



ERGONOMICS FOR THE PREVENTION OF MUSCULOSKELETAL DISORDERS

Provisions of the Swedish National Board of Occupational Safety and Health on Ergonomics for the Prevention of Musculoskeletal Disorders, together with the Board's General Recommendations on the implementation of the Provisions

List of contents

Provisions of the Swedish National Board of Occupational Safety and Health on Ergonomics for the Prevention of Musculoskeletal Disorders

Scope and purpose	5
Responsibilities of the employer	5
Non-employer responsibilities	7
Entry into force	8

General Recommendations of the Swedish National Board of Occupational Safety and Health on the implementation of the Provisions on Ergonomics for the Prevention of Musculoskeletal Disorders

Background	9
Physical loads vary in character	10
General factors potentially contributing to musculoskeletal disorders	12
Basic principles of ergonomics concerning the musculoskeletal system	13
Guidance on individual Sections	14
Guidance on Section 1	14
Guidance on Section 2	16
Guidance on Section 3	23
Guidance on Section 4	28
Guidance on Section 5	30
Guidance on Section 6	31
Guidance on Section 7	32
Guidance on Section 8	32
Guidance on Section 9	34
Guidance on Section 10	37
Guidance on Section 11	38
Guidance on Section 12	38

Appendix A. Models for the assessment of work postures, manual handling and physically monotonous, repetitive work	39
--	----

Appendix B. Checklist for identifying load factors potentially dangerous to health	40
--	----

Information from the Swedish National Board of Occupational Safety and Health	53
---	----

AFS 1998:1

Provisions of the Swedish National Board of Occupational Safety and Health on Ergonomics for the Prevention of Musculoskeletal Disorders



Adopted 29th January 1998
1998

Published 23rd April

The following Provisions are issued by the National Board of Occupational Safety and Health pursuant to Section 18 of the Work Environment Ordinance (SFS 1977:1166).¹

Scope and purpose

Section 1

These Provisions apply to ergonomic conditions concerning musculoskeletal disorders at work. The purpose of the Provisions is for workstations, jobs and work environment conditions to be designed and arranged in such a way that risks of physical loads which are dangerous to health or unnecessarily fatiguing are averted.

Responsibilities of the employer

Work postures and movements

Section 2

The employer shall as far as is practically possible design and arrange work and workstations in such a way that the employees can use work postures and working movements which are favourable to the body. Prolonged or frequently recurring work with the trunk of the body bent or twisted and with the hands above shoulder height or below knee level shall be avoided. The same applies to work which entails the exertion of force in unfavourable work postures.

If special visual aids are needed in order for favourable work postures and working movements to be possible, they shall be supplied by the employer.

¹ Cf. Directives 90/269/EEC (OJ L156, 21.6.90, p. 9) and 83/189/EEC (OJ L109, 26.4.83, p. 8) etc.

Manual handling and other exertion of force

Section 3

The employer shall ensure that work requiring the exertion of force is, as far as is practically possible, designed and arranged in such a way that the employee can work with a work object, work equipment, controls, material or transfer of persons without being exposed to physical loads which are dangerous to health or unnecessarily fatiguing.

Physically monotonous, repetitive, closely controlled or restricted work

Section 4

The employer shall ensure that work which is physically monotonous, repetitive, closely controlled or restricted does not normally occur. If special circumstances require an employee to do such work, the risks of ill-health or accidents resulting from physical loads which are dangerous to health or unnecessarily fatiguing shall be averted by job rotation, job diversification, breaks or other measures which can augment the variation at work.

Job decision latitude

Section 5

The employer shall ensure that the employee has such opportunities of influencing the arrangement and performance of his own work that sufficient variation of movement and recuperation can be achieved.

Knowledge, skills and information

Section 6

The employer shall ensure that the employee has sufficient knowledge concerning

- suitable work postures and working movements,
- the proper use of technical equipment and aids,
- the risks entailed by unsuitable work postures, working movements and unsuitable manual handling, and
- early indications of the overloading of joints and muscles.

The employer shall give the employees general information concerning the weight of the loads handled. Where possible, exact information shall be given concerning the weight of loads and the centre of gravity or heaviest side when a package is excentrically loaded.

The employer shall further ensure that the employee is given the opportunity of training in a suitable work technique for the task involved. He shall also ensure compliance with the instructions given.

Non-employer responsibilities

Employees

Section 7

The employee shall be attentive to the employer's instructions concerning the avoidance of physical loads which are dangerous to health or unnecessarily fatiguing. An employee judging that a task can entail such loads shall notify the employer accordingly.

Manufacturers, importers, suppliers and providers

Section 8

Manufacturers, importers, suppliers and providers shall as far as is practically possible ensure that the technical devices, substances and packagings delivered do not cause physical loads which are dangerous to health or unnecessarily fatiguing in connection with installation, normal use, maintenance or other commonly occurring handling. Where necessary, the delivery shall be accompanied by information as to how the devices, substances and packagings are to be handled in an ergonomically safe manner.

This does not, however, apply to products coming under EC Directives for the purpose of eliminating impediments to free trade between the Member States.

Commissioners of building or civil engineering work and others taking part in the preparation of building projects

Section 9

Whoever commissions building or civil engineering work shall at the project preparation stage, as far as is practically possible, prevent physical loads which are dangerous to health or unnecessarily fatiguing occurring during the construction phase or in the intended use of the building or structure. This applies particularly to selection of materials, accessibility and transports. The same applies to others involved in the planning, within the scope of their respective assignments.

Co-ordinator of a common worksite

Section 10

Whoever is responsible for the co-ordination of a common worksite under Chap. 3, Section 7 of the Work Environment Act shall, in such co-ordination, take account of the risks of physical loads which are dangerous to health or unnecessarily fatiguing, especially with regard to accessibility, free passage, transports and the moving of material, equipment and other goods.

Controller of a worksite

Section 11

Whoever controls a worksite under Chap. 3, Section 12, subsection one, of the Work Environment Act shall ensure the presence there of permanent devices of such a kind that persons doing work there, without being employed by him, are not exposed to physical loads which are dangerous to health or unnecessarily fatiguing. He shall also ensure that they are not subjected to such loads as a consequence of the design of movable equipment supplied to them at the worksite.

Partnerships etc. and others engaging chartered labour

Section 12

Whoever engages chartered labour to do work in his activity, and also those who, on their common account, professionally engage in activity without having employees, are equated in these Provisions with an employer. The person doing the work is equated with an employee.

This does not, however, apply to activity conducted exclusively by members of the same family. Nor do the requirements of Section 6 apply to those professionally engaging in activity on their common behalf.

Entry into force

These Provisions enter into force on 1st July 1998. The Ordinances of the National Board of Occupational Safety and Health on Bulk Carriage of Meat (AFS 1980:8) and Work Postures and Working Movements (AFS 1983:6) are repealed with effect from the same date.

BERTIL REMAEUS

Kurt Baneryd

Göran Lindh

General Recommendations of the Swedish National Board of Occupational Safety and Health on the implementation of the Provisions on Ergonomics for the Prevention of Musculoskeletal Disorders

The following General Recommendations are issued by the National Board of Occupational Safety and Health on the implementation of the Board's Provisions on Ergonomics for the Prevention of Musculoskeletal Disorders (AFS 1998:1).

General Recommendations have a different legal status from Provisions. They are not mandatory. Instead they serve to elucidate the meaning of the Provisions (e.g. by explaining suitable ways of meeting the requirements, giving examples of practical solutions and procedures) and to provide recommendations, background information and references.

The General Recommendations accompanying these Provisions are voluminous, above all because questions of ergonomics concerning musculoskeletal disorders are a web of so many different factors that relatively detailed commentaries are needed in order for the subject field to be properly understood.

Background

Musculoskeletal disorders² are very common

Disorders or injuries affecting muscles, tendons and joints are one of the commonest causes of absence from work. Time and time again, studies of how employees experience their work and their working environment show disorders resulting from excessively heavy, prolonged or non-varied loads to be one of the biggest problems of the working environment. For many years now, a large proportion of the work injuries reported under the Work Injuries Insurance Act have related to overloading of the body. More than 70 per cent of all work diseases reported and over 20 per cent of work accidents have involved

² In these General Recommendations, the term *musculoskeletal disorders* is used to denote work-related disorders of the locomotor apparatus, i.e. all forms of ill-health in the organs of locomotion which may be connected with conditions at work. Ill-health may have been caused by the work, or it may have a different origin but be aggravated by the work. The term includes everything from slight, transitory disorders to disabling, lifelong injuries. The term *musculoskeletal disorders* has been chosen, rather than *musculoskeletal injuries*, for two reasons. Firstly, this reduces the risk of confusion with the work injury concept employed in the Work Injuries Insurance Act (LAF). Secondly, the word *disorders* mirrors more accurately the preventive purpose of these Provisions, "prevention is better than cure".

musculoskeletal injuries, which together have made up more than 40 per cent of all the work injuries reported. A high level of sickness absence, rehabilitation measures and disruptions of output mean heavy expense to businesses and the community. At the same time, many individuals are afflicted with aches, pains and, sometimes, lifelong disability. Not infrequently, these persons are relegated from the labour market.

Ergonomics concerning the musculoskeletal system

These Provisions contain general rules on “*musculoskeletal ergonomics*”, i.e. on work postures, working movements, physical load and other conditions capable of affecting, directly or indirectly, the health of the *organs of locomotion* (i.e. muscles, tendons, the skeleton, cartilage, ligaments and certain nerves). Conditions of this kind can, for example, include the design of working premises, workstations, work objects, tools, the general environment, organizational aspects of work and psychological and social conditions at work.

Physical loads vary in character

The human body is made for motion. An appropriate mixture of movements, loads and recovery is needed to sustain the functions of the body.

In the assessment of a work situation, the term *load dose* is often used as a measure of the total load. The dose is calculated as a combination of how much, how heavily, how often and how long we have worked. It will be readily understood that a high load dose can have a destructive effect on body tissue. But it is perhaps more difficult to realize that load doses that are too low can also have negative effects. The types of load described below often occur simultaneously in working life and seldom individually.

Occasional heavy loads, such as a heavy lifting operation, can entail a risk of acute overloading. Disorders can also occur in connection with work which involves *repeated moderate loads*, if the work continues for a considerable length of time, as for example with work in a supermarket checkout.

Static muscular effort means that muscles are tensed without this entailing movements of the joint which the muscles extend over. One example of this is when the shoulder muscles are tensed statically in order to keep the arms raised and steady while the hands are working, for instance at keyboards. Signs of overloading will then appear after a while unless an opportunity is provided for relaxing: the individual grows tired, the muscular function is inhibited and the muscles hurt. This kind of load can eventually have harmful consequences. Often the intrinsic weight of the part of the body concerned is sufficient for overloading to occur during static muscular work (Figure 1).

When the same parts of the body are used in a similar manner for a long time without the opportunity of rest or variation, as for example in the blanking of light

parts, muscles and joints are subjected to *physically monotonous, repetitive load*.

Figure 1. Examples of static load.

To make these working movements possible, surrounding, stabilizing muscles are forced to work virtually statically. Repeated load, like static work, can give rise to disorders and, if the working conditions are not changed, injuries can develop. It is important to observe early signs of overloading, because an injury can take months, perhaps years, to develop.

Conversely, *very low loads* can also cause disorders. Excessively low loading for a prolonged period, e.g. sedentary monitoring work, is unfavourable, for example, for the organs of locomotion and circulation. The organs of locomotion require continuous activation in order to retain their strength, extent of movement and mobility. It is also a known fact that tolerance of loads declines during physical inactivity. If the muscles are not working dynamically, circulation becomes inefficient: swollen legs are one example of this.

Favourable load is characterized by recurrent variation, balance between activity and recovery and limited duration. The nature of a favourable load can vary considerably from one person to another, depending on individual abilities and sensitivity.

General factors potentially contributing to musculoskeletal disorders

Many conditions at work which can cause musculoskeletal disorders are described in the Guidance on the various Sections of these Provisions. First, though, a number of important general factors will be described which are not dealt with so exhaustively with reference to the individual Sections.

Mental strain can cause muscular tensions and in this way accentuate the effects of physical strain. Heavy pressure of time, excessive demands on oneself or from others or close concentration on the handling of fragile loads are examples of factors which can help to augment physical strain. Other negative factors of this kind are inadequate job decision latitude and inadequate social support. There are examples showing that high performance targets in a working group can lead to a hectic pace of work and to an allocation of roles within the group resulting in certain individuals being subjected to excessively repetitive or strenuous tasks. At the same time, physical work which entails monotonous repetition of movements can have an adverse effect on mental health. Good working conditions can only be achieved if all relevant factors of the working environment are considered and treated together.

Physical factors of the working environment, such as *vibrations* and *unsuitable climatic conditions*, can interact with and aggravate the risks of musculoskeletal disorders entailed, for example, by unsuitable work postures. If, for example, a person is forced to place oneself in a twisted position when working in a vibrating vehicle, the unfavourable effects of the vibrations and those of the twisted sitting position will reinforce one another. In a case of this kind, a rotating, vibration-attenuating driving seat can help to reduce both risk factors. The risk of hand/arm disorders can be reduced by deliberately choosing low-vibration, hand-held machines and minimizing the duration of their use. Capacity for exerting great force over a long period of time is reduced by a heavy thermal load. In cold working conditions, it is especially important for work to begin easily and for muscles and joints to be warmed up before full force is exerted. Suitable clothing helps to maintain the desirable thermal balance and is especially important in heavy jobs which involve frequent alternation between hot and cold surroundings. Further to these points, see the Board's Provisions AFS 1986:7 (Vibrations from Hand-held Machines), AFS 1997:2 (Work in Intense Heat) and AFS 1998:2 (Work in Cold Premises in Food Processing Industries).

Unsuitable walking surfaces can cause tense, strenuous work postures and movements, especially in situations which involve the handling of loads, jumping (e.g. on and off the tailboard of a lorry) or a great deal of walking and standing. Uneven, unsteady, sloping or slippery underfoot conditions can only be partly offset with good working shoes etc., and so there is often cause for improving the underlay. Excessively hard or non-resilient contact between foot and underlay can be remedied either by making the underlay softer or by using

working shoes with a resilient sole. Bad working shoes, e.g. shoes with no heel counter, entail a heightened risk of accidents and musculoskeletal disorders.

Load through *personal protective equipment or work clothing*. Protective and work clothing can restrict freedom of movement or increase the thermal load. Protective gloves can impair the grip. Respiratory protective equipment can impose a heavier load on the organs of respiration and circulation. Respiratory protective equipment and eye protectors can reduce the field of vision, thereby adversely affecting work postures. Equipment and working clothes must therefore be chosen with great care and consideration paid to the above mentioned factors, as well as to the protective function itself. The weight of the equipment, its centre of gravity and the way in which it is put on and taken off should also be taken into account.

Basic principles of ergonomics concerning the musculoskeletal system

Job requirements versus human capacity

Different people have different capacities for coping with physical requirements. Such capacity varies according to physical and mental strength, body measurements, sex, age, experience, fitness, motivation and (where applicable) disability. The basic principle of the Work Environment Act is that a balance between the requirements of the job and human capacity shall be created primarily by adapting the work to the human being. In doing so it is important to make allowance for the different capacities of women and men with regard to loads and the attendant risk of ill-health.

Generally speaking, a poor working environment cannot be made up for by the individual developing his or her strength and fitness, least of all where physically monotonous, repetitive tasks are involved. But lifestyle does make a difference to wellbeing at work and to the amount of energy that is left over for the employee's leisure. Through exercise, training and generally healthy living habits, the individual can keep his or her body in trim and maintain a good standard of fitness.

Sources of knowledge for the process of change

The Provisions (AFS 1996:6) on Internal Control of the Working Environment, issued by the National Board of Occupational Safety and Health, set out the duty of the employer to continuously chart and assess risks and to generally plan, implement and follow up activities with regard to risks, e.g. of physical loads dangerous to health.

To facilitate the employer's task of identifying and assessing musculoskeletal risks, App. A contains a number of assessment models offering a certain amount of quantitative guidance. App. B, additionally, contains a checklist of

suitable questions to ask in the assessment of musculoskeletal conditions at the workplace.

Chap. 2, Section 1, subsection three, of the Work Environment Act lays down that the employee shall be given the opportunity to participate in the design of his own work situation and in processes of change and development affecting his work. The employee's experience of exertion at work is an important yardstick which should serve as guidance for changes to the working environment. If work is felt to be heavy or strenuous, this may signal approaching musculoskeletal disorders. On the other hand, however, it should be noted that human beings cannot always perceive and decide whether loads are dangerous to health or not.

Reports concerning disorders, sickness absence, reported work injuries, early retirement etc. at corporate or sectorial level, as well as research overviews, official statistics etc. are also important sources of knowledge for the process of change.

Guidance on individual Sections

Guidance on Section 1 Scope and purpose

The purpose of these Provisions is to help people from suffering ill-health of the organs of locomotion as a result of work, and also to make working conditions more compatible with a continuation of employment, even if an employee has a musculoskeletal disorder. The aim should be for ergonomic conditions in all occupations to be of such a kind as to enable the majority to go on working until retirement age. Compared with the previous Provisions on Work Postures and Working Movements (AFS 1983:6), greater emphasis is now placed on the organizational aspect of work. The functional stipulations contained in these Provisions, and the guidance on them, are supplemented by illustrative examples in Apps. A and B. App. A offers a certain amount of quantitative guidance, while App. B consists of a checklist for identifying stress factors which can be dangerous to health.

These Provisions have the same extensive area of application as the Work Environment Act. It follows from this that the Provisions cannot provide exact coverage of every conceivable situation. But their basic principle is the same as that of the Work Environment Act, namely that the great majority of tasks at work shall be adapted to the capacity of the great majority of employees. This cannot be fully achieved, however. It is important to observe those occasions where the design of the workstation does not agree with the capacity of the individual. The workstation may need to be adapted. Rules on job adaptation are contained in the Board's Provisions on Job Adaptation and Rehabilitation (AFS 1994:1).

AFS 1998:1

The Provisions also apply to pupils and to tele-working, i.e. work done by the employee on the employer's behalf in the employee's home or elsewhere.

The Work Environment Act lays down that the work environment shall be satisfactory having regard to the nature of the work and to technological and social developments in the community at large. It goes without saying that the nature of work varies from one branch of employment to another: one need only compare, for example, ergonomic conditions on a construction site with conditions in caring services, engineering or banking. Different problems call for different solutions. Several Sections of these Provisions include the words "as far as is practically possible" or suchlike. This amounts to a relatively far-reaching stipulation. If it is known that a certain problem has been remedied under similar conditions, then this proves that solution of the problem is "practically possible". This requirement, however, is not absolute. There must, generally speaking, be a reasonable balance between the cost of a measure stipulated and the total benefit which that measure confers.

In certain branches of activity, the nature of work is such that the employer does not control all parts of the activity and, in many cases, it is unrealistic to require all ergonomic conditions to be adapted to the physical capacity of most employees. This is clearly illustrated by the use of firemen's breathing apparatus and other physically exacting tasks confronting public rescue services, tasks which demand an outstandingly high work capacity sustained by continuous training. But the employer's responsibility remains as regards those parts of the activity over which he does have control. In rescue services this can, for example, mean ensuring that vehicles and equipment are as good as possible in relation to the demanding nature of the work, that personnel are given necessary instructions and training opportunities, and so on.

An *unnecessarily fatiguing* physical load is not necessarily *dangerous to health* in the short term, but it will mean serious risks if it goes on long enough. For many types of load there are well-established, scientifically confirmed data regarding connections between the load and the risks of musculoskeletal disorders.

The employer is primarily responsible for the working environment. These Provisions give a closer definition of his responsibility for ensuring good ergonomic conditions at work. Several other agents, such as employees, manufacturers, suppliers, developers, planners and co-ordinators, can also make an important difference to the ergonomic situation for employees, and so their responsibilities are also defined in these Provisions. There are yet other agents, e.g. landlords of premises, installation engineers and self-employed persons, who may incur responsibility for the working environment in certain situations, but their responsibilities are not dealt with in these Provisions. The following can be said, however, concerning the provision of premises etc. If the design or nature of a facility, an area of land or a space below ground provided for work is of such a kind that the work cannot be done in compliance with Sections 2-4 and rectification cannot be achieved by authority of Sections 2-4 or

10-12, the Labour Inspectorate is empowered, under Chap. 7, Section 8 of the Work Environment Act, to prohibit the provision of it. It is especially important in a connection of this kind that access to and within the premises should agree with the requirements entailed by the activity. For example, it is inappropriate to let premises for retail or restaurant activity if the stores can only be reached by stairs or if transport flows through the premises are disrupted by an unpractical goods reception or the existence of different levels.

If working premises, work objects and equipment do not properly facilitate good ergonomic conditions, those conditions can be very difficult to achieve by other means. For example, it is difficult to work in a varied, non-strenuous manner on cramped premises with floors on different levels or at a desk or with tools which are not adapted to one's own body measurements or strength. In the procurement of technical devices, products, materials or facilities for the activity, therefore, it is important to have clearly specified requirements based on these Provisions. The same kind of consideration should be shown in the design of new products in industry. The design of the products manufactured does a great deal to influence ergonomic working conditions for the employees. Workstation design should begin with the design of the product, which in turn already takes place on the designers' drawing boards (or in their CAD computers). See also the Guidance on Section 8.

Guidance on Section 2 Work postures and movements

Most of the movements we can perform and most of the postures we can assume without much difficulty we tend to consider natural, and as such we believe that they do us no harm. This is true regarding temporary postures and individual movements performed with body control. It is even good for us to sometimes stretch our mobility to the limit. If, on the other hand, the joints are subjected to loads frequently or for long periods when they are heavily flexed, extended or rotated, care needs to be taken. In extreme positions of this kind, the joints are more liable to be injured and the muscles have less capacity for exerting force and for working in a co-ordinated manner. It is worth noting that the intrinsic weight of the body and different parts of the body can impose a considerable load in certain positions - for example if, standing with the legs straight, one bends forwards to pick up a light object from the floor or stretches one arm a long way to reach something (Figure 2).

Figure 2. The intrinsic weight of parts of body is often a heavy load.

One characteristic of a *well-designed workstation* is that most of the time one can work in an upright position with shoulders lowered and the upper arms close to the torso. The working height is roughly on a level with the employee's elbows, regardless of whether the work is done sitting down or standing up (Figure 3). Different types of task, however, demand different working heights (Figure 4). The best way of achieving adjusted working heights is for the working equipment, e.g. a work table and chair, to be adjustable, so that all employees can adjust the working heights to their own body size. If one and the same work table or suchlike is alternately used, not just occasionally, by more than one employee, the height should be easily and quickly adjustable. Individual adjustment can also be obtained, for example, by means of fixed work tables at different heights or by a facility for raising and lowering an underlay on which the employee sits or stands. The range of body measurements is especially wide in schools and child care. The needs of child care staff may call for tables, benches and chairs at adult height in every department, and for kitchen equipment (dishwashers etc.) as well as workstations for nappy-changing to be positioned at a comfortable working height.

Suitable Less suitable

Figure 3. Suitable working heights for a large and small person respectively. 95 per cent of Swedish men are smaller than the man in the drawing, and 95 per cent of Swedish women are bigger than the woman. In normal instances, the most suitable working height is on a level with the employee's elbow. Measurements in centimetres.

Figure 4. Different working heights for different types of work. For a precision job, it is advisable for the workpiece to be positioned a little higher up, given the importance of visual control. On the other hand, a job requiring the exertion of greater force should be positioned below elbow height.

The outer working range of the hands on the horizontal plane is limited by the

AFS 1998:1

reach of the arms, while most of the work done by the hands should come within the inner working area (Figure 5). The more prolonged the tasks are, and the higher the degree of precision which they demand, the more essential it becomes for the work to be done with arms and shoulders completely relaxed close to and in front of the body, i.e. centrally, in the inner working area.

Inner working area

Outer working area

Figure 5. Working areas for the hands. Measurements in centimetres.

A space which is large enough for the work, no matter whether the employee walks, sits or stands, enables the employee to move in a relaxed, dynamic and well-balanced way. One good principle of workstation design is to “make sure that the little person can reach and the big person has enough room”.

Standing and walking is good for operations which require great mobility, physical exertion and reach. Standing up to work, one also commands a good view of a large working area. One way of exerting force and acquiring greater reach which is gentle on the body is by using weight transfer techniques, meaning that the weight of the body is transferred from one leg to the other and back again. This can be done backwards and forwards or from side to side (Figure 6).

The main disadvantages of standing up are the constant load on the heart and circulation and on the foot and leg joints. Remarks concerning the impor-

tance of underfoot conditions will be found on page 12. To reduce the load and provide suitable variation, some tasks can be performed sitting or using a sit-stand seat (Figure 7). If the job cannot be done in this way, it is important that there should at least be an opportunity for sitting down during short breaks, e.g. for a shop assistant who does not have any customers for the moment or for hotel receptionists and waiting staff.

Figure 6. Shifting weight sideways

Sitting down provides good conditions for most types of computer work, offers good stability for precision work and can be necessary for pedal work. Sedentary work is less strenuous than work standing up, because it means less of a load on the circulation. Disadvantages compared with standing up are that mobility and reach are reduced, as well as the potentiality for exerting force. In the sitting position, the load on the back is somewhat greater than when standing up, due to the pelvis being tilted backwards. This can be rectified to some extent by the chair having a good backrest, adjustable arm rests and a tilting seat.

Figure 7. Taking the weight off one's feet by using a sit-stand seat with load braking castors.

Where long periods of sedentary activity are involved, there is cause to investigate the possibility of some of the tasks being done standing up instead of sitting down. It will be an advantage if work is organized so as to provide opportunities for getting up now and again.

Work in a *kneeling, crouching or squatting position* can sometimes be necessary, but it augments the risk of overloading individual parts of the body. Manual work in a *supine* position is also very strenuous, because this often means working with the arms raised and unsupported. It is essential for work postures of this kind to be kept to a minimum. Technical solutions may perhaps

AFS 1998:1

completely transform the task or at least improve the conditions for it. Limits on the duration of the work, as regards both individual sessions and daily input, also reduce the risks.

Working in a *heavily bent, twisted or extended* position can entail loads which are directly unsuitable because the joints are then put under stress in or close to their outer positions (Figure 8). Work postures and working movements in

Figure 8. Bended, twisted and extended work postures always entail risks.

which the wrists are noticeably bent or the hands above shoulder height, below knee level or outstretched are not uncommon. If movements of this kind are prolonged or recurrent, something needs to be done to change the working conditions.

If the work posture is *simultaneously bent and twisted or extended and twisted*, the risk of injury is considerable. It is particularly hazardous to perform *manual handling operations in a simultaneously bent and twisted work posture* (see also the Guidance on Section 3). Another very strenuous situation for the body occurs if, in the course of work, one is more or less fixed in a certain position without being able to change it. Here again, the stresses are aggravated if the task includes the handling of an object. If a bent or twisted work posture has to be assumed suddenly and without control, e.g. to catch somebody who loses their balance, musculoskeletal disorders can easily occur.

App. A contains a model for the identification and assessment of unfavourable sitting, standing and walking work postures.

Visual aids and lighting conditions

Being able to see, effortlessly, what one is working with is important for reducing the risk of accidents and musculoskeletal disorders. Good working conditions demand, first and foremost, adequate lighting which neither dazzles nor causes troublesome reflections. Further to this point, see the Board's Provisions (AFS 1991:8) on Lighting. If lighting and visual conditions are deficient, this is made up for by tensing not only the muscles in and around the eyes but also, for example, the muscles of the neck and shoulders. The work posture is adapted so as to be able to see the workpiece. Even if visual conditions and lighting are adequate, one may still be forced from time to time to adopt strenuous work postures in order to see things. If so, it may be necessary for the employee instead to make use of individually fitted visual aids specially adapted to the work in question. Provision of such aids is the employer's duty. They include, for example, working glasses, special additional lighting or a magnifying glass, but not, on the other hand, ordinary reading glasses.

Provisions on working glasses for computer work are contained in the Board's Provisions (AFS 1992:14) on Work with Visual Display Units. Another situation where special working glasses may be needed comes from the construction and civil engineering sector. Electricians, painters and others often work looking upwards, and this entails very serious ergonomic problems, especially if the employees normally need bifocal glasses. In order to be able to look through suitable fields with ordinary glasses, the neck has to be tilted backwards further than usual when looking upwards. People thus affected can be equipped with special glasses which also have a close distance portion at the top, so as to avoid extreme backward tilting of the neck. Vehicle inspectors, organists, etc. may have similar visual conditions.

Guidance on Section 3 Manual handling and other exertion of force

AFS 1998:1

The employer is expected to reduce the risks of injury in manual handling in a given order of priority, namely:

- (1) investigating whether manual handling can be avoided completely,
- (2) if this kind of handling cannot be completely avoided, undertaking a risk analysis of the work and then taking the measures needed as regards the design of loads, working equipment and aids, work organization and the working environment generally, and lastly
- (3) training and informing the employees so that they can help to minimize the overall risks.

Manual handling mainly refers to the transfer of loads, with one or more employees exerting muscular force to lift, deposit, push, pull, roll, carry, hold or support an object or a living being. Primarily the concept includes traditional manual labour, with a great deal of lifting, carrying, pulling, dragging etc. It also includes, for example, such tasks as putting goods up on shelves and taking them off shelves, grasping bundles of paper for sorting, loading a machine or mixer with raw materials, helping a patient to move, pushing and pulling trolleys, serving food and drink and putting away heavy outdoor play equipment etc. in the pre-school storeroom. Other tasks may involve the employee exerting considerable physical force without the main purpose being that of moving the object, for example when using hand-held machinery or tools, such as a chain saw, operating controls with heavy resistance, bricklaying, paint-spraying, steering a vehicle or controlling work processes with buttons, levers and pedals, and opening a swing door by kicking it or nudging it with the hip. In some connections, it is the degree of precision in the handling, rather than the actual force needing to be exerted, which constitutes the most hazardous factor. Figure 9 shows additional examples of manual handling or other exertion of physical force.

Figure 9. Various forms of manual handling and other exertion of physical force which can be harmful in the long run.

Heavy manual handling involves a risk of overloading above all the lumbar

AFS 1998:1

region of the spine but also arms and shoulders. This is especially noticeable when the handling operation is combined with bad work postures. Lifting with knees heavily flexed, carrying heavy loads on stairs and on uneven, unsteady or hard underlay also entails a risk of knee injuries. In addition, the heart, circulation and lungs are put under strain during heavy lifting and carrying. Work of this kind requires both strength and fitness, and even then it can still be hazardous.

Acute overloading of joints, muscles and tendons very often occurs as a result of manual handling deviating from the normal - "it went wrong". Accidents of this kind can occur, for example, when a patient who is to be moved does not co-operate as expected, when the centre of gravity in a parcel changes due to the contents shifting, or when one slips or trips and makes a sudden, unsuitable movement in order to recover one's balance. In situations of this kind, the load can become many times greater than in normal conditions. Advance planning of the best way of performing a lifting or moving operation is therefore important.

Lifting and carrying

Most transport operations can be performed on wheels at moderate expense. This is particularly vital when material, equipment or goods must be moved over long distances, as for example with the conveyance of meat in bulk, i.e. a quarter of a beef carcass or half or the greater part of a pig, which nowadays is usually done with the load suspended from a sliding or roller conveyor or carried in transport trolleys. The carrying of heavy or awkward loads on stairs entails a severe risk of acute musculoskeletal disorders and other accidents. Stairs, therefore, are normally unsuitable as regular transport routes in shops, restaurants and suchlike, for example. See also the Board's Provisions (AFS 1995:3) on Working Premises.

Figure 10. Example of lifting aid.

Whether or not a lifting and carrying job is harmful will depend on many simultaneous factors: what is lifted, how the lifting is done, in what environment and who does the lifting or carrying. This makes it very difficult to define an absolute limit value for just one of these factors, such as the maximum permissible weight of a load. But there is sufficient scientific documentation and proven experience to yield certain practical recommendations on the way in which this kind of work

can be assessed. See *App. A*, which contains a model for the assessment of lifting operations which concentrates on two main factors, the weight of the load and the distance between the body and the centre of gravity of the load when lifting.

Efforts have been made for many years to reduce the risks of back trouble in connection with lifting by means of instruction in the "right" lifting technique, i.e. lift with the back straight and the knees bent. The message is basically correct, but getting it translated into practice has been difficult. Knowledge and experience today stress the following three aspects as most important for the prevention of back injuries:

- *avoid heavy lifting if possible, use technical aids (Figure 10),*
- *make sure that the load is held close to the body,*
- *avoid lifting and twisting simultaneously.*

Lifting and transfer of persons

If the premises are spacious and well-planned, if there is sufficient suitable equipment readily available and if the nursing staff can co-operate well with each other and with the patients, using a good work technique, manual lifting will not normally be necessary, for example, in nursing and other caring services; people can be transferred without lifting them. This calls for good personnel planning, for adequate staffing and for compliance with the intended capacity of the premises.

When trying to solve a lifting problem by means of technical aids, it is important to give the personnel instruction and training in the use of the aid for the particular situation involved. Training is especially important as regards techniques for transferring people with different needs of assistance in different situations and in coping with unforeseen events, e.g. learning what to do, without hurting oneself, when a patient falls down. Lack of space can force the assistant into a heavy handling operation in a strenuous work posture. Shortage of time can also provoke undesirable behaviour. When moving a patient, for example, to and from the toilet or between wheelchair and bed, and when helping a patient to change position in bed, it is important that there should be adequate, properly planned space and time for the task. Further to this point, see the Board's Provisions (AFS 1995:3) on Working Premises and (AFS 1990:18) on Care and Assistance in Private Homes.

Pushing and pulling

Pushing and pulling means moving an object with either the whole or part of its weight resting on the underlay or with the object suspended, e.g. from a telfer. The force needed to start an object moving and keeping it in motion will depend on how heavy the object is and on the amount of friction between the object and the underlay, as well as the gradient of the underlay. In order to exert great force on the object, one must be able to get a foot-hold; in other words, the friction between shoes and the walking surface is important. Low friction between object and underlay and high friction between the individual and the walking surface should thus be aimed for.

Thresholds and other differences of level should be avoided on transport routes. Cf. the Board's Provisions (AFS 1995:3) on Working Premises.

App. A contains a model for the assessment of push-pull work.

Work using hand-held machines, hand tools and controls

Hand-held machines and tools are common factors contributing to musculo-skeletal disorders of the hands, wrists, arms and shoulders. Vibrations are one risk factor. Other risks depend on the way in which machinery and tools are designed and used. Machinery and tools are not always adapted to suit persons with small hands and limited muscle power. Women, because usually they have both smaller hands and less muscle power than men, are doubly disadvantaged in this respect.

Work using hand-held machines or tools often makes demands, not only on strength but also on precision. Where high standards of precision are required, as for example in the case of a dentist or watchmaker, static workloads can be hard to avoid. In such cases, functional tool design and good opportunities of stress relief and rest are particularly vital.

Figure 11. A holding device (dead man's grip) and sharp edges are not a good combination.

To minimize the risk of musculoskeletal disorders, the employer should provide the employees with hand-held machines and hand tools which

- permit appropriate grips adapted to the requirements of force and precision, with good friction and with the gripping force properly distributed over the hand, so as to avoid unsuitable concentrated pressure, e.g. with no sharp edges (Figure 11),
- will fit differently sized hands,
- can be used with either hand,
- if possible, permit a neutral positioning of the wrist and arm (the position of the hand when relaxed and resting on a table),
- affords good vision and good access to the workpiece,
- have trigger forces with a reasonable control resistance,
- vibrate as little as possible,
- are as light as their function will permit, and
- are well-balanced.

It is the designer of a machine or tool who is in the best position to take the above factors into account, but it is the employer who is responsible for deciding which machines, tools and aids are used for the activity. Soundly based choices will help to prevent musculoskeletal disorders.

Work using controls occurs mainly with mobile machinery and vehicles of different kinds, but also at stationary workstations. It is important that the controls should be designed and positioned to suit the employees' physical characteristics, e.g. as regards body size and strength. This applies both to manually operated controls and to pedals and other leg- and foot-operated controls. See also the Guidance on Section 4.

Guidance on Section 4 Physically monotonous, repetitive, closely controlled or restricted work

Physically monotonous, repetitive work characteristically involves one or a few tasks, with similar working movements repeated over and over again for a considerable part of the working day. The time between one operation beginning and the same operation recurring (the work cycle time) is very short. Often the task is only a small, limited part of a flowline sequence, and it is often performed at high speed. The expression *closely controlled work* means that the employee has little or no chance of influencing such factors as the pace of work, tempo, the sequence of tasks, the inflow of tasks, the deadline for completing the work, the way in which the work is to be done and the timing of breaks and recovery. *Restricted work* means that it is difficult for the employee to leave his workstation, even for short periods, without service or output being disrupted.

AFS 1998:1

Typical situations of these kinds are assembly line work, checkout work, data entry, microscopy or pipetting of long test series, laying of food trays in mass catering, loading and unloading in semi-automatic systems (Figure 12) and work with small parts at a punch press. But vehicle drivers also incur this type of work sometimes, e.g. bus drivers on certain routes. Work with many kinds of forestry machinery is particularly physically monotonous and repetitive and at the same time often requires a high standard of precision.

Figure 12. A physically monotonous, repetitive job.

Repeated performance of the same movements gives rise to a constant, uniform load. The object that is being handled need hardly weigh anything at all: the weight of the arms themselves is sufficient for an unsuitable load to be imposed on muscles and joints. This can lead to the gradual appearance of serious injuries which take a long time to heal. Once a person has been injured in this way, the disorder will easily return under the influence of similar loads in future.

It has been found that women are affected by this kind of musculoskeletal disorder more often than men. One reason, probably, is that women often remain in physically monotonous, repetitive jobs for a long time, while the men advance to other duties. Men also incur injuries when they have physically monotonous, repetitive tasks - greater strength is no protection against disorders where this kind of work is concerned.

App. A contains a model which can be consulted for the identification and assessment of physically monotonous, repetitive work.

Some possible countermeasures

In order to do something about the total load, measures may need to be taken in all the fields mentioned in the assessment model in *App. A*. Physical or technical measures alone are seldom sufficient, unless the work is mechanized completely. Instead the main concern must be to reduce the degree of repetition and to limit the length of time which the individual employee spends on this type of work. More often than not, therefore, some form of organizational change is necessary. If the arrangement of work is altered by means of job rotation, job diversification and job enhancement, employees can be given more scope for

influencing the arrangement of their own work and the timing of breaks, and there will be more opportunities for variation, participation and personal development.

- * *Job rotation* means, basically, alternating between different tasks of a similar nature. If job rotation is introduced, the important thing is that it should lead to a genuine variation of the workload. As a means of counteracting harmful physical loads, job rotation often has a limited effect.
- * *Job diversification/enlargement* means bringing together several different tasks, e.g. with the inclusion of certain supplementary duties, such as maintenance and cleaning. This means the individual being allotted a bigger share of the flowline sequence than before. In the typical instance, job diversification has the effect of lengthening the work cycle.
- * *Job enhancement/enrichment* means the employee having a wider range of duties which require a variety of skills and qualifications, e.g. through the addition of such things as a certain amount of work planning, inspection of working results or customer contacts.

As regards limiting the amount of time which the individual employee spends on physically monotonous, repetitive work, the distribution of working sessions throughout the day has an important bearing on the risk of musculoskeletal disorders. Individual spells of work should be short, spread out over the entire shift and continuously interspersed with other work, breaks and rest intervals. See also *App. A*.

If the physically monotonous, repetitive work is automated or otherwise changed, care must be taken to ensure that no "residual tasks" are created at the beginning or the end of fully or semi-automated systems. Tasks of this kind include, for example, filling and extraction of material.

Guidance on Section 5 Job decision latitude

More and more research findings are demonstrating that the risks of musculoskeletal disorders are not only affected by physical and technical aspects. Having adequate job decision latitude and being able to influence the arrangement and conduct of one's own work is an essential prerequisite of individual wellbeing and development potential. Influence over one's own work, e.g. as regards its planning and arrangement, the working method, the timing of work and breaks, the pace of work and the procurement and use of working aids, helps to prevent musculoskeletal disorders.

Social interaction at the workplace, i.e. relations with management and fellow-employees, has also proved to play an important part in the occurrence and subjective experience of disorders.

AFS 1998:1

Good job decision latitude means, among other things, being able

- to alternate between different tasks,
- to alternate between sedentary and standing work,
- to take short breaks for recuperation when the need is felt,
- to choose or adapt the pace of work,
- to get help from another person when necessary, and
- to have a say, on the strength of one's own experience, concerning the procurement of new equipment and the introduction of new working methods.

Certain pay systems, such as straight piecework and incentive pay, can lead employees to use a work technique which is ergonomically negative. There is a risk of the employees feeling themselves to be under pressure or of their own accord exceeding the limits of their physical and mental capacity. Perhaps they avoid using the strain-relieving devices at their disposal, or else they raise the pace of work to a level which is close to or in excess of their capacity. It is essential that the pay systems adopted should put a premium on quality and broad-based competence rather than on quantity and specialization.

Guidance on Section 6 Knowledge, skills and information

The avoidance of musculoskeletal disorders depends among other things on the employee knowing a suitable way of performing the task. The Work Environment Act, the Board's Provisions (AFS 1996:6) on Internal Control of the Working Environment and this Section make it the employer's duty to ascertain that the employee has the training, knowledge or skill necessary for the prevention of musculoskeletal disorders. To be capable of honouring this obligation, the employer needs to be personally competent to assess and explain ergonomic risks and how to minimize them, or to have access to this competence in some other way. Occupational health services or some other external work environment expertise can provide useful help in this connection. If the employee does not have the necessary knowledge, he or she must be given the instructions and/or training that are needed.

In order to put the right amount of effort into handling a load, one needs to know its approximate weight. In this respect, both unexpectedly light and unexpectedly heavy loads can cause problems. At workplaces where manual handling is a regular practice, some system should be considered for marking the weight of loads.

It is important that the introduction of newly hired employees and changes in the manner of working should be accompanied by training in work techniques. Sufficient time should be reserved for the employee to be able to practise suitable work postures and working movements, learn to handle equipment and working aids and learn how people can collaborate on tasks which are difficult to perform single-handed. Instruction may sometimes also be necessary on the use of controls and technical aids. Simple checklists can be a useful means of ensuring that nothing is overlooked.

The individual must be sufficiently well-informed to be able to take early signs of overloading seriously. Incipient muscular pain is easily ignored, especially in stressful situations. If tiredness and pain in muscles and joints are frequently repeated, the pain can eventually grow more intense, becoming more or less permanent.

Instructions and information should be repeated at regular intervals. In the course of internal control, the employer needs to check that current routines for instruction etc. are relevant and adequate and that the instructions given are being complied with.

Guidance on Section 7 Employees

Adequate prevention of musculoskeletal disorders is difficult without the employees themselves being involved. For one thing, risks are influenced by personal characteristics and attitudes, added to which, it is the employees who, in a very direct and concrete manner, can identify ergonomic problems at work. The individual person's experience of exertion is often a good yardstick of the workload, though the risks of disorders are sometimes underrated. It is important for the employer's attention to be drawn to operations producing signs of overloading, so that steps can be taken to improve working conditions. It is also important that the employer should take such reports seriously and take whatever action is justified.

It is also important that the employer's instructions should be seen as an appropriate means of achieving the desired effect. Motivation for complying with an instruction about using lifting aids will be seriously frustrated if the lifting aid in question is felt to be unnecessary and greatly lengthens the time needed for the task.

The Work Environment Act lays down that an employee who finds that a protective device, e.g. on a machine, is in the way may not remove it in order to achieve a better work posture. Instead the protective device or the working method shall be altered, so that the work can be done in a way which is both safe and ergonomically acceptable.

Guidance on Section 8 Manufacturers, importers, suppliers and providers

This section applies to products which do not come under EC product directives. The latter, which also contain ergonomic stipulations, have been transposed into Swedish rules, as for example in the Board's Provisions (AFS 1993:10) on Machinery and Certain Other Technical Devices (amended and reprinted in AFS 1994:48) and (AFS 1996:7) on Design of Personal Protective Equipment.

Technical devices include, for example, office furniture, containers, lifting and conveyor devices, hand tools, implements etc., as well as different kinds of

machinery.

The main responsibility for the working environment lies with the employer. Manufacturers, importers, suppliers and providers have the responsibility of taking ergonomic factors into account right from the manufacture and delivery of the products, so that they can be installed, used, maintained and decommissioned in a manner compatible with Sections 2-5 of these Provisions (for an example, see Figure 13). Responsibility for the practical use made of these products by a buyer, however, rests with the employer.

Figure 13. One and the same grip won't suit all hand sizes

Chap. 3, Section 8 of the Work Environment Act lays down that product information material to the prevention of ill-health and accidents be appended to the product. It is important that the information should be intelligible - normally by being written in Swedish - to the people who are going to use it. The greater the deviation which use of the product entails from everyday situations, the more urgently necessary information becomes concerning ways in which health-endangering physical loads can be avoided. A simple product may not need to be accompanied by any information at all, while a more complicated one may need everything from a brief explanation of appropriate use to a comprehensive book of instructions.

Product information is also taken to include data helping the buyer to choose products appropriate to the users' physical characteristics (body measurements etc.), e.g. information concerning the choice of tools according to hand size and the selection of office or school furniture according to body size (Figure 13).

The marking of products with instructions for individual setting and adjustment, e.g. how to adjust the height of a work table, is a helpful practice, especially if a

workstation is used by more than one person.

Suppliers and providers of packaged products are required among other things, under Chap. 3, Section 10 of the Work Environment Act, to ensure that the packaging does not entail any risk of ill-health or accidents.

A purchaser is dependent on the extent to which the manufacturers have been able to incorporate ergonomic considerations in their products. Similar dependence can also occur within a single enterprise. Opportunities for persons responsible, say, for providing a good productive environment in an enterprise are greatly affected by the way in which the firm's technical design department has designed the products to be manufactured. Production-friendly designs are a good thing both ergonomically speaking and from a production viewpoint.

Guidance on Section 9 Commissioners of building or civil engineering work and others taking part in the preparation of building projects

Commissioners and planners of various kinds "create workplaces" for people during both the construction and utilization phases. It is very important that they should incorporate ergonomic factors in their planning and design work. Alterations after construction has started or after the building has been completed are both expensive and difficult to achieve.

By his decisions during the early project stages, the person ordering and paying for a construction project (the client) does a great deal to decide what the working environment will be like during the construction and utilization phases, both by determining and bearing the cost for the project and through his choice of consultants and his definition of their assignments. He is responsible for the co-ordination of the planning activities.

It is important that the client should choose consultants (planners etc.) with sufficient knowledge of work environment matters. This includes a knowledge of ergonomic conditions and hazards. The persons taking part in the planning also incur separate responsibility within the scope of their assignments. Further to this, see the Board's Provisions (AFS 1995:3) on Working Premises, (AFS 1994:52) on Building and Civil Engineering Work and (AFS 1995:4) on Design of Buildings and Plant.

Figure 14. Work in crawl spaces entails very difficult work postures.

The project execution stage

Crawl spaces under buildings (Figure 14) and other cramped, badly positioned installation spaces where work has to be done, such as machine rooms for lifts, are one example of poor planning which can be a cause of serious ergonomic problems both during the construction phase and in connection with maintenance. Commissioner and planners should ensure, as far as possible, that work in spaces of this kind can be avoided. Working spaces ought if possible to be of standing height (2.10 m) and the installations should be easily accessible for servicing, maintenance and reading. If planning leads to low, cramped spaces, limitation of the time an employee is allowed to work in such a space is often the only possible way of bringing down the risk of musculoskeletal disorders to an acceptable level.

Building board selection presents an opportunity for reducing the load on construction workers (Figure 15). 90 cm wide gypsum wallboard, which weighs 25 per cent less than traditional boards and, because of its reduced width, is easier to handle, satisfies structural engineering requirements for many purposes. It is important that narrower boards should be used whenever structural considerations permit.

Figure 15. The working environment is affected by the person planning a building project. If care is taken to choose better-designed products, the load on construction workers will be correspondingly reduced.

There are ergonomic hazards involved in the manhandling of heavy brick and of large, heavy building blocks. Bricks weighing more than about 3 kg which can be manipulated with one hand are normally unsuitable. Two-hand building blocks weighing more than about 10 kg entail risks, especially during bricklaying above shoulder height and below knee level. If the blocks chosen weigh more than about 20 kg, it should be made clear in building documents and suchlike that use of lifting aids is a precondition of acceptable bricklaying conditions.

Assembly of plumbing and electrical installations in ceilings, like other work above shoulder height, presents a serious risk of musculoskeletal disorders. It is particularly important that an attempt be made at the planning stage to minimize work of this kind.

The utilization stage

Good ergonomics and rational production depend among other things on suitable access and transport routes for moving and handling equipment and material. Wheeled handling should be possible.

It is important that the rooms, sections and fittings of the building should be designed to accommodate the cleaning work which will be done there; for example, there must be adequate space for doing the work and free passage for the cleaning trolley. The materials chosen for flooring, walls etc. should tally with the cleaning methods which the commissioner recommends for the future use of the premises.

AFS 1998:1

Refuse storage areas should be large enough, also with a view to pre-separation and recycling of refuse, and should be easy to keep clean. Wheeled transport should be made possible to and from the refuse storage areas. See also the Board's Provisions (AFS 1995:3) on Working Premises.

In the planning and construction of premises for caring services, it is essential to provide sufficient space, e.g. in toilets, so that, when the employees are assisting patients, inmates etc., their work postures and working movements will not be impeded by walls or fittings. See also the Board's Provisions (AFS 1995:3) on Working Premises.

The construction and utilization stages

There are times when, in spite of careful planning, ergonomic conditions for the construction and utilization stages cannot be made completely satisfactory. If so, this must be made quite clear, e.g. in the tendering documents, in the building documents or in some other way, so that the contractors will be able in time to take steps to create acceptable conditions for their employees.

Guidance on Section 10 Co-ordinator of a common worksite

Careful and early planning, in both time and space, is extra important at changeable worksites, e.g. construction sites. Co-ordinating responsibility for the working environment devolves most often on the contractor. He influences the working conditions, not only of his own employees but also of the subcontractors and their employees. He must ensure, for example, that lack of co-ordination does not lead to unnecessary movements of material, that a building hoist and building crane used by several enterprises are retained for as long as they are needed and that collisions in time and space between different occupational categories are avoided. The design and positioning of material dumps and access routes are among the critical points to be considered. Co-ordinating responsibility also includes ensuring that there are routines and agreements between different contractors for keeping things clean and tidy.

Co-ordinating responsibility is not confined to construction sites. It also exists, for example, in shopping centres and suchlike places where a single goods reception is used by several businesses. Activities then have to be co-ordinated, e.g. with regard to the timing of deliveries and transport operations, so that unnecessary workloads will be avoided. It may be advisable for the person in charge of co-ordination to be given the opportunity of expressing viewpoints on factors such as these before delivery agreements and suchlike are signed.

In this connection, mention can also be made of the duty of self-employed persons under Chap. 3, Section 6 of the Work Environment Act to consult others, e.g. the person responsible for co-ordination, on ergonomic conditions and other matters at a common worksite.

Guidance on Section 11 Controller of a worksite

Under Chap. 3, Section 12 of the Work Environment Act, the person in charge of a worksite, e.g. the employer responsible in a shop or restaurant, also has a certain responsibility for ergonomically acceptable working conditions as regards persons who work there intermittently without actually being employed by him. This responsibility includes ensuring that there are permanent devices at the worksite of such a kind that the risks of musculoskeletal disorders can be reduced to an acceptable level, as well as ensuring that the devices are kept in their intended working order as time passes. Devices of this kind include, for example, loading bays, hoists etc. used for delivering goods to shops, department stores, restaurants or warehouses. The same responsibility also includes non-fixtures, such as mobile loading devices or trolleys provided for loading or unloading work.

Another example is that of fixed accessories to a building, such as sinks, if they are used by outside personnel.

In addition to van or lorry drivers and cleaning staff, postmen, consultants and other transport, service and maintenance personnel often work on premises or in environments over which their own employers do not have direct control. If so, they are dependent on their interests being provided for by the person responsible under this Section.

Guidance on Section 12 Partnerships etc. and those engaging chartered labour

Parents and children, as well as brothers and sisters living in the same household, are usually taken to be members of one and the same family.

Models for the assessment of work postures, manual handling and physically monotonous, repetitive work, as indicated in the Guidance on Sections 2-4*

Background

There has long been a need for practical, systematic and simple methods for the identification and assessment of ergonomically hazardous jobs or situations. Employers, not least, need aids of this kind for their continuous investigation of the risks entailed by activities, as stipulated in the rules on internal control of the working environment and in the present Provisions. Using the models, it should be possible to obtain an initial indication as to whether or not a certain job or operation entails physical loads dangerous to health, and in this way an initial documentary basis for remedial action.

Hopefully, the models can also be used for ergonomic analyses by the personnel categories who in the course of their daily work directly influence working methods and workstations in the activity concerned, i.e. production planners and organizers, process engineers, planners, technical designers, structural engineers and others.

Principles of the assessment models

Very often, the connections between work and the risk of musculoskeletal disorders are relatively complicated. The models have been simplified, so as to improve the chances of their actually being put to practical use. They take in just a few aspects of one type of load at a time, and for this reason cannot be used as exact load limit values. But they furnish sufficient guidance to serve as the basis of a practical process of change, both at existing workstations and in the planning of new workstations and jobs.

Due to their simplified nature, if the models are employed uncritically, this can result in both overestimates and underestimates of the actual risks. To arrive at a comprehensive assessment, more factors need to be taken into account and more accurate models used, which in turn calls for a thorough knowledge of ergonomics.

*-----
* This is an elaboration of the models presented in *Vägar till färre arbetsskador - utveckling av nordisk ergonomitillsyn, modeller för ergonomisk riskvärdering*. TemaNord 1994:514

The models are based on a triple-zone system (red, yellow and green), so as to provide an easy indication of working conditions which are *clearly hazardous* or which entail *negligible risks*, as the case may be.

The colours in the models have the following meanings.

Red field = unsuitable

The work loads are of such magnitude and character that *all or most of the employees* risk developing musculoskeletal disorders in the short or long term.

Conditions ought normally to be remedied immediately so as to eliminate or reduce the risk, unless there are special reasons for deferring action. Reasons of this kind may, for example, be that there are very great practical difficulties involved in rapidly remedying the deficiencies which entail risks, or that specially chosen employees have acquired special knowledge of the risks and skill in avoiding them.

Yellow field = evaluate more closely

The work loads are of such magnitude and character that *a not insignificant number of employees* risk developing musculoskeletal disorders in the short or long term.

More exact investigations and assessments are needed in order to decide conclusively the degree of risk involved. It is above all time factors (tempo, frequencies, duration etc.) which may require closer investigation.

Green field = acceptable

The work loads are of such magnitude and character that *only one or two employees if any* risk developing musculoskeletal disorders in the short or long term.

Where the majority of employees are concerned, then, the loads do not present any risk of injury. A certain amount of caution can, however, be recommended where special risk groups (e.g. pregnant women, minors or employees who have recently been ill) are concerned. General measures are not normally needed, but individual ones must be taken where necessary.

Models for the assessment of sedentary, standing and walking work postures

An assessment model is given below for identifying unfavourable work postures. It is impossible to decide the degree of harmfulness of *each individual* work posture, because the different postures are often hard to segregate. Most often, though, there are one or a few dominant work postures which affect the ergonomic load more than others, e.g. those which occur most commonly during the working day or those which amount to extreme positions, if only for short periods. It is these work postures which the model is intended for assessing. First, then, these work postures have to be identified. Next one consults the chart to see whether the postures in question can be classified as *red, yellow or green* for one or more parts of the body.

In principle, only one indent in a square needs to be applicable in order for that square to be regarded as red or yellow, as the case may be. The greater the number of assessments coming in a red field, the more reason there is for remedial action.

The parts of the body mentioned in the model are points for observation and not necessarily the parts which are injured. For example, "unstable underlay" in the model means a risk of back disorders rather than a risk of leg ailments.

The model refers to a full working shift. This normally consists of 4-8 hours a day. The expression "a significant part of the shift" means here that the work posture occurs without interruption, or with only very short interruptions, for more than half the shift. "Intermittently" means that the work posture alternates with other work postures to such an extent that the total time for which it is occupied does not exceed half the shift.

Note that the model does not take into account whether the job requires much or little exertion. Where high levels of exertion are involved, any of the yellow or green jobs can turn red.

The time aspect is always important: **no work posture which can be assumed naturally is intrinsically dangerous to health. The risks occur if the posture is assumed too often or too long.**

Sedentary, standing and walking work postures

	Red	Yellow	Green
SITTING	One of the following occurs during a significant part of the shift	One of the following occurs intermittently during the shift	The following applies for a significant part of the shift
Neck	<ul style="list-style-type: none"> - bent, with no freedom of movement - twisted, with no freedom of movement - bent and twisted simultaneously - freedom of movement severely restricted 	<ul style="list-style-type: none"> - bent, with no freedom of movement - twisted, with no freedom of movement - bent and twisted simultaneously - freedom of movement severely restricted 	<ul style="list-style-type: none"> - central position, with freedom of movement
Back	<ul style="list-style-type: none"> - bent, with no freedom of movement - twisted, with no freedom of movement - bent and twisted simultaneously - freedom of movement severely restricted - no backrest 	<ul style="list-style-type: none"> - bent, with no freedom of movement - twisted, with no freedom of movement - bent and twisted simultaneously - freedom of movement severely restricted 	<ul style="list-style-type: none"> - free movements possible - well-designed backrest - option of changing to standing position
Shoulder/arm	<ul style="list-style-type: none"> - hand at or above shoulder height - hand beyond forearm distance, unsupported 	<ul style="list-style-type: none"> - hand at or above shoulder height - hand beyond forearm distance, unsupported 	<ul style="list-style-type: none"> - working height and reach adapted to task and individual - good arm support
Legs	<ul style="list-style-type: none"> - insufficient leg room - no support for the feet - freedom of movement severely restricted - leg-operated pedal work* 	<ul style="list-style-type: none"> - insufficient leg room - no support for the feet - freedom of movement severely restricted - leg-operated pedal work* 	<ul style="list-style-type: none"> - free leg space - good footrest - seldom leg- or foot-operated pedal work* - option of changing to standing position

AFS 1998:1

	Red	Yellow	Green
STANDING/ WALKING	One of the following occurs during a significant part of the shift	One of the following occurs intermittently during the shift	The following applies for a significant part of the shift
Neck	<ul style="list-style-type: none"> - bent, with no freedom of movement - twisted, with no freedom of movement - bent and twisted simultaneously - freedom of movement severely restricted 	<ul style="list-style-type: none"> - bent, with no freedom of movement - twisted, with no freedom of movement - bent and twisted simultaneously - freedom of movement severely restricted 	<ul style="list-style-type: none"> - upright posture, with freedom of movement
Back	<ul style="list-style-type: none"> - bent, with no freedom of movement - twisted, with no freedom of movement - bent and twisted simultaneously - freedom of movement severely restricted - unstable or sloping underlay 	<ul style="list-style-type: none"> - bent, with no freedom of movement - twisted, with no freedom of movement - bent and twisted simultaneously - freedom of movement severely restricted - unstable or sloping underlay 	<ul style="list-style-type: none"> - upright posture, with freedom of movement - option of changing to seated position
Shoulder/arm	<ul style="list-style-type: none"> - hand at or above shoulder height - hand at or below knee height - hand more than $\frac{3}{4}$ arm's length from body 	<ul style="list-style-type: none"> - hand at or above shoulder height - hand at or below knee height - hand more than $\frac{3}{4}$ arm's length from body 	<ul style="list-style-type: none"> - working height and reach adapted to task and individual
Legs	<ul style="list-style-type: none"> -insufficient room for legs and feet - unstable underlay - sloping underlay - leg- or foot-operated pedal work* 	<ul style="list-style-type: none"> -insufficient room for legs and feet - unstable underlay - sloping underlay - leg- or foot-operated pedal work* 	<ul style="list-style-type: none"> - freedom of movement on non-slip, even and level underlay - no leg-operated and seldom foot-operated pedal work* - option of changing to seated position

* Leg-operated pedal work = the brake or clutch pedal of a motor vehicle

* Foot-operated pedal work = the accelerator pedal of a motor vehicle

Model for assessment of lifting work

The following model for the assessment of lifting work concentrates on two main factors, the weight of the load and the distance in front of the body of its centre of gravity. Thus important factors such as lifting frequency, the duration of lifting work, lifting heights, the ease with which the load can be grasped and so on are not included in the actual model. In order to include the effects of these and any other factors in the analysis, supplementary assessments have to be made. The model is valid for both sexes.

Distance from lumbar region

Within forearm distance, 30 cm approx.	Within $\frac{3}{4}$ arm's length, 45 cm approx.
--	--

Weight of the load (kg)

	Red
Yellow	
Green	

Model for assessment of a symmetrical lifting operation in the standing position, using two hands and under ideal conditions. Horizontal distance = the distance between the lumbar region and the centre of gravity of the load when lifting.

One conclusion drawn from this model is that handling of loads weighing more than 25 kg is unsuitable in the majority of cases. Important influencing factors

AFS 1998:1

The following are the most important of the many factors which should be taken into account in the assessment of risk, especially if the first assessment comes in the yellow field. The greater the number of "aggravating" factors, the lower the recommended maximum weight will be compared with ideal lifting conditions.

in the task:

- if the work is done for a long time, frequently, under pressure of time, if the handling is machine-controlled or suchlike, if the employee cannot decide for himself when a break is called for,
- if the handling has to be done with the trunk bent or twisted or, worse still, with the trunk both bent *and* twisted,
- if the object is carried for long distances,
- if the handling requires precision.

in the object:

- if the object is difficult to grasp or cannot be handled close to the body; large, unwieldy, warm, cold, sharp, wet, with no natural or specially attached handles etc.,
- if the object is fragile or unstable or if the contents are mobile or liable to shift, e.g. vessels containing liquids, sacks of potatoes.

at the workplace:

- if the space is insufficient, with the result that the employee is prevented from working with suitable postures - too cramped, not enough headroom etc.,
- if there are obstructions in the form of different levels, e.g. stairs and thresholds, or untidyness
- if the floor/underlay is slippery, uneven, sloping or unstable,
- if climatic conditions are unsatisfactory.

connected with the person who does the lifting:

- if the employee has insufficient physical capacity, e.g. as regards muscular strength, aerobic capacity or body control,
- if the employee has insufficient command of non-injurious work techniques, if the employee is wearing unsuitable clothing or footwear.

Lifting and moving of living beings require special deliberations and allowances. See the Guidance on Section 3.

Model for assessment of pushing and pulling work

Force [N]	Red	Yellow	Green
Starting	>300	300-150	<150
Continuously	>200	200-100	<100

This model refers to good ergonomic conditions, i.e. a symmetrical two-handed grip, properly designed handles positioned at a suitable height and good ambient conditions. If, for example, the object is to be moved over a long distance, the operation is repeated frequently or for a long time, the grasping height deviates considerably from about elbow height, then the values in this model should be correspondingly reduced, and the same applies if the work is done using one hand only. Several of the conditioning factors in the assessment model for lifting work are also applicable to pushing and pulling work.

Force is measured in Newtons [N] using a dynamometer.

Model for identifying and assessing physically monotonous, repetitive work

The following assessment model can be consulted for the identification and assessment of physically monotonous, repetitive work. In the final assessment of risk it is always important to include *the total time* devoted to the work and *how it is spread out* over the day.

	Red	Yellow	Green
Work cycle	The work cycle is repeated several times a minute for at least half the shift	The work cycle is repeated several times a minute for at least one hour of the shift <i>or</i> many times an hour for at least half the shift	The work cycle is repeated a few times every hour.
Work postures and working movements	Constrained or uncomfortable work postures and movements.	Limited scope for changing work postures and movements.	Well-designed work-place. Good possibilities of varying work postures and movements.
Job decision latitude	The work is completely controlled by something else or by other people.	The work is partly controlled by something else or by other people. Limited possibilities of influencing the way in which the task is performed.	Good possibilities of adapting the work to one's own ability. Influence on the planning and arrangement of work.
Job content Training/ competence requirements	The employee performs an isolated task in a production process. Short training phase.	The employee performs several tasks in a production process. Job rotation can occur. Training for several tasks.	The employee takes part in several tasks or in the whole of the production process, planning and instruction included. Continuous competence development.

Aggravating factors:

- if the work requires a great deal of physical exertion, precision or speed of movement,
- if the workpiece is heavy and difficult to grasp,
- if a reward system is used which puts a premium on quantity,
- if production is frequently subject to unexpected disruptions over which the employee has no control, and
- if social relations and social support at the workplace are deficient.

Assessment

The work cycle is the overriding factor. If this is found to come in a *red* field, the work is judged to be physically monotonous and repetitive. Work of this kind is judged to be harmful, and it is very important that remedial measures should be taken within the near future. The risk of negative effects becomes even greater if one or more of the other factors also come in a red field. If the work cycle is judged to come in a *yellow* field, conditions should be evaluated more closely. If one or more other factors come in a red or yellow field, the work is rated unsuitable and measures should be taken. If the work cycle is judged to come in the *green* area, the work is no longer to be regarded as physically monotonous and repetitive. Where other factors are concerned, working conditions improve as one moves towards a green field. The aggravating factors are always included in the total assessment.

Explanations concerning the model

The diagram is based on a full working shift, which is usually 4-8 hours a day.

Work cycle: The time elapsing from the moment one begins machining/processing an object until the same operation recurs with the next object is the duration of a work cycle as that term is commonly used in industry. It is not unusual for the same working movements to be repeated several times within a working cycle of this kind, i.e. for the "technical working cycle" to consist of several "kinetic cycles". It is "kinetic cycles" of this kind that are referred to here. If no such cycles are clearly distinguishable, the "technical" working cycle can be used as a starting point. Fingers and wrists can cope with a higher frequency of movement than elbows and shoulder joints without suffering injury. A more serious view is to be taken, then, if large parts of the body are involved.

Work postures and working movements: As an aid to the assessment of work postures, reference is made to the assessment model for strenuous work postures and to the Guidance on Section 2. In the assessment of working movements, attention must be paid to which parts of the body are used.

Job decision latitude: The "job decision latitude" concept is addressed in Section 5 and the Guidance on the same. Being controlled by something else can, for example, mean sitting at a conveyor belt, where the individual is unable to influence the speed of the machine. Long queues of customers can entail a mental stress which limits the job decision latitude. Piecework implies an element of self-determination, in that the employee can decide for himself how much is to be produced. In practice, however, it frequently operates in the opposite direction, since there are always minimum requirements concerning output volume.

Job content and training/competence requirements: Job content refers among other things to the possibilities of seeing the whole context of production

AFS 1998:1

and the way in which one's own work fits into it. Good job content means that the work consists of parts which are different in character but clearly belong together, e.g. because they include elements of planning, implementation and inspection. The employee is in a position to use the whole of his/her competence and to develop at work. A job with little job content means that there is only about one simple task involved.

There are jobs with conspicuously limited job content in which the only stimulus is the amount which the individual can produce and/or the incentive pay connected with so doing. The mental stimulus then connected with feeling oneself to be "good at the job" entails a danger to physical health, because the load on the body increases with rising performance, at the same time as the time available for breaks and recuperation diminishes.

Training/competence requirements refer to the induction, introduction and subsequent training which the employee needs in order to do the job. Tasks of a more composite nature cater to employees' need for using both their physical, mental and creative capacity. Jobs with a good job content usually require longer training and continuous competence development.

Example of a checklist for identifying load factors potentially dangerous to health*

The following is an example of a checklist which can simplify the identification of potentially health-endangering loads in a particular task. Some of these risks may require closer investigation. The models in App. A will furnish guidance for assessing the risk level of some situations.

How to use the checklist

- o Before making an assessment of an employee's job, clarify the tasks which his job includes and how large a part of the total work input each task occupies. Find out too, whether the employee feels that one or more tasks are strenuous or have caused a disorder. Next, decide whether the whole of the employee's job or just one or a few tasks are to be assessed. Work through the checklist for each of the tasks selected for assessment.
- o Answer questions 1-17 and include factors a-g at the end of the list.
- o Prepare a summary assessment in which the risk factors are dealt with in order of estimated gravity. Phrases from the list can be used and supplemented with descriptions of repetitions per unit of time, number of kilos lifted, the extent of forward bending entailed by a certain work posture, and so on. Note that it is not the intention with this checklist that the number of affirmative answers should be aggregated into a single unit of quantitative assessment.

Questions concerning load factors

1. Is the walking surface
 - (a) uneven, sloping, slippery or non-resilient?
 - (b) are there thresholds, differences of level or other obstructions?
2. Are working tools and other equipment unsuitably designed or poorly adjusted from the viewpoint of the employee and the task?
3. Is there insufficient space for working movements and working material?

* This is an elaboration of Kemmlert K. New analytic methods for the prevention of work-related musculoskeletal injuries, published in "Fifteen years of occupational accident research in Sweden", pp. 187-196, Rådet för arbetslivsforskning (1996).

AFS 1998:1

4. Is the working chair poorly designed or poorly adjusted?
5. In work performed whilst standing, is there no possibility of sitting down to rest?
6. Does the work involve sitting down for a long time?
7. Is the working height poorly adapted to the task and to the employee's body size?
8. Are visual conditions poorly adapted to the visual requirements of the job, thereby leading to strenuous work postures?
9. Is prolonged or recurrent work done with the back:
 - (a) bent forwards, backwards or sideways?
 - (b) twisted?
 - (c) bent and twisted simultaneously?
10. Is the neck repeatedly or for long periods:
 - (a) bent forwards, backwards or sideways?
 - (b) twisted?
 - (c) bent and twisted simultaneously?
11. Is prolonged or recurrent work performed with the arm stretched forwards or outwards unsupported or above shoulder height?
12. Is work repeatedly done with the forearm and hand with:
 - (a) twisting movements?
 - (b) forceful movements?
 - (c) uncomfortable handpositions/grips?
 - (d) keys or button sets?
 - (e) heavy demands on precision?
13. Is fatiguing leg work involved?
 - (a) repeated climbing of a stool, stepladder or suchlike?
 - (b) repeated jumping, prolonged crouching or squatting?
 - (c) is one leg used more often than the other for support?
 - (d) with pedals?

14. Is manual lifting involved? Consider such factors as:
 - (a) how often lifting occurs
 - (b) the weight of the load
 - (c) handling beyond forearm's length
 - (d) handling below knee level
 - (e) handling above shoulder height
 - (f) ease or difficulty of grasping the load
 - (g) precision requirement of lifting
 - (h) transfer of persons.
15. Is there repeated, prolonged or uncomfortable carrying, pushing or pulling of loads?
16. Is prolonged or recurrent work done
 - (a) repeating similar working movements?
 - (b) repeating similar working movements beyond comfortable reach?Consider such factors as the weight of workpieces and tools and the ease or difficulty of grasping them.
17. Are technical aids lacking which could make work easier?

Include these factors as well:

- (a) Are there time factors, such as the length of the working session, the distribution of rest intervals and breaks, work cycle times etc., which accentuate the impact of any of the risk factors in 1-17?
- (b) Are the possibilities of influencing the arrangement and conduct of one's own work too small?
- (c) Is the work done under pressure of time or does it entail negative stress?
- (d) Does the work involve unusual or unexpected situations?
- (e) Is the impact of any of the risk factors in 1-17 accentuated by cold, heat, draughts, noise or suchlike?
- (f) Are negative effects produced by impacts, jerks or vibrations?
- (g) Does the employee lack sufficient knowledge of importance in this context?

Information from the Swedish National Board of Occupational Safety and Health
--

Other relevant rules

Statute Book of the Swedish National Board of Occupational Safety and Health (AFS)

AFS 1982:12	Work in Cold Premises in Food Processing Industries (superseded by AFS 1998:2 as from 1st July 1998)
AFS 1982:20	Restaurants and Other Catering Establishments
AFS 1986:7	Vibrations from Hand-held Machines
AFS 1986:19	Pre-school (Nursery School) and After-school Centres
AFS 1987:15	Presses
AFS 1990:18	Care and Assistance in Private Homes
AFS 1991:8	Lighting
AFS 1992:14	Work with Visual Display Units
AFS 1992:19	Work in Checkouts
AFS 1993:10	Machinery and Certain Other Technical Devices (amended by Ordinance AFS 1994:48, new edition)
AFS 1994:1	Job Adaptation and Rehabilitation
AFS 1994:32	Pregnant and Breast-feeding Employees
AFS 1994:52	Building and Civil Engineering Work
AFS 1995:3	Working Premises
AFS 1995:4	Design of Buildings and Plant
AFS 1996:1	Minors
AFS 1996:5	Use of Work Equipment
AFS 1996:6	Internal Control of the Working Environment
AFS 1996:7	Design of Personal Protective Equipment
AFS 1997:2	Work in Intense Heat
AFS 1998:2	Work in Cold Premises in Food Processing Industries (supersedes AFS 1982:12 with effect from 1st July 1998)

Other rules

EU - Council Directive of 29 May 1990 on the minimum health and safety requirements for the manual handling of loads where there is a risk particularly of back injury to workers (90/269/EEC), 1990
SS-EN 614-1 Safety of Machinery - Ergonomic Design Principles - Part 1: Terminology and General Principles, 1995.

Other publications

The Swedish National Board of Occupational Safety and Health

Arbetsmiljö för alla - om rehabilitering, 1996, H 136
Ensidigt och monotont arbete, 1991, H 152

The Swedish Joint Industrial Safety Council

Ergonomi, 1998, H 309

The Swedish National Board of Occupational Safety and Health and Statistics Sweden (SCB)

Sifferfakta om belastningsergonomi, 1998, ADI 507
Ensidigt upprepat arbete. Information om utbildning och arbetsmarknad, 1995:7
När kroppen tar stryk. Statistiska meddelanden, 1997, AM 45 SM 9701

National Institute of Occupational Safety and Health, NIOSH

Applications Manual for the Revised NIOSH Lifting Equation. US Department of Health and Human Services, Cincinnati, 1994

The Nordic Council of Ministers

Vägar till färre arbetsskador - utveckling av nordisk ergonomitillsyn, modeller för ergonomisk riskvärdering. TemaNord 1994:514

The Council for Working Life Research

Kemmlert K. New analytic methods for the prevention of work-related musculoskeletal injuries. In "Fifteen years of occupational accident research in Sweden", pp. 187-196, 1996

Rules, books, brochures and films from the Swedish National Board of Occupational Safety and Health can be ordered from:
Publikationsservice, Box 1300, S-171 25 SOLNA, Sweden
Tel. +46 8 730 97 00 Fax +46 8 730 98 17