



SWEDISH  
WORK  
ENVIRONMENT  
AUTHORITY

AFS 1998:5

# Work with Display Screen Equipment

Provisions of the Swedish National Board of Occupational Safety and Health on Work with Display Screen Equipment together with General Recommendations on the implementation of the Provisions

## **Translation**

In the event of disagreement concerning the interpretation and content of this text, the printed Swedish version shall have priority

The Work Environment Authority's Statute Book

The Swedish Work Environment Authority was formed through a merger of the Swedish National Board of Occupational Safety and Health and the Labour Inspectorate, on 1<sup>st</sup> January 2001.

Provisions adopted by the Swedish Work Environment Authority are published in the Statute Book of the Swedish Work Environment Authority. Provisions earlier published in the Statute Book of the Swedish National Board of Occupational Safety and Health simultaneously still apply. Both Statute Books' names are abbreviated AFS.

Please note that references to statutes always give the original number of the document concerned, regardless of any subsequent amendments and reprints.

Concerning amendments to and reprints of Provisions of the Swedish National Board of Occupational Safety and Health and of the Swedish Work Environment Authority, reference is made to the latest Statute Book Register (in Swedish). A list of Ordinances, General Recommendations, Directions and Notices is also published in English.

Swedish Work Environment Authority  
SE-171 84 SOLNA , Sweden

Telephone: +46 8 730 90 00  
Telefax: +46 8 730 91 67  
Publishing Services, telefax: +46 8 735 85 55

[www.av.se](http://www.av.se)

## List of contents

### Provisions of issued by the Swedish National Board of Occupational Safety and Health on Work with Display Screen Equipment

Scope .....	5
Screen and keyboard .....	5
Lighting and visual conditions .....	6
Work postures and working movements .....	6
Eyesight test and special glasses for display screen work .....	7
Arrangement and organisation of display screen work.....	8
Emissions .....	8
Software and systems .....	8
Penal Provisions.....	9
Entry into force .....	9

### General Recommendations of the Swedish National Board of Occupational Safety and Health on the implementation of the Provisions on Work with Display Screen Equipment

Introduction.....	10
Internal control of the working environment in connection with display screen work .....	12
The Council Directive on the minimum safety and health requirements for work with display screen equipment (90/270/EEC) .....	12
Guidance on individual Sections .....	12

### Information from the Swedish National Board of Occupational Safety and Health.....27

## Provisions of the Swedish National Board of Occupational Safety and Health on Work with Display Screen Equipment



Adopted 22nd October 1998

Published 23<sup>rd</sup> December 1998

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

### Scope

#### Section 1

These Provisions apply to work done using a display screen with appurtenant equipment. The term "computer display screen" denotes an alphanumeric or graphic display screen, regardless of how the image is produced.

The Provisions do not apply to work done using an oscilloscope or a digital or text presentation display on a measuring instrument, typewriter, cash register, pocket calculator or suchlike. Nor do they apply to portable systems during brief, non-permanent use at a workplace. Section 6 does not apply to persons equated with employees under Chap. 1, Section 3 of the Work Environment Act.

### Screen and keyboard

#### Section 2

A computer display screen and keyboard shall be easily readable and shall be designed in such a way as to facilitate use. The image on the screen shall be free from disturbing flicker and other forms of instability. The screen shall be free of reflective glare and reflections liable to cause discomfort to the operator. The characters on the screen shall be well-defined and large, and shall have sufficient contrast. The distances between characters and lines shall be sufficient for good readability. The brightness or the contrast between the characters and the background shall be easily adjustable by the operator, and also be easily adjustable to ambient conditions.

---

<sup>1</sup> Cf. Council Directive 90/270/EEC (OJ L 156, 21.6.1990, p. 14)

## **Lighting and visual conditions**

### **Section 3**

Room lighting shall ensure satisfactory lighting conditions in the room and an appropriate contrast between the screen and the background environment, taking into account the operator's capacity, the vision requirements of the display screen work and the type of work. Room lighting must not impede the reading of the display screen. Task lighting shall be provided if needed. It shall be adjustable and must not dazzle.

A display screen workstation shall be so designed that disturbing glare and reflections do not occur from the surrounding environment. This shall be achieved by co-ordinating workplace and workstation layout with the positioning and technical characteristics of the artificial light sources. Windows shall be fitted with a suitable system of adjustable covering to attenuate the daylight that falls on the workstation. The keyboard shall have a matt surface to avoid reflective glare.

Desking surfaces shall have low-reflection surfaces where necessary for the avoidance of disturbing reflections.

Visual and lighting conditions must not give rise to unsuitable work postures.

## **Work postures and working movements**

### **Section 4**

The workstation shall be dimensioned, designed and equipped so that the operator can find comfortable work postures and vary work postures and working movements.

The work desk and work surface shall be large enough to allow a flexible arrangement of the screen, keyboard, computer mouse or other operating device, documents and related equipment.

The space at the keyboard and the space for a computer mouse or other operating device shall be sufficient to provide support for the hands and arms of the operator.

### **Section 5**

The display screen and keyboard or equivalent shall be positioned so as to be adaptable to the body measurements of the operator, so as to achieve a suitable working height and visual angle in relation to the screen. The keyboard and the

display screen shall as far as is practically possible be rotatable, adjustable and moveable to suit the needs of the operator. A document holder, if used, shall be stable and adjustable and shall be positioned in such a way that unsuitable head and eye movements are avoided.

The work chair shall be stable and allow the operator easy freedom of movement and a comfortable position. The chair shall be easy to adjust. The seat shall be adjustable in height. The backrest shall be adjustable in both height and tilt.

## **Eyesight test and special glasses for display screen work**

### **Section 6**

The employer shall see to it that an employee normally having to work with a display screen for more than one hour during the working day undergoes an eye and eyesight test. This test shall be carried out by a person with the necessary capabilities. If an eye and eyesight test of this kind has recently been carried out through arrangement by another employer, a new test shall be carried out only if the present display screen work entails new or different vision requirements or if the employee's vision status has changed since the last test. An eye and eyesight test shall subsequently be provided at regular intervals and whenever the employee reports discomforts which may be connected with the visual demands of the work.

If the results of an eye and eyesight test shows supplementary examination by an ophthalmologist to be necessary in view of the visual requirements of the display screen work, examination of this kind shall be arranged by the employer.

If an eye and eyesight test shows that it is necessary and normal corrective appliances cannot be used, the employer shall provide the employee with special corrective appliances tested for the display screen work concerned.

Measures needing to be taken by virtue of this Section must not involve employees in additional financial cost.

## **Arrangement and organisation of display screen work**

### **Section 7**

Display screen work which is closely controlled or restricted in a physical or mental respect or is monotonously repetitive may not normally occur.

## **AFS 1998:5**

### **Section 8**

In the event of eye strain or other strain-related disorders resulting from work with display screens in spite of the measures referred to in Sections 2-7, work shall if possible be arranged in such a way that the operator can switch to other, less strenuous tasks. If this cannot be arranged, the operator shall have sufficient breaks in the course of work for disorders to be avoided.

## **Emissions**

### **Section 9**

Emissions from the display screen and appurtenant equipment, such as noise, heat, chemical substances and electrical and magnetic fields, may not be disturbing or cause the operator discomfort or unpleasantness constituting a risk to his/her safety and health.

## **Software and systems**

### **Section 10**

Software and systems shall be suitably designed with regard to the requirements of the task and the aptitudes and needs of the operator. Software must be easy to use and, where appropriate, adaptable to the operator's level of knowledge or experience. Systems shall as far as possible give the operators feedback with regard to the work done. They shall display information in a format and at a pace which are adapted to the operators.

In the design and selection of software, special consideration shall be paid to the ergonomic principles applying to human capacity for perceiving, understanding and processing information.

No quantitative or qualitative control, through the data system, of the employee's work input may be undertaken without the employee's knowledge.

## **Penal Provisions**

### **Section 11**

The stipulation in Section 6 (2) is a Provision as referred to in Chap. 4, Section 5 of the Work Environment Act (SFS 1997:1160). Under Chap. 8, Section 2 of the Work Environment Act, offences against this Provision may be punished by fines.

## **Entry into force**

These Provisions enter into force on 1st April 1999. The Provisions issued by the National Board of Occupational Safety and Health on Work with Visual Display Units (AFS 1992:14) and the General Recommendations of the National Board of Occupational Safety and Health on Computer Aids at Work (AFS 1986:27) are repealed with effect from that date.

Helena Nilsson Lannegren

Kurt Baneryd

Göran Lindh

AFS 1998:5

## **General Recommendations of the Swedish National Board of Occupational Safety and Health on the implementation of the Provisions on Work with Display Screen Equipment**

The following General Recommendations are issued by the National Board of Occupational Safety and Health on the implementation of its Provisions on Work with Display Screen Equipment (AFS 1998:5).

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.

### **Introduction**

Deficiencies in the physical design of the display screen workstation or in the arrangement and organisation of display screen work can lead to physical and mental loads of such a kind as to cause discomforts and ill-health at work. Musculoskeletal disorders are common. Most reports in the official occupational injury statistics of suspected occupational diseases in display screen work refer to disorders of this kind, e.g. in the neck, shoulders and arms. These disorders can often be prevented and the efficiency of work be improved by suitable design of the technical equipment, the lighting environment, the workstation and the work organisation. Mental strain and stress-related problems may also occur as a result of the working situation. It is an established fact, for example, that prolonged response times and unplanned system interruptions are frequently experienced as mentally strenuous.

Although it has not been proved that display screen work entails an elevated risk of eye injuries, many persons working more or less continuously at display screens experience eye strain symptoms such as smarting, gritty feeling, sensitivity to light and suchlike as well as headache in connection with their work. With advancing age, most persons require special corrective appliances in order to be able to work with a display screen without discomfort.

## **AFS 1998:5**

The equipment can generate emissions<sup>2</sup>, such as flickering light and disturbing noise, which are capable of causing irritation and other discomforts to the operator.

This is an important point to consider in the selection and installation of the equipment.

It is essential that selection of software and systems should emanate from the needs of the operators. The operators need to have adequate knowledge, so as to be capable of using the information processing system in the best possible way.

It is also essential that education and information measures should be planned at an early stage in the introduction of new or modified computer aids at work.

SWEDAC, the Swedish Board for Technical Accreditation, has laid down guidelines for the authorised voluntary testing of display screens with reference to visual ergonomic properties and emission factors (e.g. electrostatic potential and electric and magnetic fields). Those guidelines are being partly superseded by the international standard EN/ISO 9241 Ergonomic requirements for office work with visual display terminals (VDTs). Testing agencies are accredited by SWEDAC.

The above mentioned standard consists of 17 parts, several of which have been adopted as Swedish standards. Standards are not mandatory rules. Mandatory rules covering the standard are contained in the present and other Provisions issued by the National Board of Occupational Safety and Health.

Guidelines for the eco-labelling of display screens, processing units and keyboards have also been laid down, e.g. by TCO (the Swedish Confederation of Professional Employees) together with NUTEK (the Swedish National Board for Industrial and Technical Development) and the Swedish Society for the Conservation of Nature (SNF).

CE-labelling is stipulated by a number of Council Directives, e.g. Directive 73/23/EEC, amended 93/68/EEC (electrical equipment designed for use within certain voltage limits), and Directive 89/336/EEC, amended 92/31/EEC and

---

<sup>2</sup> Emission = release of radiation, substances etc. into the surroundings.

## **AFS 1998:5**

93/68/EEC (electromagnetic compatibility). CE-labelling of a display screen only means that the requirements of these Directives are satisfied. It does not imply conformity to other requirements, such as those of the present Provisions.

### **Internal control of the working environment in connection with display screen work**

The duty of the employer to plan, investigate and remediate the working environment, e.g. in connection with display screen work, is defined in the special Provisions issued by the National Board of Occupational Safety and Health concerning Internal Control of the Working Environment.

### **The Council Directive on the minimum safety and health requirements for work with display screen equipment (90/270/EEC)**

The EC Council Directive on the minimum safety and health requirements for work with display screen equipment (90/270/EEC) has been transposed to Swedish stipulations through these Provisions. Articles 3, 6 and 8 of the Directive, however, have been transposed to Swedish stipulations through rules contained in the Provisions of the National Board of Occupational Safety and Health on Internal Control of the Working Environment.

## **Guidance on individual Sections**

### **Guidance on Section 1 Scope**

A display screen is normally used together with a keyboard, a computer mouse or some other operating device for entering, processing, monitoring and retrieving data, for word processing, graphics processing, computerassisted design (CAD) or process control. The term "alphanumeric screen" used in these Provisions denotes a screen showing alphabetical and digital characters. The Provisions can also be consulted for other types of work to which these regulations do not apply, but where similar visual requirements are involved.

The Provisions apply to those incurring responsibility for the working environment under the Work Environment Act in the appropriate respect, primarily to employers but also to those who, under Chap. 1, Section 3 of the Work Environment Act, are responsible for the working environment of pupils

and others. The requirements of Section 6, however, do not apply to pupils, inmates of institutions or conscripts and the equivalent.

The Provisions also apply when work is done away from the main workplace, e.g. from the worker's home.

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.

### **Sections 2 and 3: Display screen, keyboard and lighting**

The quality and readability of the image have an important bearing on computer work and on requirements concerning lighting conditions. Important properties include, for example, character size, contrast, the spacing of lines and characters, edge sharpness and resolution, and the polarity (light or dark background) of the image as well as its stability and freedom from flicker. Image quality can deteriorate as a screen ages, and so it is important that the screen should be checked at regular intervals.

Readability can be good if an individual character (letter of the alphabet) occupies a visual angle of 20-22 arc minutes<sup>3</sup>. At a visual distance of (normally) 70 cm, this corresponds to a character size of about 3.5 - 4 mm. At the same time the visual angle, and character size with it, may need to be greater for reading, say, coloured symbols. Colour distinguishing ability diminishes with surface area. Colours are liable to be confused at sizes of less than about 30 arc minutes.

---

<sup>3</sup> 1 degree = 60 arc minutes.

## AFS 1998:5

Readability is facilitated if, for example

- the distance between characters on the screen is at least one stroke width (e.g. the stem breadth of a letter of the alphabet),
- words on the screen are at least one character apart,
- the pitch (spacing between lines) is at least one pixel<sup>4</sup>, (i.e. with no parts of characters or accents coming between the lines).

A light screen with a light background and dark characters (positive polarity) is preferable in ordinary office conditions. This reduces differences of luminance<sup>5</sup> in the visual field at the workstation, since walls and paper, for example, are usually bright. If the screen has positive polarity, this saves the eye from having to adjust when the operator's gaze alternates between the bright paper and to the dark screen. This kind of adjustment is fatiguing to the eye, especially if it occurs frequently, and can give rise to various discomforts, e.g. headache and tiredness. When a dark screen is used, a compromise is often necessary to allow for the brightness of the paper. Surfaces with excessively high luminance can be illuminated less or made duller, for example, by means of textile material or a wall screen with lower reflectance<sup>6</sup>. With a dark screen, the ambient lighting in the room often needs to be lowered, which can impair the visual ergonomics of other tasks. A light screen is also less sensitive to disturbing mirror images, glare and reflections from the surrounding environment, and this in turn may simplify the positioning of screen and workstation in the room. In this way the working premises can be kept brightly lit.

A high degree of edge sharpness, i.e. a sharp distinction between characters and background, is important for the avoidance of eye discomfort.

It is essential that the luminance<sup>7</sup> contrast between character and background, in the case of character details involving a risk of confusion (e.g. the difference between "c" and "e") should not be less than about 3:1.

Flicker problems may occur if the display screen does not have a high enough renewal rate<sup>8</sup> (at least 70 Hz is usually recommended). Research in recent years has shown that some people can be adversely affected by light modulation (variations in intensity), both visible (flicker) and invisible, both as one of several causal factors of eye discomfort and probably also, according to

---

4 Characters on a screen are often made up of dots, known as pixels.

5 Luminance = the brightness of a surface emitting light (e.g. a lamp) or reflecting it. Luminance is measured in candela per square metre (cd/m<sup>2</sup>).

6 Reflectance = the capacity of a surface to reflect light. Often expressed as a percentage.

7 Luminance = the intensity of light radiating from a surface emitting light (e.g. a light bulb) or reflecting it. Luminance is measured in candelas per square metre.

8 The renewal rate is the speed at which the image on the screen is updated.

with subjective electrical hypersensitivity. Software can also make a difference to the image renewal rate. Certain programs or program-controlled applications (on colour screens, for example) can use lower renewal rates and may therefore cause flicker problems. This problem can be solved by altering the screen settings. Flicker can be a problem on large screens (about 17A and upwards), mainly because these can have a lower renewal rate and because, with a greater part of the field of vision occupied by the screen, the more flicker-sensitive peripheral vision is affected to a greater degree.

Large screens take up more space, which can mean that a deeper table is needed so as to achieve a suitable visual distance from the screen and make room for document, keyboard, work surfaces etc. Larger screens may also need to be positioned in such a way that they can be lowered to give an appropriate visual angle (cf. the Guidance on Sections 4 and 5).

A colour screen can have inferior resolution and edge sharpness compared with monochrome screens. The use of colour as an information carrier can, however, make the information more lucid and easier to distinguish, identify and interpret. Positive effects of colour coding are conditional on the colour code being closely adapted to the task. Colour coding is most advantageous if colour is used to supplement other coding, i.e. together with, say, shape, size or positioning. The number of colours used, and which colours and combinations of colour, are important factors to consider. A person see and perceives the same colour differently, depending on the background colour it is presented against. When reading a text on a display screen, for example, the luminance contrast between characters and background is extremely important for readability. Some colour combinations give poorer luminance contrast. The operator can have a great deal of liberty to adjust and alter colours on the screen, but easy resetting is vital. When using colour as an information carrier, it is important to allow for the fact that many people have defective colour vision (between 8 and 10 per cent of the male population, for example, have the commonest form of reduced colour vision, known as red/green colour blindness). This is one reason why the use of colour as the one and only information code is unsuitable.

Glare and reflections on the screen and keys can often be avoided by suitably adjusting the relative positions of the display screen and light fittings. Dark and relatively shiny keys are very liable to give off reflections. This problem can be avoided by having keys with a matt and not a dark finish. A tabletop which is white or excessively dark is unsuitable in terms of visual ergonomics, because it gives the wrong luminance ratios. The tabletop should not be shiny either, because it would be liable to give off reflections. Factors in the surrounding environment which can cause reflections and glare on the screen, keyboard and work surfaces are artificial sources of light, windows and other openings, transparent or translucent walls, and brightly coloured fixtures or walls. Particularly important on premises with several workstations are, for example,

## **AFS 1998:5**

the light distribution and glare protection of the fittings. The workstation should be positioned so as to minimise glare and reflections from windows. The screen is best positioned at right-angles to incoming daylight. It is important to be able to screen off disruptive daylight, e.g. with curtains or blinds. Reduction of lighting or daylighting is a *pis aller*: problems of this kind are primarily solved by optimising the positioning of the workstation. Research has indicated that excessively dark premises entail problems. Rules on workplace lighting conditions are contained in the special Provisions on Lighting issued by the National Board of Occupational Safety and Health. The General Recommendations on implementation of the Lighting Provisions offer further information and guidance to facilitate compliance with the lighting requirements of the present Provisions.

Variable strength adjustable task lighting may be necessary for certain kinds of display screen work, so as to adjust the light more closely to the characteristics of the individual and to the tasks involved.

It is essential that the room lighting as well as the task lighting should be flicker-free.

A laptop computer based, for example, on LCD technology<sup>9</sup>, has certain advantages but also disadvantages compared with a CRT<sup>10</sup> screen. The advantages include a flat, distortion-free surface, high edge sharpness, less sensitivity to reflections in a number of connections (where certain types of LCD screen are concerned), a natural downward angle of vision, the smaller field of vision occupied by the computer, and its compactness. Disadvantages include difficulty in adjusting the brightness and contrast to bright and dark surroundings respectively, the risk of disruptive reflections from overhead lighting in the upward-tilted screen, the slow image renewal rates of certain LCD screens, and, on some LCD screens, a limited angle of vision with adequate contrast.

### **Guidance on Sections 4 and 5: Work postures and working movements**

The arrangement and content of work have a crucial bearing on the possibilities of avoiding unsuitable loads in connection with display screen work. It is important that work should provide opportunities of variation, flexibility, self-determination etc. (cf. the Guidance on Sections 7 and 8). If the workstation is used by more than one person, it is particularly important for the equipment to be suitable for different individuals, different kinds of work and different routines without other inconveniences occurring. The Provisions of the National Board of Occupational

---

<sup>9</sup> LCD: Liquid Crystal Display.

<sup>10</sup> Cathode Ray Technology.

#### **AFS 1998:5**

Safety and Health on Ergonomics for the Prevention of Musculoskeletal Disorders, for example, require the employer to ensure that the employee has

adequate knowledge of the best way of working in order to avoid undue strain. Instruction may be needed on how to set and individualise the adjustment devices of tables, chairs and other equipment and how to use technical aids. It is also important for the employee to be offered opportunities of training in suitable working techniques.

The Board's General Recommendations on implementation of the Provisions concerning Ergonomics for the Prevention of Musculo-skeletal Disorders provide further information and guidance to facilitate compliance with the requirements of these Provisions concerning work postures and working movements.

For the avoidance of uncomfortable loads and sitting postures, it is important for the chair to be easily adjustable to the operator's body measurements and requirements. Comfortable and variable work postures can be adopted if the chair seat is vertically adjustable, the seat depth variable and the height and angle of the back rest adjustable. It is essential that a person desiring a foot rest should be issued with one.

A low-profile keyboard (max 3 cm from the desktop to the contact surface of the middle row of keys) can usually be placed directly on a vertical adjustable table with a low edge. A high keyboard can be fitted with a wrist support to relieve the strain on the muscles of the forearm, shoulders and neck during micropauses.

The keyboard of a laptop computer is normally of a piece with the screen and is often higher, sometimes with different key functions from those of an ordinary separate keyboard, which can detract from the possibilities of adjusting work postures and working routines. A separate keyboard is therefore an advantage when a laptop computer is being used for any considerable length of time.

When using a mouse and suchlike operating devices, it is important to be able to work with the forearms relaxed on the table, so as to relieve the load on the shoulder muscles. When using a mouse, the whole of the forearm should be supported. It is also essential that the operating device can be positioned and used in close conjunction with the keyboard, so as to avoid movements with the wrist turned outwards, the arm outstretched or the shoulder joint rotated outwards. More intensive use of the mouse may call for a simple means of pushing or moving the keyboard clear, so that the mouse can be positioned straight in front of the operator. An entire work surface on one level makes it easier for keyboard and mouse to be positioned according to use. It is essential for the mouse to be shaped in such a way that work postures with the wrist turned upwards or turned inwards/outwards are avoided. From a musculoskeletal point of view it is also important for the operator to be able to plan and arrange

**AFS 1998:5**

his work and to take breaks, so that excessively intensive use of the mouse can be avoided.

Keyboards are often quite wide, with the result that the operating device cannot be used close to the body. A keyboard with a separate or separable number pad makes it possible for the operating device - the mouse, for example - to be positioned with maximum proximity to the operator, within forearm reach and shoulder width. It is also worth noting that women and children are usually less broad-shouldered than men. Keyboard shortcuts are another way of reducing the musculoskeletal strain involved by using a mouse or other operating device. The software also makes a difference to the way in which keyboard and operating devices are used and, consequently, to the musculoskeletal strains which are liable to occur. For example, the design of menu dialogues makes a difference to the way in which the mouse is used. There are also instances of software applications requiring the use of several different operating devices, which can entail particular demands on workstation design. From a musculoskeletal viewpoint, being able to use different operating devices and to alternate between the left and right hands offers the advantage of greater variety at work. It is important that the operator should be able to raise and lower the table without difficulty, so that the work posture can be adapted as necessary. The screen may need to be placed on an adjustable base.

The ability to alternate between sitting and standing when working at a display screen is conducive to more varied and flexible work postures and working movements.

The display screen should be positioned in such a way that the operator has a straight neck and a slightly downward gaze when looking at the screen. In normal office work or suchlike situations, it is important to be able to position the entire display screen below eye level. For this reason, putting the screen on top of the computer unit is usually inadvisable.

The smaller size of a laptop computer offers advantages to the operator, partly because it can occupy even limited work spaces, and because the operator naturally has a downward angle of vision. On the other hand a laptop computer can impose certain limitations on work posture, due among other things to the visual direction sometimes being horizontally limited. When this happens, the work posture may become more rigid and forward-inclined. For these reasons, a laptop computer is best reserved for occasional work.

**Guidance on Section 6 Eye and eyesight testing**

Complete eye and eyesight testing includes refraction measurement, determination of visual acuity and suitable correction for close work, with the prescription of glasses where necessary. A person with the necessary

#### **AFS 1998:5**

capabilities for carrying out eye and eyesight testing may, for example, be an authorised optician or ophthalmologist. It is important that great consideration be given to the work situation involved. It is an advantage if the person carrying out

the test (e.g. an authorised optician or ophthalmologist) also carries out a workstation assessment.

Eye and eyesight testing can, where appropriate, be divided into two stages:

1. Vision screening, to decide whether correction is needed for display screen work, performed by personnel trained for the purpose.
2. Complete eye and eyesight testing, as described above, for persons considered, after vision screening, to be in need of it.

Eye and eyesight tests can appropriately be arranged through occupational health services, if available. Through workstation examinations, the occupational health services can analyse and document the visual requirements of the work and other factors contributing to good vision ergonomics and, competence permitting, take charge of the eye and eyesight tests. In order to serve its purpose, the eye and eyesight test must be designed according to the visual requirements of the work. For practical reasons the visual distance to the screen is frequently about 50-70 cm. Normal reading glasses for presbyopia are usually designed for a reading distance of about 35-40 cm. This makes normal reading glasses unsuitable for the longer visual distance to the display screen. If working conditions are such that the visual distance varies a great deal, between about 35 cm and about 200 cm, ("close work progressive lenses") may be needed.

Presbyopia and refraction errors, if uncorrected or corrected for the wrong working distance, can cause discomfort during display screen work.

Employer and employee agree on a suitable interval for recurrent eye and eyesight testing for the duration of employment. Determination of a suitable interval may require consultation with a person with the requisite competence, e.g. occupational health care staff or an authorised optician.

The stipulation in Section 6, paragraph 2, only concerns ophthalmological examination with reference to the visual demands of display screen work, i.e.

work done using a display screen with appurtenant equipment. This stipulation is prompted by the provision in Article 9, paragraph 2 of the Council Directive on the minimum safety and health requirements for work with display screen equipment (90/270/EEC).

The expression "special corrective appliances" in this Section refers to glasses which are fitted for display screen work (see Section 1 and commentary,

**AFS 1998:5**

concerning the scope of the Provisions). Glasses which are specially adapted for display screen work are to be regarded as working equipment.

**Guidance on Sections 7 and 8 Arrangement and organisation of display screen work**

It is important that special attention be paid to monotonously repetitive work, to routine work and to work involving a great deal of control or restriction. Work of this kind includes, for example, continuous data entry, editing and proof-reading against a display screen. Display screen work involving intensive and monotonous inputting for a large part of the working day substantially augments the risk of musculoskeletal injuries to the hand and wrist. Work situations of this kind can be avoided, for example, by diversifying the job so as to include other tasks which will provide an opportunity of variety, independent planning and professional development. The ability to see and understand how different tasks are interconnected and how one's own work forms part of and contributes to the overall scheme of things is highly important.

With the growth of opportunities for communicating with others through the computer, display screen work can mean isolation from social contacts. Therefore it is important that work should be planned and arranged so as to afford opportunities of personal contact. The working premises and general workplace environment should be designed accordingly.

Deeper and wider utilisation of information technology is making the computer a progressively more important working tool. Working sessions at the display screen can be extended, at the same time as the work itself may be found stimulating, developmental and independent. Work of this kind can also entail harmful stresses. Physical variation of work is important, e.g. in the sense of being able to find comfortable and varied work postures and working movements (see comments on Sections 4 and 5). Musculoskeletal conditions at work are dealt with in the Provisions of the National Board of Occupational Safety and Health on Ergonomics for the Prevention of Musculoskeletal Disorders. Variation by means of breaks and alternation with other tasks aims at preventing the strain in the course of a working day from causing excessive fatigue or other discomforts which can be harmful in the long run. It is essential for the individual to be free to alternate tasks or take breaks according to his/her own needs. The length of time for which work with a display screen can be continued depends to a great extent on the nature of the work. There are some jobs where 1-2 hours' continuous work is feasible, while others may demand such close attention or such a degree of visual exertion as to necessitate shorter sessions. It is an advantage for work with a display screen to be organised from the very outset in such a way that it will naturally alternate with other tasks. The employer's responsibility for investigating working conditions, assessing risks and carrying out practical measures is defined in the Board's special Provisions on Internal

## **AFS 1998:5**

Control of the Working Environment. If difficulties occur, a further review of the conditions specified in Sections 2-7 of these Provisions will have an important

part to play. The requirements in Section 8 are to be seen as supplementary to other measures.

### **Guidance on Re Section 9 Emissions**

Workstation equipment can produce emissions<sup>11</sup>, such as noise, heat and electrical and magnetic fields. Certain display screens and certain software applications also emit light of such modulation (variation) that it is perceived as flicker; see also the Guidance on Sections 2 and 3.

Noise from the equipment can be a source of disturbance to the operator, especially as regards noise which is liable to distract attention, reduce powers of concentration, cause additional subjective tiredness, cause reduction of work capacity, or impede verbal communication. Noise of this kind is emitted, for example, by fans in computers, printers and other office machines. This, then, is an important point to bear in mind when designing a workstation - perhaps, for example, by attempting to minimise the amount of apparatus and machinery present in rooms where there are people working. Noise of this kind is also one of the aspects requiring special attention in a room where there is more than one person working, e.g. an "open-plan office" or a control room. Noisy equipment can be silenced, e.g. by enclosing it or installing it on separate premises. It may also be necessary to improve the acoustics of the room.

It is important that the workplace should have a suitable thermal climate. The expression "thermal climate" refers, among other things, to temperature, radiant heat, air humidity and air currents. Regulations concerning the indoor climate of working premises are contained in the Board's Provisions on Working Premises.

Heat emission from workstation equipment is another potential cause of discomfort to the operator. In such case, it is important for the equipment to be positioned in such a way that the surplus heat can be removed without subjecting people near the equipment to discomfort, e.g. from draughts.

It is important to ensure that cables and wiring for computer equipment do not trail on the floor, where they gather dust and obstruct cleaning. This is also inappropriate in terms of electrical safety, since cables and wires exposed on the floor are more liable to be damaged. It is essential for computer equipment to be connected to earthed power sockets.

---

<sup>11</sup> Emission = release of radiation, substances etc. into the surroundings.

#### **AFS 1998:5**

Chemical substances can be emitted from equipment when it gets warm or when it is being used, and especially from new equipment when first commissioned. The emission, usually recognisable as a "smell of plastic", emanates from residual quantities of solvents and other volatile substances in the plastic and

fades with the passing of time. Hypersensitive/hyper-reactive persons are especially liable to experience discomfort from emissions of this kind. New equipment can be "burned off", i.e. run at full capacity round the clock for a certain length of time on thoroughly ventilated premises, before it is taken into service.

Most display screens today are built up round cathode ray tubes, which emit electric and magnetic fields. The possibility of this implying a risk to human health has been observed for a long time, with special reference to pregnancy disturbances, to skin disorders and to so-called electrical hypersensitivity. Research, however, has failed to establish any connections between display screen work and pregnancy disturbances. Where skin disorders are concerned, certain studies do suggest a connection with display screen work, but no connection has been detectable with the electric or magnetic fields emitted from display screens. If anything, the focus of attention is more on dry and/or warm air and stress in connection with display screen work as possible causes. It is believed likely that the problem of electrical hypersensitivity is due to a combination of several factors, both occupationally and individually related. It is unclear whether electric or magnetic fields are among these factors; repeated experiments have failed to establish any such influence. Other factors suggested as possible contributory factors where "electrical hypersensitivity" is concerned include, for example, allergies, light sensitivity, modulated (varied) light, chemical substances, factors relating to the individual, and the way in which work is organised. Research continues, but pending research findings, greater preparedness is needed for helping and supporting those who experience discomfort. If problems of this kind occur at the workplace, it is important that the employer, assisted for example by the occupational health service, should carry out an investigation and take steps to help the person affected. It is essential for these measures to be taken as early as possible, and for the investigation to employ a broad perspective, without narrowing down the inquiry at an early stage to individual factors.

External magnetic fields of the order of 0.5 - 1 micro tesla at 50 Hz can disrupt the screen image in a way which causes it to appear shaky or flickering to the operator. Interference fields can come from other electrical apparatus right next to the display screen, in which case the problem can be overcome by increasing the distance between the screen and the source of interference. The interference may also be due to external magnetic fields, e.g. from a power line, a mains power unit in the building or vagabond currents in cables and water mains. If so, the problem may be harder to tackle.

### **Guidance on Section 10 Software and systems**

It is essential for the software proposed and the systems planned to be evaluated in terms of their positive and negative effects on the working environment.

When introducing a new or modified software or system, it is vital for the employer to find out whether the employees have sufficient skills for using the new or modified computer support. If their skills are insufficient, it is important that the employer should ensure that they acquire the knowledge that is lacking, e.g. by means of training and information. Training measures accompanying the introduction of new or modified computer support need to be planned with due allowance for individual differences of prior knowledge and professional experience. The training should not only be concerned with the people working with a certain equipment learning the best way of doing their own work and how to handle the equipment. It is also important that the training should confer a knowledge of the purposes of the computer system and the main outlines of its structure, knowledge of the entire operation, and knowledge of the working process and of the goods and services produced. In addition to preparatory training measures, of course, recurrent training will also be needed.

Criteria of a good physical, psychological and social working environment are fundamental to the design of jobs involving the use of computers. If the computer is to be an efficient tool and aid to work, software and system performance should be mutually adapted and chosen according to the needs of the operator and the requirements of the activity and the task. To this end it is important that operators should be enabled to participate in the design and selection of system and software. Given broad-based operator involvement from the very outset, the transition to a new or modified information processing system can also be accomplished more smoothly and efficiently. For this reason too, it is important for the operators to be involved right from the planning stage.

The operator's communication with the information processing system, "the man-machine interface", is outstandingly important both for personal safety and for conditions of physical and mental stress generally. Interface design is especially important where process control systems are concerned. An efficient man-machine interface calls for a cogently worked out design of data presentation and of operators' working procedures, i.e. their way of searching for information and performing operations. In tasks such as process control and monitoring, the man-machine interface usually operates by way of several screens, which in turn means special demands, for example, on the way in which information is designed and presented. If software and system design is guided by human capacity for apprehending, understanding and processing information - that is, human cognitive capacity - opportunities for a good man-machine interface can be created.

**AFS 1998:5**

The man-machine dialogue should be constructed so as to facilitate use.

The operator needs to be able without difficulty to see how software and system are configured. To this end, it is important for information to be presented in a manner which is intelligible to the non-specialist and in a language which the operator can understand. The information presented on the screen must also be that which the operator, on the basis of previous experience, expects to be given.

For the sake of good human-computer interaction, the system should permit a high level of operator control. This requires the system and software to be sufficiently flexible to be adapted to the knowledge or experience of different operators. It is important, for example, that the system should give the operator a choice between alternative ways of achieving a certain result. It is important that the operator should have the greatest possible liberty to choose and adjust for himself such parameters as when, where and how quickly information is presented and in what format.

The Internet, Intranet, electronic mail, bulletin systems etc. have greatly enlarged the possibilities of receiving and searching for information. Receiving e-mail in the middle of another task can be palpably disruptive. If the operator feels the flow of information to be uncontrollable, this can become a stress factor. The quantity and complexity of the flow of information are increasing the necessity of adapting information to the task and operator concerned, so as to make it easier for the operator to select information. It is important for the operator to be able to create for himself a general picture from the mass of information, to see what is and what can become available, where information may be located, how it can be looked for and so on. It is essential that as little effort and attention as possible should be devoted to getting one's bearings in the mass of information and finding the information searched for, when concentration and intellectual activity need to be devoted to actual questions and problems and to the content of the information found. A fundamental requirement is for the operator to have the knowledge he needs concerning the software and systems, so as to be able to cope with the flow of information. This calls for information and training. It may be necessary to define procedures and routines for the handling of information in computerised systems such as e-mail.

For the sake of job satisfaction, the individual needs to be able to influence the quality of his work and to check the result of it. The system, therefore, should give the operator immediate - or the swiftest possible - feedback on his own performance and actions. Times which in other connections seem short can, as response times during display screen work, be experienced as long periods and as enforced inactivity. This is a source of psychological strain and can lead to stress reactions. It is especially important for the operator to be informed if the waiting period is going to be longer than normal or expected. Passively waiting

#### **AFS 1998:5**

and not knowing why something is taking such a time and what is going on in the information processing system is a strenuous experience, even where the waiting times involved are very short. If it takes the system a while to execute a command, the operator needs to be given sufficient indication that the system is working to carry it out. The operator also needs to be able to follow what is happening, so that he can ensure that things are going as intended and, if possible, take corrective action if they are not. Aspects of this kind are especially relevant to process control situations.

It is important to make plans for averting and alleviating the negative effects of disturbances and failures right from the dimensioning and design of the system.

The system should tolerate the occurrence of errors and the interruption of dialogue without information being lost or other vital factors being jeopardised. This applies both to faults caused by technical failure and to errors resulting from the human factor.

The use of display screens and computers at work can imply closer qualitative or quantitative surveillance of the employees. This in turn may be experienced as an encroachment on privacy and may augment the mental burden of work if it takes place without the employees' knowledge.

It is also incompatible with the requirements of a mentally and socially good working environment for computer technology to be put to such use that particulars concerning an individual employee are used in a manner which entails the infringement of personal privacy.

**AFS 1998:5**

## **Information from the National Board of Occupational Safety and Health**

### **Other relevant rules**

#### **The Statute Book of the National Board of Occupational Safety and Health (AFS)**

AFS 1980:14 Psychological and Social Aspects of the Working Environment

AFS 1998:1 Ergonomics for the Prevention of Musculoskeletal Disorders

AFS 2000:42 Workplace Design

AFS 2001:1 Systematic Work Environment Management

### **Other publications**

#### **Development Council Government Sector**

The Computer and the Working Environment, 1999 .

Ways to User-Friendly Computer Support. An overview, 1995.

### **Prevent**

Checklist for Datascreen Workstations.

The Computer in the Working Environment, 2000.

**The National Board of Health and Welfare,  
The National Board of Housing, Building and Planning,  
The National Board of Occupational Safety and Health,  
The National Electrical Safety Board, and  
The Swedish Radiation Protection Institute.**

Low-Frequency Electrical and Magnetic Fields: The Precautionary Principle for National Authorities. Guidance for decision-makers, 1996.

**Studentlitteratur**

Allwood, C.M. Human-Computer Interaction, 1991.

Chaib, M. Perspectives on Human-Computer Interactions. A Multidisciplinary Approach. 2001 \*

Engfelt, P-H., Johansson, C R., Pärletun, L G. The Office, the Technology and the Human, 1996.

**Swedish Defence Research Agency, FOI**

Derefeldt, G., & Berggrund, U. Colour as a Vehicle of Information, 1994, FOA-R? 94-00048-5.2? SE

**The Swedish Confederation of Professional Employees, TCO**

TCO '03 Displays, 2003. \*

The Home As Workplace, 1997. \*

The Screen Checker, 1986.

The Software Checker, 1990.

The Swedish Foundation for Occupational Safety and Health for State Employees

Nyman, K.G., & Spångberg, O. The Vision, the Eye and the Work, 1990.

The Computer, the Human and the Working Environment, 1990.

**The Swedish National Energy Administration**

Office Lighting. Programme requirements for good, energy-efficient lighting in offices, 1994.

Office Lighting. Project description and results. The NUTEK demonstration project for good, energy-efficient lighting in offices, 1994.

\* available in English

**AFS 1998:5**

**International standards**

**EN/ISO 9241 Ergonomic requirements for office work with visual display terminals (VDTs)**

- Part 1. General introduction
- Part 2. Guidance on task requirements
- Part 3. Visual display requirements
- Part 4. Keyboard requirements.
- Part 5. Workstation layout and postural requirements
- Part 6. Guidance on the work environment
- Part 7. Requirements for display with reflections
- Part 8. Requirements for displayed colours
- Part 9. Requirements for non-keyboard input devices.
- Part 10. Dialogue principles
- Part 11. Guidance on usability
- Part 12. Presentation of information.
- Part 13. User guidance
- Part 14. Menu dialogues
- Part 15. Command dialogues
- Part 16. Direct manipulation dialogues
- Part 17. Form-filling dialogues.