits — they make a valid contribution to the assessment of a person’s ability to continue to perform safely.

Examples of these methods are a standardised, computerised tracking task that can assess the level of fatigue relative to a person’s previous performance, and the use of software to estimate the level of fatigue, given the start and finish times of the previous seven days of work.
4 A suggested approach for the workplace

4.1 Managing stress
4.2 Managing fatigue
4.3 Assessing an employee’s safety to carry on working
As stated at the beginning of this booklet, employers require a system for dealing with an impaired employee, whatever the cause of impairment.

Employers must consider impairment as a potentially significant problem if their accident and illness rates suggest uncontrolled hazards in the workplace. Fatigue may be one of these hazards and needs to be assessed in the same manner that an employer assesses the fitness for work of someone they suspect is impaired because of any other causes, such as illness, use of alcohol or other recreational drugs or medication prescribed by their doctor.

Only one hazard (alcohol) has an accepted test providing a result which can be equated with impairment. In the case of other hazards leading to impairment (e.g., other recreational drugs, fatigue, disastrous life events, or changes in medication for an ongoing illness) it is seldom obvious that the employee is impaired. In many cases the impairment can be subtle and the assessment of its potential to affect workplace health and safety may well require medical assessment, and will certainly require discussion and input from the employee.

Below are some practical suggestions for the control of the hazards identified.

### 4.1 Managing stress

Stress may occur when: (i) people realise that they are not coping with the demands being placed on them, and (ii) when this realisation is important and unpleasant to them.

The qualifications are necessary to distinguish between the effects of a lack of ability on performance and the effects of stress on performance. Further, if an individual perceives that she or he cannot cope with the demands (of work, say), but this does not worry them, then stress will not be a problem, but productivity may be.

These differences create difficulties in dealing with the causes and effects of stress. Another is that a person’s perception of a situation may not be as bad as it is, or that an “inability” to cope may be perceived rather than real\(^56\). People may be more or less aware of not coping. Some people may regard their ability more highly than they should, or may be unaware of the markers that indicate both personal health and performance problems.

**Prevention categories**

Four broad types of strategy for preventing stress are evident, as listed below.
Primary prevention (elimination)
1. Reduce the extent of and/or impact of stressors.

Secondary prevention
2. Increase the goodness of fit between people and tasks by selection or training.
3. Provide support for people at work.

Tertiary prevention (minimisation)
4. Alter the way people perceive and deal with the demands (and the effects of these demands) placed on them — the typical “stress management” approach.

Another approach is to ask what properties of a job, when present, will promote psychological well being. Emery and Emery\(^5\), in pioneering research in the Australian context, listed six intrinsically positive facets of jobs:

1. Adequate “elbow room”;
2. Learning on the job and continuing to learn;
3. An optimal level of variety;
4. Receiving help and respect from work-mates;
5. Meaningful and socially acceptable work; and
6. A desirable future.

These considerations lead to table 3, which outlines an approach to the identification, assessment and control of hazards in the workplace that lead to stress.

**Figure 3: Primary, secondary and tertiary prevention of stress**
### Table 3: Stress — hazards and solutions

<table>
<thead>
<tr>
<th>Identified hazards</th>
<th>Suggested solutions</th>
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<td><strong>Intensity and duration of physical and mental effort</strong></td>
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</table>
| **Excessive physical work** Discussion with workers and examination of accident and injury rates will indicate when work is exceeding the physical abilities of the people doing it. A number of practical alternatives are available. | **Elimination** Substituting manual tasks with machinery.  
**Isolation** Restricting that work to specially trained individuals  
**Minimisation** Increasing the staffing, increasing rest periods or changing the work process to avoid excessive peaks of demand or excessive sustained physical effort. |
| **Too little mental and physical activity** Complete inactivity is a stressor in its own right, leading to boredom. | If elimination or isolation is impracticable, a simple solution may be job rotation within the shift to other more active jobs. |
| **Excessive mental activity** Evidence suggests that people are able to cope in the short term with very high mental demands, but that a lack of recuperative periods leads to chronic mental fatigue with deterioration in job performance. | If elimination or isolation are impracticable, possible solutions to minimise the hazard will include ensuring that there are enough staff to do the job, job rotation, planning work to minimise peaks in workloads, enforced rest periods, introduction of training routines at preset periods and ensuring staff take appropriate holidays. |
| **Environment comfort factors** | |
| **Lighting, noise, workstation design** | These basic aspects of workplace hygiene are more straightforward to identify, assess and control, compared to the complexities of the other factors relevant to stress and fatigue in the workplace. Refer to OSH codes and guidelines. |
| **Mental and emotional wellbeing** | |
| **Support and resources in the face of responsibilities, worries, conflicts and social interactions** | The positive aspects of work — when catered for — can increase the enjoyment of it. Employers should be aware of the risks of placing impossible demands on employees. If employees are expected to accept added responsibilities and accountabilities, this must be accompanied by appropriate training and resources so that employees can meet these additional expectations. Where the home and work interface are combining to upset an employee’s mental and emotional wellbeing, a sensitive employee assistance programme (EAP) will allow the employee access to appropriate services to help resolve these conflicts. A flexible approach to sick/holiday leave will often allow people to resolve these problems themselves. |
| **The organisational demands of work** | Five major variables may be considered in the design of work and tasks to eliminate or minimise stress: Control, Uncertainty, Support, Conflict, and Demands. The following issues, listed under these headings and resulting from extensive research, may be regarded as a consensus of the recommendations in this area. (Adapted from references 1, 58.)  
**Control** The provision of some control over the appropriate aspects of the work and the workplace, perhaps through participative decisionmaking; performance monitoring with relevant feedback to individuals.  
**Uncertainty/ambiguity** Clarity in work assignments, the consistent application of clearly stated company policies and a timely and free flow of easily accessible information; an early resolution of the uncertainty stemming from job insecurity or redundancy. |
Support for those with a high responsibility for people or continued exposure to client/customer groups; social or physical isolation reduced to a minimum.

Conflicts
Clear and stable job descriptions and task assignments; supportive supervisory styles, participative decisionmaking and prior agreed mechanisms to reduce conflict; open discussion of potential and real conflicts; resources equal to demands.

Demands
Jobs require a variety of skills, abilities and knowledge; boring and/or paced work reduced to a minimum or shared equally among staff; the demands of the job and the abilities of the individual are equated; feedback about performance is given to all, including service workers; information jobs enlarged rather than reduced in scope.

Employers can provide a number of human resource policies including employee assistance programmes, sickness policies and, in some cases, medical insurance benefits that will encourage the early reporting of health problems by the employee.

Employers should adopt a sympathetic and active rehabilitation programme for those with illness or injury, provide health information to their employees, and encourage such positive health actions as getting adequate exercise (e.g., supporting workplace sports teams), providing food appropriate for the time of day at work (where there is a cafeteria), and consider providing a smoke-free workplace.

Employers should ensure that where shift-work is a requirement of the process shift rosters are designed in consultation with the workforce. Employers should provide education about the impact of shift-work (including its effects on circadian rhythms) and about coping strategies, to all employees entering shift-work, as well as providing updated information for those already in shift-work, and for roster designers.

Employers should ensure that all rosters permit adequate rest time for employees to be able to arrive at work well rested. This will require consideration of the circadian variation in the person’s ability to obtain sleep. Employers should ensure that rest breaks between shift-cycles are sufficient to permit full recovery from any sleep loss accrued during the shift cycle.

As with all industrial health problems, previous experience acts as a predictor of the future.

4.2 Managing fatigue

The prevention of fatigue begins with careful planning of tasks and their scheduling. Tasks should be designed so that extremes of exertion (mental and physical) are avoided and so that there is sufficient recovery time available.

Table 4 presents a framework for managing these issues (adapted from Cox).
Table 4: Principles for managing fatigue at work

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<tr>
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<th>Principle</th>
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<tr>
<td>1</td>
<td>Planning the organisation of work prevents health problems.</td>
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<td>2</td>
<td>Successful implementation of work requires extensive open communication between all parties in the workplace (e.g. quality circles, TQM processes, employee representatives).</td>
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<tr>
<td>3</td>
<td>All aspects of the work organisation must be considered, including staffing levels, performance evaluation systems and remuneration systems.</td>
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<td>4</td>
<td>Work schedules identified as causing excessive fatigue should be eliminated or the fatigue minimised by redesign.</td>
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<td>5</td>
<td>Individuals should have the maximum degree of responsibility and independence that is practical and appropriate to their abilities, and their training should reflect these current abilities and their probable future work.</td>
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<tr>
<td>6</td>
<td>Economic factors and production demands should not displace measures designed to control fatigue.</td>
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<tr>
<td>7</td>
<td>Individuals need to feel that they have some influence and control in their work.</td>
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<tr>
<td>8</td>
<td>Fatigue should be recognised as a legitimate and significant workplace hazard, requiring appropriate measures to be instituted to allow recuperation.</td>
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To be implemented effectively, these suggestions require that managers and workers have good information about the mechanisms underlying fatigue so that they can make informed decisions. This information should cover the physiological factors behind fatigue, the impact of workplace conditions in causing fatigue and practical countermeasures to reduce fatigue.

Case study: A multi-level approach to fatigue management

While many of the underlying physiological factors are generic, the work-related factors contributing to fatigue are very varied. They represent an interplay between regulatory requirements, such as hours-of-work regulations and safety legislation, scheduling practices within industries and companies, work requirements for individual jobs, and the various coping strategies employed by each worker.

Recognising these complexities, the NASA Fatigue Countermeasures Programme has developed a multi-level approach to fatigue management in the US aviation industry\textsuperscript{28,35,36}. This approach relies on co-ordinated action and co-operation throughout the industry, including regulatory authorities, companies, and workers and their representatives. By examining all the possible avenues for improving fatigue management, it offers greater flexibility, for example when some approaches must be excluded because of cost factors, or operational constraints, such as airport availability, aircraft capabilities, etc.

Industry-wide education is recognised as a key element in this approach. In recent years, there have been major advances in basic scientific understanding of the physiology of sleep and the circadian clock. There is growing research activity aimed at the development and testing of pharmaceutical, behavioural, and other countermeasures to minimise the impact of disturbed schedules on worker health, safety, and productivity\textsuperscript{60,61,62}. However, there has been a major failure of transfer of this knowledge to the public, the health professions, other shift-working industries, and health and industrial policy makers\textsuperscript{15,63,64,65}.  

\textit{Stress and Fatigue — Their impact on health and safety in the workplace}
To address the need for educational materials adapted for the United States aviation industry, a 1.5-hour educational module has been developed\textsuperscript{64}. It includes basic information on sleep and circadian rhythms, and the disruptive effects of different types of flight operations on these physiological systems, together with specific fatigue countermeasure suggestions for use by flight crews. An estimated 40,000 US crew members trained on this program in 1995, and it has been recommended that such training become mandatory\textsuperscript{61,62}.

In addition, company managers, schedulers, trainers and federal regulators have received in-depth education on fatigue in two-day workshops co-presented by NASA staff at the NASA Ames Research Center. The Federal Aviation Administration is currently revising the flight and duty-time limitations for the United States aviation industry, taking into account this and other research activities from the Fatigue Countermeasures Programme. The success of this approach has prompted the National Transportation Safety Board to promote it for other sectors of the United States transportation industry.

While this case study describes initiatives in a large industry where safety is critical, the following elements of the programme could be applied anywhere:

- Recognition within the industry of the fatigue problem;
- The development of an education programme;
- In depth education for managers and supervisors; and
- Careful attention to the design of rosters.

### 4.3 Assessing an employee’s safety to carry on working

The practical and vital question here is whether or not an employee is in a fit state to carry on working safely. Stress, fatigue or shift-work may compromise this ability.

One of the many practical approaches that could be used to assess the probability of fatigue in an employee is presented in table 5. This is not a scientific formula, and it should not be used to differentiate between safe and unsafe situations. It is rather an aide-memoir, and the questions raise the issues that bear on whether stress and fatigue may be impairing that employee’s ability. There is no obligation to use this particular method, but some form of assessment should take place.

In the course of managing their business, employers regularly ask themselves basic questions concerning the performance of the task. For example: Are there enough people to do the work? Do they have the right equipment? Are they clear about their functions? Table 5 extends these questions by asking: Is the person fit to be at work?

It is not OSH’s view that a formal written record needs to be kept. Many methods of this type will be in use — albeit informally — by many supervisors. Some of the
questions are difficult to answer — or even to ask — and others will require a value judgement to be made.

The HSE Act requires employers to take all practicable steps to prevent harm. Employers who make errors of judgement while acting in good faith would not be criticised, but employers who fail to ask questions may be in breach of their legal obligations.

Table 5: Assessment of an employee’s safety to carry on working

<table>
<thead>
<tr>
<th>Criterion</th>
<th>Assessment scale</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. How many hours did the employee work in the past week?</td>
<td>Won’t usually need assessment</td>
</tr>
<tr>
<td></td>
<td>Under 40 hours</td>
</tr>
<tr>
<td></td>
<td>Increasing need for assessment</td>
</tr>
<tr>
<td></td>
<td>Over 65 hours</td>
</tr>
<tr>
<td>2. What is the pattern of the hours worked in the past week?</td>
<td>Regular</td>
</tr>
<tr>
<td></td>
<td>8-hour shifts</td>
</tr>
<tr>
<td></td>
<td>Extended</td>
</tr>
<tr>
<td></td>
<td>irregular shifts</td>
</tr>
<tr>
<td>3. Is the employee suffering from acute sleep loss?</td>
<td>Regular sleep of usual day/night pattern and length</td>
</tr>
<tr>
<td></td>
<td>Disturbed or curtailed sleep</td>
</tr>
<tr>
<td>4. Does the employee have a sleep debt?</td>
<td>No reason for sleep debt</td>
</tr>
<tr>
<td></td>
<td>Hours worked and personal circumstances make sleep debt a probability</td>
</tr>
<tr>
<td>5. Is the employee required to work at a time that is out of synchrony with the waking cycle of the employee’s circadian rhythm?</td>
<td>No</td>
</tr>
<tr>
<td></td>
<td>Sleep periods are out of synchrony with the employee’s present circadian rhythm</td>
</tr>
<tr>
<td>6. What events are currently occurring away from work — is the employee experiencing life stressors?</td>
<td>None</td>
</tr>
<tr>
<td></td>
<td>Life events pose major problems</td>
</tr>
<tr>
<td>7. How well has this employee coped in the past?</td>
<td>Has coped well in the past</td>
</tr>
<tr>
<td></td>
<td>Has not coped well in the past</td>
</tr>
<tr>
<td>8. Does the employee get support at work — and at home?</td>
<td>Has had good support in the past</td>
</tr>
<tr>
<td></td>
<td>Support networks not evident</td>
</tr>
<tr>
<td>9. What is the physical intensity of work?</td>
<td>Medium</td>
</tr>
<tr>
<td></td>
<td>Very low or very high</td>
</tr>
<tr>
<td>10. Does the employee’s physical fitness match the demands of the work?</td>
<td>Close fit between fitness and requirements</td>
</tr>
<tr>
<td></td>
<td>Obvious discrepancies</td>
</tr>
<tr>
<td>11. What are the mental and emotional demands of the work?</td>
<td>Medium</td>
</tr>
<tr>
<td></td>
<td>Very low or very high</td>
</tr>
<tr>
<td>12. Does the employee’s mental/emotional state match the demands of the work?</td>
<td>Close fit</td>
</tr>
<tr>
<td></td>
<td>Obvious discrepancies</td>
</tr>
<tr>
<td>13. Do environmental factors pose an additional load?</td>
<td>No influences</td>
</tr>
<tr>
<td></td>
<td>Major influences</td>
</tr>
</tbody>
</table>
5 Additional information

5.1 Shift-work
5.2 References
5.1 Shift-work

Shift-work and workplace fatigue: An issue for health, safety, and productivity

The most extensive information linking sleep loss, circadian disruption, and fatigue to specific safety incidents and accidents comes from studies in the United States public transportation sector, including airlines, railways, maritime, and highway driving. Fatigue is the most commonly cited probable cause of heavy trucking accidents in the United States. It is implicated in one-fifth of aviation safety incidents, and is likely to be an important contributing factor in many accidents currently attributed to human error. This includes two thirds of all accidents among commercial air carriers, and up to 90 percent of accidents in general aviation. Errors made by nightworkers in the early hours of the morning have been identified as critical factors in catastrophes and major incidents in the nuclear power industry (including the near-meltdown at Three Mile Island and the Chernobyl disaster), and in the American space programme, including the Challenger disaster. As these examples illustrate, fatigue-induced human errors can have major consequences for public safety, as well as for the workers involved.

Studies of error rates and productivity in round-the-clock industries, where work requirements and the work environment are comparable on all shifts, consistently show poorest performance on the night shift. Similarly, standard performance tests administered to shift-workers either at work, or at home between shifts, show poorest performance when they are working nights. In the extreme, when sleepiness is severe enough to cause an individual to disengage briefly from the environment (so-called “micro-sleeps”), and this coincides with a critical need for action, then an accident may ensue. Micro-sleeps have been measured (by electroencephalogram and electro-oculogram) in train drivers and airline pilots during critical phases of scheduled operations.

The assessment of shift-work

In this section some recommendations about the planning and implementation of shift-working are given in table A1, and in table A2 some questions that should be asked when designing roster systems are suggested. Table A3 lists individual factors that should be considered and table A4 a number of miscellaneous factors that affect responses to shift-work.

A number of factors common to successful shift-working companies have been stated by Dawson. These factors focus on shift-working rather than roster design:
- Accountability — someone has specific responsibility for shift-work management.
- Promote consultative decisionmaking, including workers and management
- Shift the locus of control towards workers and shift teams
- Provide an appropriate induction to shift-work
- Provide education and training
- Include partners and families in consultation and education.

Table A1: Shift-work assessment — Questions that may bear on the successful implementation of shift-working

<table>
<thead>
<tr>
<th>Aspect of shift-work</th>
<th>Assessment factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>The nature of the work</td>
<td>Is the work physically arduous? Does the work require a high degree of mental effort? Is the work monotonous? Is the work repetitive? What is the nature of the tasks? What is the work/rest regimen? Are adequate breaks provided? Is the worker exposed to heat, noise or air contaminants? Does any additional exposure to noise, heat and air contaminants from working more than 8 hours a day mean that workplace exposure for these standards require modification? Applicable to all the above — Has management made some kind of assessment about the suitability of the work and tasks for shift-workers, with their known limitations and problems?</td>
</tr>
<tr>
<td>The person</td>
<td>What is the age of the employee? What is the health status of the employee? What is the employee’s experience of shift-work? What is the employee’s state of adaptation to shift-work? Has the employee been informed about the hazards of shift-work? Has the employee been trained in how to minimise the effects of shift-work? Can the employee sleep properly during the day?</td>
</tr>
<tr>
<td>The nature of the shifts and the roster system</td>
<td>Is night-working reduced to the minimum possible? When do the shifts start? How long are the shifts? In what direction do the shifts rotate? How rapidly do they rotate? (number of consecutive days on each shift) How long is there between each similar shift? Is there sufficient time between shifts when they change? Are there sufficient days off? Do employees get consecutive days off and full weekends off? Are double shifts avoided?</td>
</tr>
</tbody>
</table>

continued overleaf........
Owing to the immense variety of contexts in which shift-work occurs, there are no hard and fast rules about the way that roster systems should be drawn up. The focus of the planning should be on shift-working, with all its connotations and consequences, rather than roster designs. Table A2 presents questions that should be addressed when rosters are designed.

**Table A2: Planning and implementing rostering systems (adapted from Knauth74)**

<table>
<thead>
<tr>
<th></th>
<th>1. Is night work reduced as much as possible?</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2. Is the rate at which shift systems rotate appropriate to the rest of the shift-working context?</td>
</tr>
<tr>
<td></td>
<td>3. Is it possible for the majority of shift-workers to avoid permanent night work?</td>
</tr>
<tr>
<td></td>
<td>4. If extended hours (over 8 hours) are to be worked:</td>
</tr>
<tr>
<td></td>
<td>(i) Are the nature of the work and the workload suitable?</td>
</tr>
<tr>
<td></td>
<td>(ii) Is the system designed to avoid the accumulation of fatigue?</td>
</tr>
<tr>
<td></td>
<td>(iii) Are arrangements to cover for absentees adequate?</td>
</tr>
<tr>
<td></td>
<td>(iv) Will overtime be avoided?</td>
</tr>
<tr>
<td></td>
<td>(v) Are toxic exposures limited?</td>
</tr>
<tr>
<td></td>
<td>(vi) Is a complete recovery after work possible?</td>
</tr>
<tr>
<td></td>
<td>(vii) Is there a high acceptance of the working time?</td>
</tr>
<tr>
<td></td>
<td>5. Can early starts be avoided for the morning shift?</td>
</tr>
<tr>
<td></td>
<td>6. Is the degree of flexibility of working time (in all shifts) appropriate for the overall context of the shift-work?</td>
</tr>
<tr>
<td></td>
<td>7. Can quick changeovers from one shift to the next be avoided to the extent dictated by the overall shift-working context?</td>
</tr>
<tr>
<td></td>
<td>8. Are the number of consecutive working days limited to a number that is appropriate to the overall context of the shift-working?</td>
</tr>
<tr>
<td></td>
<td>9. Can breaks of two full days and some full weekends be provided?</td>
</tr>
<tr>
<td></td>
<td>10. Is the direction of shift rotation appropriate to the overall context of the shift-working?</td>
</tr>
</tbody>
</table>
Table A3 describes some of the situational factors that will be relevant to shift-working and to shift-workers. Others may well be relevant in particular situations.

**Table A3: Individual factors that affect the responses to shift-work**

- Training and experience
- Coping skills
- General health
- Age
- Gender
- Diet
- Rigidity of sleeping habits
- Circadian adaptability
- Morningness/eveningness
- Neuroticism
- Introversion/extroversion

**Table A4: Miscellaneous factors that affect responses to shift-work**

- Is the shift-worker single, or living with a partner?
- Is the partner a shift-worker?
- How many children are affected, and what ages are they?
- What is the socio-economic level of the shift-working population?
- What housing do the shift-workers have?
- What job alternatives are there in the locality?
- What local shift-working traditions exist?
- What leisure activities are available?
- What social support is available for shift-workers?
- What is the size of the local shift-working community and what is their attitude to it?
- How much commuting must shift-workers do?
5.2 References

Part 3: The interrelationship between work, stressors, stress, shiftwork and fatigue


27. Complied from various sources, including Gilmour McGregor Associates.


33. NASA Fatigue Training Module.


Part 4: A suggested approach for the workplace


59. Definition: “a good employer”. Section 56, State Sector Act 1989


**Part 5: Further information**


