

**ERGONOMIC WORKING STANDARDS FOR PERSONNEL
ENGAGED IN THE PREPARATION, SCANNING AND
REPORTING OF CERVICAL SCREENING SLIDES**

NHSCSP standard previously referenced as MDA standard 02104

Appendices include:

Postural advice for cytology screeners

NHSCSP equipment guidance notes on laboratory furniture

NHSCSP equipment guidance notes on microscopes

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1. INTRODUCTION

1.1 Background

Scanning of cervical slides for the identification of preinvasive disease of the uterine cervix is among the most difficult of diagnostic tasks as it requires the continual undivided attention of the screener. The task becomes even more onerous if the screener is fatigued or distracted, giving rise to the consequential risk of errors.

A national survey of working conditions in cytology laboratories undertaking the reporting of cervical screening slides was carried out. It found that problems of muscular discomfort, lack of posture training, unsatisfactory equipment, furniture and working environment were common. For this reason, a working party was set up by the NHS Cervical Screening Programme (NHSCSP). This comprised cytopathologists and biomedical scientists expert in the management of personnel engaged in the preparation, scanning and reporting of cervical slides, assisted by a team from the Applied Vision Research Unit of the University of Derby. The working party drew up ergonomic working standards to be achieved by centres undertaking this work.

The original version of this document 'Minimum Ergonomic Standards for Personnel Engaged in the Preparation, Scanning and Reporting of Cervical Screening Slides MDA/97/31' and the 'Guidance Addendum MDA/97/31S' have now been superseded by this revised version, previously referenced as MDA 02104, prepared by a working party of the NHSCSP Laboratory Managers QA Group.

The principal changes are listed in Appendix 1. It will be seen that they are mainly cosmetic, and cervical cytology laboratories which meet the requirements of the original standard will not be affected. The standard will continue to be reviewed periodically with a view to progressive improvement.

1.2 Scope

This document describes the ergonomic working standards for three areas within the cytopathology department: the staining/preparation area, the screening area and the clerical area. Requirements are defined within each area for the equipment and furniture to be used. Recommendations are also prescribed for environmental conditions and correct working postures.

Standards are given in terms of statements which *must* be adhered to in order to meet minimum requirements, and those which it is recommended *should* be adhered to in order to establish an efficient and effective working environment.

Measurements and recommendations have been derived from current British and European Standards and Health and Safety legislation. Where this has not been possible, then ergonomic and anthropometric data have been used to provide the appropriate measurements and values. These have been obtained from the Department of Trade and Industry (DTI) and include adjustments for clothing and shoe heels where appropriate.¹ This

report uses data for the 95th percentile man to allow for the large user and data for the 5th percentile woman to allow for the small user.

Local NHS Trust Health and Safety policies should also be consulted along with these standards.

The standards specified in this document apply to NHSCSP cytology work at screener and consultant level and have not been formulated to apply to areas, equipment or work practices for other NHS work applications. Individual sections should not be consulted in isolation, but the document should be read through completely before attempting to comply with the standards because many of the individual requirements interact in the working environment.

- 1.3 Location of the cervical screening facility**
- To ensure that expert supervision of screening activities is provided and that specified working standards are maintained, the cervical screening facility should be located within a cytopathology department. The screening of cervical slides in remote premises such as a screener's home must not be regarded as meeting these ergonomic working standards.
- 1.4 Implementation of ergonomic working standards**
- The findings of a survey carried out in 2000 of equipment suitability and postural problems in cytology laboratories undertaking cervical screening (Appendix 2) indicate that some laboratories do not meet these NHSCSP ergonomic standards. Cytology laboratories undertaking cervical screening should carry out a review of their ergonomic working conditions and take steps to make such changes as are necessary to conform with these standards. The benefits of cytology screeners being able to adopt a correct and comfortable working posture, and the implementation of suitable environmental conditions particularly noise level, lighting, temperature and ventilation, will be shown in a higher throughput and greater accuracy in reporting, with a consequent reduction in the risk of error.
- 1.5 Laboratory accreditation**
- Accreditation of a laboratory engaged in cervical cytology must confirm that these ergonomic working standards are met or alternatively require evidence that the laboratory is working towards full compliance with the standards.
- 1.6 Equipment compliance with the NHSCSP ergonomic working standards**
- Evaluations of equipment for compliance with these ergonomic working standards may only be undertaken by assessors nominated by the NHSCSP, under the regulations for equipment evaluations prescribed by the Medical and Healthcare Products Regulatory Agency (MHRA) (formerly the Medical Devices Agency (MDA)). Claims of compliance may only be based on the findings of the subsequent NHSCSP Equipment Evaluation Reports.
- 1.7 Abbreviations**
- | | |
|---------------------------------|--|
| Superscript numbers in the text | These are the numbers of the references listed on p. 31. |
| BS | British Standard |
| db(A) | Decibels – a weighted sound level closely resembling the subjective impression |
| lx | Lux – a measurement of the illumination level |
| mm | Millimetres |
| RH | Relative humidity |

1.8 Definitions

Anthropometrics

The branch of human sciences that deals with body measurements, particularly with measurements of body size, shape, strength and working capacity.¹

Bench height

The distance from the top surface of the bench to the floor (Figure 1).

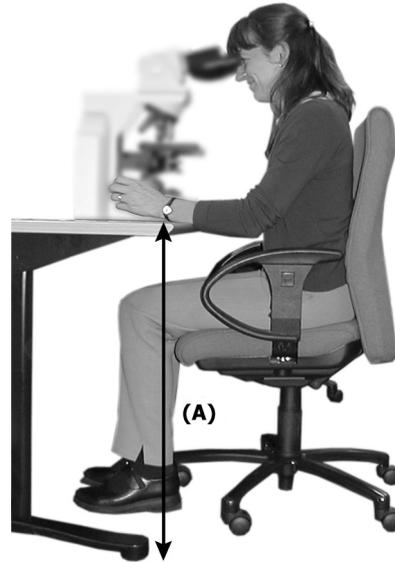


Figure 1 Bench height (A).

Cervical cytology

The examination of cervical samples for the presence of cellular abnormalities which may predict preinvasive disease.

Clerical area

An area used by personnel for the preparation, compilation and storage of records concerned with the cervical screening facility.

Comfortable

An environment in which the person can work at ease, free from pain or anxiety.

Computing equipment

Comprises a monitor (also termed VDU), mouse, keyboard and, where applicable, the computer unit itself.

Cytology screening

The process of viewing a slide of a cervical sample under a microscope in order to identify and report abnormalities.

Elbow height

Seated elbow height is the height of the elbow from the floor when the person is seated in an upright posture (Figure 2).



Figure 2 Seated elbow height (A).

Standing elbow height is the height of the elbow above the floor, with the arm at the side of the body, when the person is standing in an upright posture (Figure 3).



Figure 3 Standing elbow height (A).

Ergonomics

The scientific study of human work. The application of scientific information concerning human beings to the design of objects, systems and environments for human use.^{2,3}

Ergonomic Working Standards

<i>Must</i>	Compliance is mandatory to meet this standard.
<i>Percentile</i>	The value at which a certain percentage of the population will equal or fall below. For example, in terms of height, the 5th percentile means that 5% of the population is shorter than or as tall as this value, and the 95th percentile means that 95% of the population is shorter than or as tall as this value.
<i>Should</i>	Compliance is recommended to meet this standard.
<i>Staining and preparation work</i>	The process of preparing samples for screening.
<i>Suitable</i>	Appropriate for the task without causing an imbalance in physical demands or task efficiency.
<i>User</i>	A person who operates a piece of equipment, or uses furniture, workstations or areas in the cervical cytology laboratory.
<i>Work height</i>	This is the height at which the actual work is being performed (Figure 4).
<i>Workstation</i>	An area dedicated to a specific worker or work task.

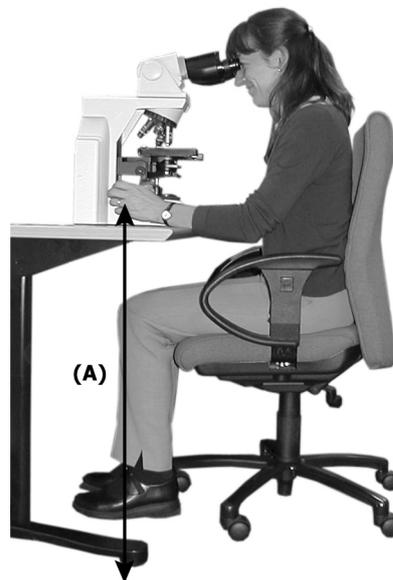


Figure 4 Work height (A).

2. POSTURE

Good working posture will facilitate users to complete work tasks safely, efficiently and effectively. Where the work posture is compromised, the user may experience fatigue, discomfort and deterioration of concentration, diminishing their work capacity and accuracy. Creating and maintaining a good posture is therefore fundamental to a healthy working environment:

- each person must be given training on work posture (see section 4 and Appendix 3). This should be arranged in collaboration with the Occupational Health Department
- a relaxed and supported posture should be maintained whenever possible
- each person must have appropriate equipment and furniture to enable them to achieve and maintain a good posture
- each person must take appropriate work breaks to rest and relax muscles to prevent fatigue and muscular discomfort (see section 3)
- each person should be able to adjust their posture as this can be useful in alleviating muscular discomfort. Screeners may require to adjust their furniture or equipment slightly throughout the day.

2.1 Seated work

- Each person should be able to work in a relaxed and comfortable posture.
- In order to achieve a comfortable working posture, tasks should be completed with the hands at a height approximately equivalent to the user's seated elbow height (Figure 2). This may not necessarily be bench height.
- The lower back should be supported by the chair back.
- The feet should rest flat on the floor. If this is not possible then a footrest should be provided.
- The bench should be of a sufficient height to allow the user to position their legs comfortably beneath the bench surface. This requires clearance between the underside of the bench and the top of the legs to prevent pressure being placed on the legs (Figure 5 (A)).
- There should be sufficient depth beneath the bench for the user to stretch their legs in order to relax the knee and leg muscles (Figure 5 (B)).
- Equipment should be positioned so that the person does not need to stretch, bend or twist to reach items.
- The person must have the opportunity to move away from the seated posture at regular intervals (see section 3).

2.1.1 Microscopy

- The user must be able to use the microscope and operate the controls in a relaxed and supported posture.
- The angle of the binocular microscope eyepiece must be adjusted to enable the user to view slides with limited inclination of the neck (Figure 6), keeping the neck and shoulder muscles relaxed. Prolonged or acute extension of the neck will require the muscles in the shoulder,

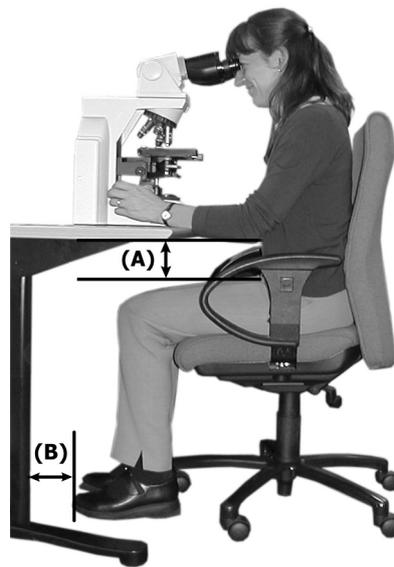


Figure 5 Posture for seated work.

Key points

- Work height approximately equivalent to seated elbow height
- Feet resting on floor or footrest
- Clearance between the underside of the bench surface and legs (A)
- Room to stretch legs below bench surface (B)
- Lower back supported by chair back

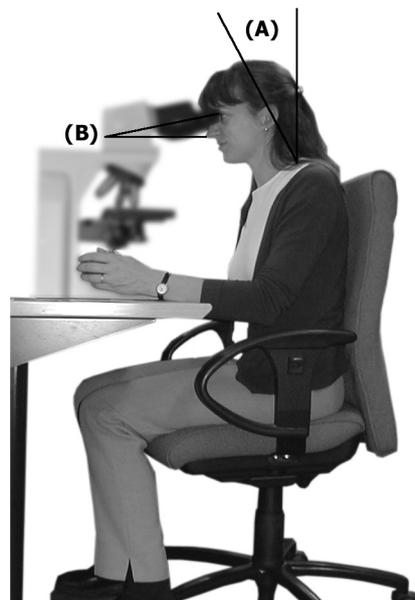


Figure 6 Posture for microscopy.

In addition to the postural recommendations for Figure 5:

- Neck inclined as little as possible from the vertical (A)
- Microscope eyepiece angled up to 30° from the horizontal (B)

neck and lower back to support the weight of the head, leading to muscular fatigue and discomfort. Microscopes with adjustable angle eyepieces are available and are the preferred option for this work.

- If working for prolonged periods (eg longer than 30 minutes) the user must be able to rest their forearms and hands on a suitable surface, either the bench surface or an appropriate cushioned arm rest, to prevent unnecessary fatigue or discomfort in the shoulder and arm muscles.
- The user should rest their eyes frequently by looking away from the microscope eyepiece.

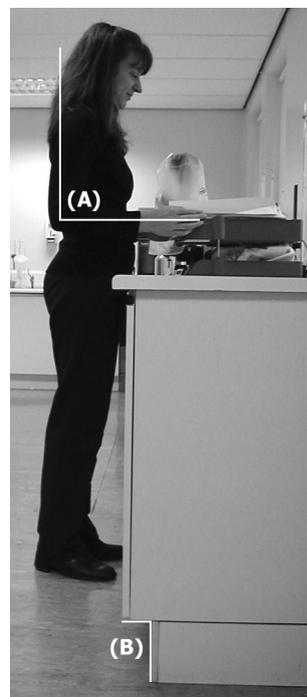
2.1.2 *Microscopy and computer based work*

Clerical functions using computers should not be carried out in the screening area. Noise from keyboard entry creates an unnecessary distraction within the screening environment. It is recognised that computers are used by screeners to a limited extent for data entry and reporting. The following must be adhered to:

- if the computer has to be located in the screening area, it must comply with the conditions detailed in section 7.4
- to limit neck movement, the top of the monitor screen should be positioned at the same height as the person's eye-height, which is approximately the same height as the microscope eyepiece
- the keyboard, and mouse if used, should be positioned on the side of the microscope most appropriate for the handedness of the user
- there must be adequate clearance under the bench to permit the user to be able to rotate and move their chair to adopt a straight posture when using the computer monitor, keyboard, mouse (if used) and the microscope. All equipment must be placed to minimise bending and twisting.

2.2 Standing work

- Work should be conducted at the approximate standing elbow height of the user (Figure 7 (A)). When performing certain tasks, the work height may be higher than the bench height.
- The user should be able to position their feet appropriately to ensure that they can bring their body in close enough to the bench to reach and operate equipment (Figure 7 (B)).
- Equipment should be positioned so that the user does not have to operate it in a bent, twisted or stretched posture. The back, legs and



- Work height equivalent to the standing elbow height (A)
- Little or no bending of the knees or lower back
- Space to position feet under the bench if required (B)

Figure 7 Posture for standing work.

knees should be straight but relaxed and extension of the neck should be minimised.

- The time spent standing should be minimised to prevent muscular fatigue developing in the legs and lower back.

3. WORK BREAKS

Screeners must maintain their vigilance so that the occasional abnormality is detected among a generality of normal slides. Vigilance is 'a state of readiness to detect and respond to specified small changes occurring at random intervals'. Deterioration in this performance is known as 'vigilance decrement'. The laboratory day should be organised so that vigilance decrement is minimised.^{4,27} Current evidence from relevant studies²³⁻²⁶ indicates that working arrangements should take account of the following:

- screeners can be utilised on cervical cytology microscopy for at least 4 hours in a normal working day
- the evidence²⁴ further supports that certain individuals may be able to work safely beyond this time without vigilance decrement. Current evidence shows this is up to 5 hours, providing adequate breaks are taken
- after 2 hours continuous work without a change in activity, a complete break from screening should be taken to alleviate any visual and muscular fatigue which may occur. The break should be of at least 20 minutes' duration and should be taken away from the workstation²⁴
- regular microbreaks of several seconds should be taken to stretch and relax muscles. These microbreaks can be taken at the workstation and involve the screener performing small changes of posture, such as stretching, and also glancing away from the microscope to change their viewing distance. Screeners should be encouraged to take these regularly.

4. TRAINING

- Staff must be given training on the adjustment and use of equipment and furniture to suit their postural requirements.
- All staff must be given training on posture. Refer to Appendix 3 for further information. Staff should understand the importance of a good working posture as well as those postures that should be adopted for different work activities to minimise muscular discomfort and prevent injury (see section 2).
- All staff should be given instruction on the procedure for reporting and dealing with occurrences of muscular discomfort.
- Staff required to handle the storage of containers for glass slides must have appropriate training and awareness of manual handling techniques.

5. STAINING/PREPARATION AREA

5.1 General requirements

- The bench must be stable, robust and able to support the weight and operation of the equipment placed upon it.
- Prolonged activities should be conducted at elbow height wherever possible to minimise fatigue and muscular discomfort.
- If the bench height is adjustable, the adjustment should not impair the bench stability and should be safe to operate.⁵

5.2 Benches

5.2.1 Bench surface

- The bench surface should have a matt finish to minimise reflections and glare.
- The bench surface material should comply with British Standard 3202⁶ to resist the absorption of chemicals and to be easily cleaned.
- The edge of the bench must be smooth and rolled.
- The bench depth and width should be dictated by the dimensions of the equipment to be accommodated upon it. The bench depth (see Figure 9 (A)) should be a minimum of 800 mm.⁷ If access is required to the rear of the bench, the depth should be a maximum of 850 mm.⁷
- The bench should not transmit vibration and be a maximum thickness (see Figure 9 (C)) of 40 mm.^{4,5}

5.2.2 Bench height for standing work (refer also to section 2.2)

- A fixed bench height cannot comfortably accommodate all standing users, therefore a bench which adjusts in height is strongly recommended. An adjustable bench should position the work at a height between 900 mm and 1200 mm. This is the approximate elbow height of the 5th and 95th percentile population.^{1,5} The bench surface height should then be adjusted to accommodate the work height required by the user.
- If all of the work is to be performed standing, the optimum height of a bench of fixed height is very difficult to determine. A compromise for most users may be reached at a height around 1000 mm,^{1,5} but it could still result in poor posture for many users because it is either too high or too low. If possible, several heights should be tried with intended users before a final selection is made. A compromise may be a fixed bench height of 900 mm. This is the standing elbow height of the 5th percentile woman with allowance for shoes.¹ This height enables shorter users to be able to reach and operate all of the equipment placed on the bench. The taller user can then be accommodated by using a chair that is adjustable in height. For such sitting work, there must be sufficient leg room available under the bench and footrests will have to be provided for some users.

5.2.3 Bench height for seated work

- A fixed bench for seated work should have a minimum clearance of 650 mm^{5,20} from the floor to the underside of the bench (see Figure 10). This is to allow the tallest user to sit with their legs comfortably beneath the bench surface. The recommended fixed bench height for seated work is 720 mm ± 15 mm.^{5,20}

- An adjustable bench for seated work should have a minimum height adjustment range of 660 to 770 mm.^{5,20} The work height should be adjusted to equal the seated elbow height of the user (Figures 1 and 2).

5.2.4 Leg room

Standing work

- The user should be able to position their feet appropriately to ensure that they can bring their body in close enough to the bench to reach and operate equipment (Figure 7 (B)).

Seated work

- Lateral leg room should be wide enough for the user to pull a chair under the work bench (see Figure 9 (B)). This should be a minimum of 600 mm.^{5,20}
- There should be sufficient forward leg room for the user (Figure 5 (B)). This depth should be a minimum of 600 mm.^{5,20}

5.3 Chairs and stools

- Where appropriate, chairs and stools must comply with the standards stated in section 6.2, the exception being when special safety issues necessitate particular seating requirements. In addition, the furnishing materials must be easy to clean and resist the absorption of chemicals.
- Any seating used must be adjustable in height to allow the user to position themselves comfortably, particularly if the seating is to be used for a long period of time (more than 30 minutes).

5.4 Footrest

- Wherever possible, the furniture height should allow the user to rest their feet on the floor while seated. When circumstances do not permit this, a footrest must be provided if the user is required to work there for more than 30 minutes.
- The footrest should be a minimum of 350 mm deep and 450 mm wide to ensure that the whole of the foot is supported.⁵ To be suitable for the chair height given in section 6.2.2, the footrest should be adjustable in height between 40 and 200 mm from the floor.¹ When height dimensions of the bench and seat are outside those prescribed in sections 5.2 and 5.3, a footrest of an appropriate height must be provided. The user should be able to adjust this without rising from their seat.
- If it is not possible to have a separate footrest in a laboratory area, then a ringed footrest around the base of the chair is acceptable, providing that it is at a suitable height and causes the user no discomfort.
- At the correct height setting, the feet should be comfortably supported without raising the underside of the thighs off the seat, and adequate support should be provided by the chair backrest.

5.5 Slide preparation equipment

- Staining equipment must only be located and operated in special staining/preparation rooms designated for that purpose and never in screening or clerical rooms.
- Staining equipment must be monitored and maintained on a regular basis.
- Staining equipment must be placed on suitable benches that allow the operator access to the work, without unnecessary constraints.

Ergonomic Working Standards

- Whether standing or seated, the user should be able to operate the equipment without having to twist, bend or stretch unduly for prolonged periods. The user must be able to access the work and all parts of the equipment without risk of injury or chemical spillage.
- The use of chemicals with staining equipment must adhere to *COSHH Regulations 1999*.⁸

6. SCREENING AREA

6.1 Screening bench or desk

6.1.1 General requirements

- Each user should have their own individual workstation.
- When more than one person uses the workstation, the furniture and equipment must be adjustable to enable all users to achieve a comfortable working posture.
- The extra time spent by individual users setting up the furniture and equipment to suit their individual requirements may well justify the cost of providing individual workstations.
- The bench must be stable, robust and support the weight of the microscope, peripheral items, paperwork and, where appropriate, the computer equipment.
- The bench should not transmit vibration and should be no more than a maximum thickness (see Figure 9 (C)) of 40 mm.^{4,5}
- If the bench is adjustable, the adjustment should be stable and safe to operate.⁵

6.1.2 Bench surface

- The edge of the bench surface must be smooth and rolled.
- The bench surface must have a matt finish to minimise reflections and glare.⁵
- There should be sufficient room in front of the keyboard (if used) for the user to rest his or her hands (between 100 and 150 mm).²⁰
- The bench surface material or parts of the surrounding framework that come into contact with the user during the intended use should not be cold to the touch.⁵

Bench surface area

- The bench must be deep enough and wide enough to accommodate the microscope, slides, computer monitor, keyboard, mouse (if used, see section 2.1.2), paperwork and any required peripheral equipment on the bench surface, such that the user can comfortably reach and operate all equipment and items required to complete the work task. It must also allow space for the user's arms as they access and operate equipment (Figure 8 (A)).

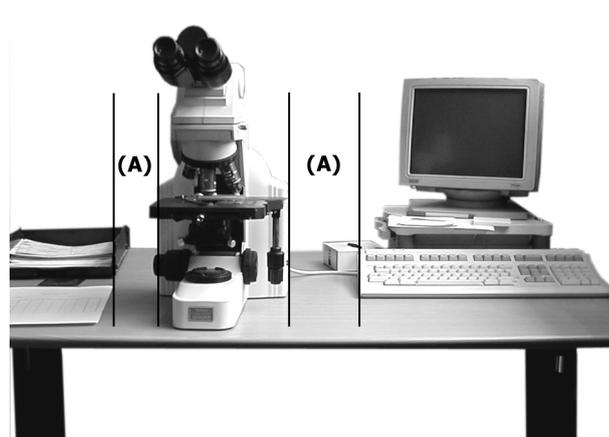


Figure 8 Space for user's arms.

Rectangular benches

- The minimum linear length for one microscope place and tray is 1500 mm.⁴ This length will need to be longer (up to 2000 mm) if computing equipment is placed on the bench or a large surface area is required for paper work. The bench depth (Figure 9 (A)) should be a minimum of 800 mm.²⁰ If access to the rear of the bench is required, the depth should not exceed 850 mm.⁷

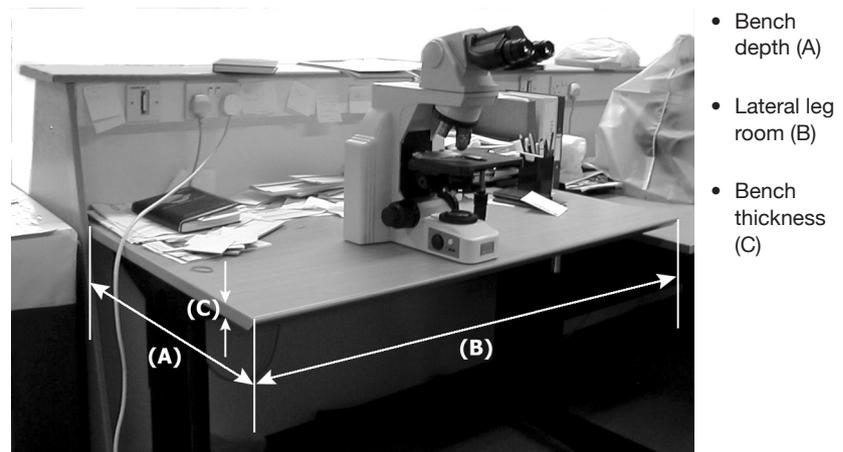


Figure 9 Bench measurements.

Non-rectangular benches

- If work surfaces of non-rectangular shapes (eg L-shaped, curved, semicircular or combinations of these) are provided, the usable surface area should be more than 1.2 m².

6.1.3 Bench height

- A height adjustable bench for seated work should have a minimum height adjustment range of 660 to 770 mm.^{5,20} The work height should be adjusted to equal the seated elbow height of the user (Figures 1 and 2).
- If fixed benching has to be used for seated work, it should have a minimum clearance (Figure 10 (D)) of 650 mm from the floor to the underside of the bench.^{5,20} This is to allow the tallest user to sit with their legs comfortably beneath the bench surface. The recommended fixed bench height for seated work is 720 ± 15 mm.^{5,20}

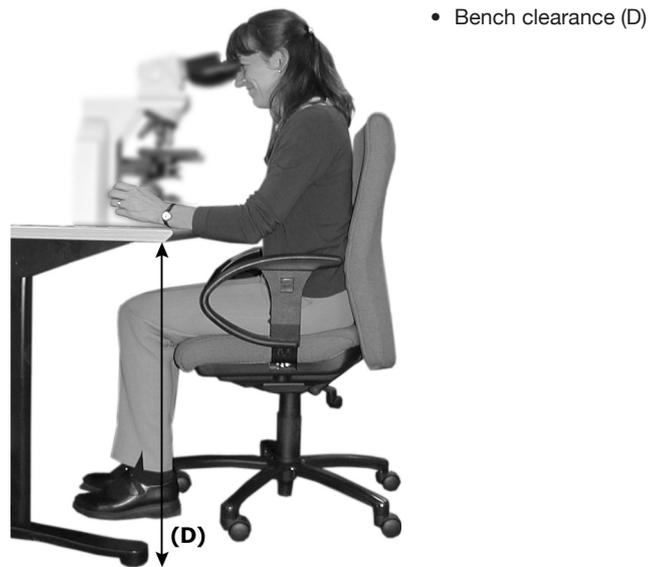
6.1.4 Leg room

- Lateral leg room should be wide enough for the user to pull a chair under the work bench (Figure 9 (B)). This should be a minimum of 600 mm.^{5,20}
- There should be sufficient forward leg room (Figure 5 (B)). The depth should be a minimum of 600 mm.^{5,20}

6.2 Screening chair

6.2.1 General requirements

- The chair must be stable and robust.²¹
- The user must be able easily to adjust the chair seat height, from a seated position, together with the angle and height of the seat back.



- Bench clearance (D)

Figure 10 Bench measurements.

- The chair must have a five-star base with a minimum floor contact diameter of 600 mm.^{5,21} It should also swivel.⁵
- If the screening area has a carpeted floor, the chair base should have castors to enable movement around the workstation. The type of castors used must suit the properties of the floor surface.⁵

6.2.2 Chair dimensions

- The seat height (Figure 11 (A)) should be adjusted so that the user's seated elbow height (Figure 2) is equal to the work height (Figure 4). It should be adjustable within a minimum range of 400 to 510 mm.²¹
- The backrest should be adjustable within a minimum range of 0–20° from the vertical (Figure 11 (B)) to provide a comfortable working posture.²¹
- The width of the chair seat (Figure 11 (D)) should be not less than 400 mm.²¹

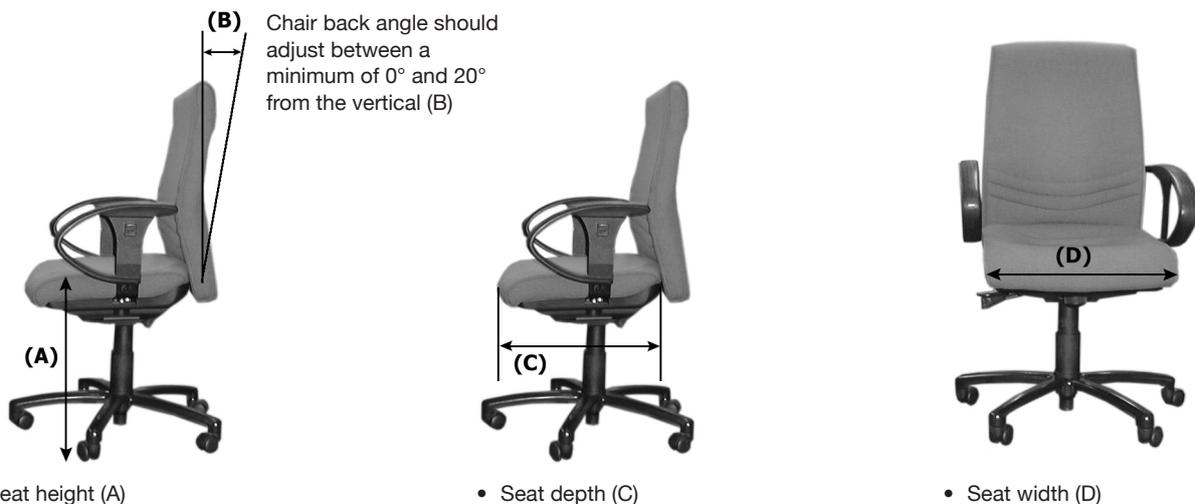


Figure 11 Chair dimensions.

- The depth of the chair seat (Figure 11 (C)) should not exceed 420 mm.²¹
- The chair should have a lumbar support which can be adjusted in height to suit the postural requirements of the user. Point 'A' in Figure 12 should adjust between 170 and 220 mm above the seat surface.¹⁴



- Point (A) is the widest part of the lumbar back rest

Figure 12 Height of lumbar back rest.

6.2.3 Chair upholstery

- The front seat edge should be rounded to minimise pressure on the legs and knees.
- The chair must be made from a durable, non-flammable, cloth material suitable for the screening environment.⁹
- The chair padding should be on a solid base and of a sufficient thickness to comfortably support the user.

6.3 Footrest (see section A4.5.2, p. 54)

- Wherever possible, the furniture height should allow the user to rest their feet on the floor. If circumstances do not permit this, a footrest must be provided.
- The footrest should be a minimum of 350 mm deep and 450 mm wide to ensure that the whole of the foot is supported.⁵ To be suitable for the chair height given in section 6.2.2, the footrest should be adjustable in height between 40 and 200 mm from the floor.¹ The user should be able to adjust the footrest without rising from the seat. If height dimensions of the bench and seat are outside those prescribed in section 6.2.2, a footrest of an appropriate height must be provided.
- At the correct height setting, the feet should be comfortably supported without raising the underside of the thighs off the seat, with adequate support to the back by the chair backrest.

6.4 Microscope

- All users must be given training in the setting up, adjustment and cleaning of their microscope.
- The microscope must be serviced at the interval recommended by the microscope manufacturer. The tension and range of adjustment of the microscope controls should be maintained at the appropriate level for that user.
- The microscope eyepiece angle should be adjustable. All new microscopes purchased must have an adjustable eyepiece. The eyepiece angle should be adjustable, 30° up from the horizontal, to

suit the requirements of the user (Figure 6 (B)). If the microscope eyepiece angle is not adjustable, the microscope must be positioned such that the user can view slides through the eyepiece with limited extension of the neck.

- The user must be able to adjust the height of the microscope to accommodate their postural requirements.
- The height of the microscope eyepiece and lens assembly should be adjustable to enable the eyepiece height to equate to the user's eye level and for the lower arms to remain resting on the bench surface. Elevation of the microscope base itself will raise the lower arms from the bench surface, leaving them unsupported and liable to fatigue and discomfort in the arm and shoulder muscles.
- If the microscope height can only be raised by elevating the base, an arm support must be provided. This is to allow the arms to remain supported during operation of the microscope controls and to prevent fatigue and discomfort. This arm support must not be cold to the touch.
- The angulation or height adjustment of the microscope eyepiece must not be detrimental to the quality of the microscope image.
- The microscope optics, field of view and lighting must be of a quality that will enable the abnormal cell changes which the user has been trained to detect to be clearly and unmistakably visible. The scanning mechanism must enable the total area of the smear to be covered in sections, with the image quality in terms of resolution, contrast and colour of each section being maintained over the whole of each field of view.

6.5 Computer equipment for screeners

See section 2.1.2.

7. CLERICAL AREA

- *Health and Safety (Display Screen Equipment) Regulations 1992*¹⁰ should be fully complied with.

7.1 Benches and desks

7.1.1 General requirements

- The bench must be stable, robust and able to support the weight of a computer and peripheral equipment.
- The bench should not transmit vibration and should be a maximum thickness (Figure 9 (C)) of 40 mm.^{4,5}
- If the bench height is adjustable, the adjustment should not impair the bench stability and should be safe to operate.⁵

7.1.2 Bench surface

- The edge of the bench surface must be smooth and rolled.
- The bench surface must have a matt finish to minimise reflections and glare.⁵
- The bench surface material or parts of the surrounding framework which come into contact with the user during the intended use should not be cold to the touch.⁵

Bench surface area

- The bench must be deep enough and wide enough to accommodate the computer monitor, keyboard and mouse on the bench surface.
- There should be sufficient room in front of the keyboard for the user's hands to rest. This should be between 100 and 150 mm.²⁰

Rectangular benches

- The recommended dimensions for benches with computing equipment located on them are 1600 mm wide by 800 mm deep (Figure 9 (A)).²⁰ If access to the rear of the bench is required, the depth should not exceed 850 mm.⁷

Non-rectangular benches

- If work surfaces of non-rectangular shapes (eg L-shaped, curved, semicircular or combinations of these) are provided, the usable work surface area should be more than 1.2 m².

7.1.3 Bench height

- A height adjustable bench for seated work should have a minimum height adjustment range of 660 to 770 mm.^{5,20} The work height should be adjusted to equal the seated elbow height of the user (Figures 1 and 2).
- If fixed benching has to be used for seated work, it should have a minimum clearance of 650 mm from the floor to the underside of the bench (Figure 10 (D)).^{5,20} This is to allow the tallest user to sit with their legs comfortably beneath the bench surface. The recommended fixed bench height for seated work is 720 ± 15 mm.^{5,20}

7.1.4 Leg room

- Lateral leg room should be wide enough for the user to pull a chair under the work bench (Figure 9 (B)). This should be a minimum of 600 mm.^{5,20}

- The space under the bench should be sufficient to provide forward leg room for the user (Figure 5 (B)). This depth should be a minimum of 600 mm.^{5,20}

7.2 Clerical chair

7.2.1 General requirements

- The chair must be stable and robust.²¹
- The user must be able easily to adjust the chair seat height, from a seated position, together with the angle and height of the seat back.
- The chair must have a five-star base with a minimum floor contact diameter of 600 mm.^{5,21} It should also swivel.⁵
- If the clerical area has a carpeted floor, the chair base should have castors to enable movement around the workstation. The type of castors used must suit the properties of the floor surface.⁵

7.2.2 Chair dimensions

- The seat height (Figure 11 (A)) should be adjusted so that the user's seated elbow height (Figure 2) is equal to the work height (Figure 4). It should be adjustable within a minimum range of 400 to 510 mm.²¹
- The backrest should be adjustable within a minimum range of 0 to 20° from the vertical (Figure 11 (B)).²
- The width of the chair seat (Figure 11 (D)) should be not less than 400 mm.²¹
- The depth of the chair seat (Figure 11 (C)) should not exceed 420 mm.²¹
- The chair should have a lumbar support that can be adjusted in height to suit the postural requirements of the user. Point 'A' in Figure 12 should adjust between 170 and 220 mm above the seat surface.²¹

7.2.3 Chair upholstery

- The front seat edge should be rounded to minimise pressure on the legs and knees.
- The chair must be made from a durable, non-flammable, cloth material suitable for the screening environment.¹⁵
- The chair padding should be on a solid base and of a sufficient thickness to comfortably support the user.

7.3 Footrest (see section A4.5.2, p. 54)

- Wherever possible, the furniture height should allow the user to rest their feet on the floor while seated. Where circumstances do not permit this, a footrest must be provided.
- The footrest should be a minimum of 350 mm deep and 450 mm wide to ensure that the whole of the foot is supported.⁵ To be suitable for the chair height given in section 6.2.2, the footrest should be adjustable in height between 40 and 200 mm from the floor.¹ The user should be able to adjust the footrest without rising from the seat. If height dimensions of the bench and seat are outside those prescribed in sections 7.1.3 and 7.2.2, a footrest of an appropriate height must be provided.
- At the correct height setting, the feet should be comfortably supported without raising the underside of the thighs off the seat, with adequate support to the back by the chair backrest.

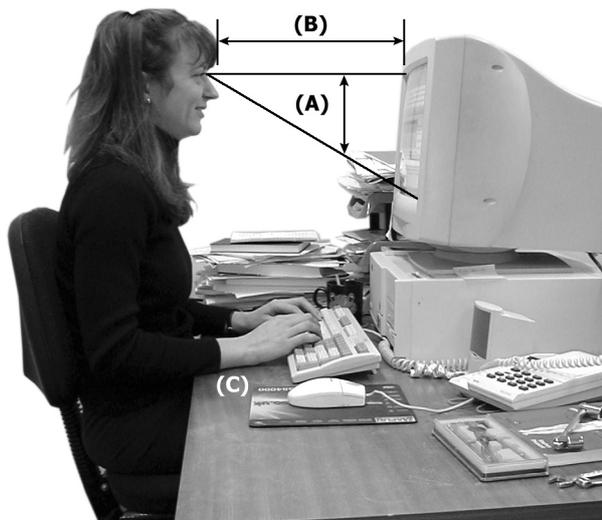


Figure 13 Layout for a computer workstation.

- Monitor to be positioned so that a viewing angle of between 0° and 30° from the horizontal can be established (A)
- Monitor at a suitable distance from the user to avoid visual discomfort (B)
- Room in front of the keyboard to rest the arms/wrists (C)

7.4 Computer equipment

- All aspects of work with computer monitors must be in accordance with the *Health and Safety (Display Screen Equipment) Regulations 1992*.¹⁰
- The computer should be situated in its own space without impinging on the space or operational functionality of other equipment.
- The computer user should not be required to stretch, twist or bend their body in order to operate the equipment. The user must be able to sit down to operate the computer at an appropriate bench or desk with sufficient leg room and working space.
- The user must not be subject to glare or distracting reflections on the monitor screen. The screen should be repositioned or a screen filter should be provided if required. Light sources should also be baffled to prevent glare (see section 8.6).
- The monitor should be placed at a comfortable distance from the user (between 500 mm and 700 mm) to minimise the risk of eye strain (Figure 13 (B)).²²
- The monitor should be angled so that the user can comfortably see the screen. The vertical angle between the horizontal and the user's line of sight should be within the range of 0° to 30° (Figure 13 (A)).³
- A document holder may be appropriate for some tasks as it will raise the height of the paperwork to a height similar to that at which the user reads information from the monitor. For some tasks, this will prevent strain on the neck and shoulders from constant head movement.

8. ENVIRONMENTAL CONDITIONS

- 8.1 General requirements**
- The cytology screening department should have outside windows to provide a pleasant working environment.
 - Optimum temperature and light conditions are best provided by a north facing aspect. Alternatively, shading and screening along with air conditioning may be used to create conditions as near as practicable to those provided by a north facing aspect.
 - A good ambience is as important as furniture and equipment in providing satisfactory ergonomic working conditions.
- 8.2 Temperature**
- The room temperature must be comfortable for work, in accordance with the *Workplace (Health, Safety and Welfare) Regulations 1996*.¹¹
 - The temperature must be adjusted to suit the requirements of the room users. A temperature of between 20°C and 24°C (68°F and 75°F) should be established for sedentary work depending on the air flow and the time of year.^{2,22}
 - The room temperature should be adjustable within individual rooms.
 - A uniform working temperature should be established in each room.
 - Thermometers should be provided to enable users to determine the room temperature.
 - Any methods of heating or cooling must not result in fumes, gas or vapour escaping into the room.
- 8.3 Humidity**
- The level of room humidity must be maintained between 30% and 60% relative humidity (RH).²
- 8.4 Ventilation**
- Ventilation must provide a suitable flow of fresh air through the facility, in accordance with the *Workplace (Health, Safety and Welfare) Regulations 1996*¹¹ and should not cause uncomfortable draughts or circulate unpleasant odours.
 - Ventilation should be controllable within individual rooms.
 - Where external windows are used to provide ventilation within a room, they should provide sufficient air movement and be easy to access.
 - If external windows do not provide sufficient ventilation within the room, alternative ventilation systems should be introduced.
 - Air conditioning systems should be regularly cleaned and maintained to keep environmental conditions at an optimum level.
 - No workstation should be positioned directly in a draught from a ventilation duct.
 - Ventilation noise should be minimised (see section 8.7).
- 8.5 Extraction cabinets**
- Mechanical extraction facilities must be provided in staining and preparation areas for the extraction of chemical fumes.
 - The extraction facility must be regularly tested, monitored and maintained in accordance with the manufacturers' recommendations and *COSHH Regulations 1999*.⁸

8.6 Lighting

- Extraction facilities must be correctly sited within the room.¹²
- Lighting must be maintained at a suitable level, in accordance with the *Workplace (Health, Safety and Welfare) Regulations 1996*.¹¹
- The light level should be evenly distributed throughout the room.
- Sharp contrasts in light levels from overhead lighting, sunlight or from light sources within equipment should be avoided within the room.
- A consistent level of lighting should be maintained within the room to prevent the user from experiencing visual discomfort when looking between dull and bright light areas. Bright sources of light should be baffled, and dull areas illuminated.
- The level of lighting for general office and computer work should be between 500 lx and 700 lx.³ Brighter levels may be required for precision work, and the room lighting levels should be adjusted accordingly to give suitable and sufficient light.^{11,13}
- The colour and hue of artificial lighting should be as close to natural daylight as possible.
- There must be no flicker or noise from the light sources above the level specified in section 8.7. Artificial lighting should be baffled to prevent glare or reflections at the workstations.
- The lighting level should be controllable within the room.
- Light levels from external sources should not create glare, reflections or sharp contrasts with internal light levels.
- Where necessary, external windows should have blinds that should be easy to reach and operate.
- Workstations should not be situated in front of windows that receive direct sunlight, unless the windows have blinds.
- Artificial lighting and external windows should be regularly cleaned to maintain uniform light level.

8.7 Noise

- Noise levels must not rise above 40 dB(A).^{18,19} This is particularly important in the screening room in order to avoid distraction of screeners.
- Other measures to avoid distraction of screeners include:
 - telephones and printers should not be located in the screening area
 - pedestrian traffic through the screening area should not be permitted
 - enquiries should be dealt with by administration staff.
- The floor of the screening and clerical areas should be carpeted to help to reduce noise levels. This will also enable chairs to be fitted with castors and allow movement around the workstation where required.
- Where possible, the cytology laboratory should be sited in a quiet area of the hospital that is not subject to external noise.
- Although some screeners can become accustomed to a constant background noise, intermittent or unexpected noise must be avoided.

9. FLOORING

- The flooring must be slip resistant and easily cleaned, in accordance with *Health Building Note 15*.¹⁴
- The floors of the screening and clerical areas should be carpeted (see section 8.7).
- The floor of the staining/preparation area should be non-permeable, sealed and able to contain spillage.¹⁴

10. HYGIENE FACILITIES

- Hygiene facilities must be in accordance with the *Workplace (Health, Safety and Welfare) Regulations 1996*.¹¹
- Washbasins must be provided in staining/preparation rooms at the exits and at other convenient locations for other staff.
- All washbasin taps must be operable by the elbows, wrists or arms.
- Soap dispensing machines and disposable hand towels should be provided.

11. WASTE FACILITIES

- Waste disposal facilities must be provided in all rooms. These should be adjacent to the location where the waste is created but not obstructing access to equipment or pedestrian routes.

12. PROTECTIVE EQUIPMENT

- All protective equipment must comply with the *Personal Protective Equipment at Work Regulations 1992*.¹⁵
- Laboratory coats must be worn in all staining and preparation areas and for all tasks involving the use of chemicals.
- Laboratory coats must be made of a material that is thick enough to absorb any chemical spillage before it can contact the skin. The material must be comfortable and must not restrict movement. The cut and style of the coat should allow free movement of the arms and shoulders and flexion of the back.
- Protective gloves must be available for all staining and preparation tasks and for the handling of all cytology slides until the slides have been cover slipped. Gloves should be appropriate to the task, in accordance with *British Standard EN 374*.¹⁶ Latex gloves can cause skin irritation and, if used, must be assessed under the *Control of Substances Hazardous to Health Regulations 1999 (COSHH)*.⁸ Where appropriate, non-latex gloves must be provided.

13. STORAGE

- Slides must be stored in accordance with the *Manual Handling Operations Regulations 1992*.¹⁷
- Space must be provided for slides awaiting screening and for screened slides to be archived.
- Slide storage must be provided on a reinforced floor that can support the weight of the slides to be stored.⁴
- Stored slides must be easy to access and transport.¹⁷
- For safety reasons, no slides should be stored above 1440 mm. This is the 5th percentile standing eye height.¹
- Screened slides should be stored in a suitable location outside the screening area and should be easily retrievable for audit/management purposes They should be stored for a minimum period of ten years.⁴
- Slide storage must not intrude on the user's work space or impinge on other storage or equipment space.
- Suitable metal cabinet storage facilities must be provided for the storage of chemicals, in accordance with the *COSHH Regulations 1999*.⁸
- Lockable storage facilities must be made available for the user's personal belongings. These should be on castors or wheels so that they are easily moveable, thus giving greater flexibility.⁴ Storage facilities should be accessible to the user in a secure area that does not interfere with work space.

14. RELAXATION FACILITIES

- Areas should be made available to cytology staff where informal discussion can be conducted and relaxation and refreshment obtained.

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**APPENDIX 1: PRINCIPAL REVISIONS
TO MDA/97/31 IN NHSCSP ERGONOMIC
WORKING STANDARDS (previously
referenced as MDA 02104)**

- | | |
|----------------------|--|
| Section 1.1 | <ul style="list-style-type: none">• Second paragraph: reference to national survey added• Third and fourth paragraphs added |
| Section 1.2 | <ul style="list-style-type: none">• Fifth paragraph, first line: ‘at screener and consultant level’ added |
| Section 1.5 | <ul style="list-style-type: none">• New section |
| Section 1.6 | <ul style="list-style-type: none">• New section |
| Section 1.7 | <ul style="list-style-type: none">• New section: replaces MDA/97/31S |
| Section 1.8 | <ul style="list-style-type: none">• Was section 1.6 in MDA/97/31 |
| Section 1.9 | <ul style="list-style-type: none">• Was section 1.7 in MDA/97/31 |
| Section 1.10 | <ul style="list-style-type: none">• This section has been added to show changes to MDA/97/31 |
| Section 2 | <ul style="list-style-type: none">• Fifth bullet point added |
| Section 2.1 | <ul style="list-style-type: none">• First bullet point changed |
| Section 2.1.1 | <ul style="list-style-type: none">• Third bullet point added |
| Section 2.1.2 | <ul style="list-style-type: none">• New section: the information contained in section 2.1.2 of MDA/97/31 has been incorporated into section 7 of MDA 02104 |
| Section 2.1.3 | <ul style="list-style-type: none">• Section 2.1.3 of MDA/97/31 has been incorporated in section 7 of MDA 02104 |
| Section 2.2 | <ul style="list-style-type: none">• Bullet point 1: reference to ‘work height’ added |
| Section 4 | <ul style="list-style-type: none">• Second paragraph ‘Refer to Appendix 3 for further information’ added |
| Section 5.1 | <ul style="list-style-type: none">• Section text changed |
| Section 5.2 | <ul style="list-style-type: none">• Section text changed |
| Section 5.2.3 | <ul style="list-style-type: none">• Second paragraph ‘minimum’ added |
| Section 5.3 | <ul style="list-style-type: none">• First bullet point changed |
| Section 6.1 | <ul style="list-style-type: none">• Section paragraph and first bullet point added |

Ergonomic Working Standards

- Section 6.1.3** • Figure 10: clearance under the bench (D) added
- Section 6.3** • First bullet point changed
- Section 6.4** • Text changed
- Section 7.1** • Text changed
- Section 7.2** • Text changed
- Section 8** • Two bullet points added from MDA/97/31S
- Section 8.7** • Maximum noise levels added
- Section 10** • Second bullet point changed
- Section 12** • Fourth bullet point changed
- Section 13** • Sixth bullet point changed
• Anthropometric dimensions now taken from European Standards

APPENDIX 2: SUMMARY OF THE RESULTS OF THE NATIONAL SURVEY OF CYTOLOGY WORKING CONDITIONS

A2.1 Introduction

A survey of cytology screeners' working conditions was made in October 2000, two years after the publication of the original version of this standard (MDA/97/31). A questionnaire was sent to each individual cytology screener and the main findings are summarised in this appendix. They are based on 608 completed questionnaires (26% response rate). The survey was also used to establish the awareness of the standard among cervical cytologists.

A2.2 Equipment

A2.2.1 Microscopes

Sixty percent of respondents found their microscope suitable or very suitable, but those who reported poor suitability also reported more discomfort, particularly in the neck. Particular microscope problems were also related to reported discomfort and poor concentration, the main problems being the height and angle of the eyepiece and the location of the adjustment/focusing controls.

A2.2.2 Computing equipment

Fifty percent of those using computer equipment found it suitable or very suitable. Twenty-three percent reported having specific problems with their computing equipment, the main problem being the space available on the desk to use the mouse and keyboard. Those who experienced such problems reported discomfort in the shoulders and upper back.

A2.3 Furniture

A2.3.1 Chairs

The chairs were found to be suitable or very suitable by 39% of respondents when preparing or mounting slides, 61% when undertaking microscopy and 56% when performing computing work. The main problems appeared to be the ability to rest their feet flat on the floor, chair height, inadequate backrest support and the adjustability of the chair.

For those respondents performing microscopy, only 82% were able to adjust their chair to sit comfortably.

- This indicates that, although adjustable chairs are being provided, they do not always provide the ease or range of adjustability required, or the user is not trained to operate them.

Fifty percent of respondents reported having to stand to adjust their chair when performing microscopy and this will deter people from making small adjustments to their chair while screening.

Measurements of the chairs used gave a seat height that was above the recommended standard in 61% of the respondents. This can account for problems with the ability to rest the feet on the floor. Sixty-six percent of measured seat depths were greater than that recommended in the standard.

- If the seat depth is too great, it can cause problems of back support.

A2.3.2 Benches

The benches were found to be suitable or very suitable by 52% of respondents for preparing slides, 48% when undertaking microscopy and 40% while performing computing work. Specific problems were inadequate space on the bench surface, the ability to rest their feet on the floor and their arms on the bench, bench height, the sharpness of the bench edge and the ability to move the chair around the bench.

Many of the measured bench dimensions recorded were not in accordance with those recommended in the standard. The bench height tended to be higher than that recommended.

- This could be associated with the problem of not being able to rest the feet flat on the floor. Other problems associated with high benches include raised elbows (if resting on bench surface), which places strain on the shoulders, or the bench height being raised above the elbows, which can cause pressure to be placed on the lower arms by the bench edge.

Bench thickness tended to be higher than that recommended, which can cause problems because of limited space between the underside of the bench and the chair seat. Bench length and depth was less than recommended in the standard, particularly where computing equipment was used.

- This is a leading cause of discomfort in cramped working conditions and inflexibility in equipment placement.

A2.4 Screening workspace

The majority of staff considered that they had enough space to move freely around their workstation and 44% found that the layout of the screening room was 'suitable'. Those who had space problems also reported discomfort, job stress, poor job satisfaction and poor concentration.

Shared workstations gave rise to problems with equipment and furniture.

- Time spent in having to adjust their equipment and furniture in order to achieve a correct posture would account for this.
- Reports of poor concentration could be due to having to reposition equipment and furniture while working.

A2.5 Working environment

Only 35% of respondents found their environmental conditions to be suitable or very suitable. Room temperature was the most frequent cause of adverse comment. Environmental problems were related to poor concentration, discomfort and tired eyes.

A2.6 Training

Fifty one percent of respondents had received no formal training to help them achieve a correct working posture. Where formal training had been received, in most cases it had been given by a local occupational health

department and other qualified personnel. People who had received training were less likely to experience discomfort and could work for longer before discomfort was experienced. They also reported greater job satisfaction and found their work less stressful.

A2.7 Standards

Sixty-seven percent of respondents were aware of the standard MDA/97/31. Cytology screeners need to be aware of the importance of environmental and ergonomic factors. They also need to be aware of any standards that contribute to improving concentration and physical and visual comfort. They should be encouraged to take a proactive approach to minimising these problems. The latest version of the *NHSCSP Ergonomic Working Standards* contains useful guidance on posture training, furniture and equipment in the appendices that is intended to assist screeners.

A2.8 Conclusions

The survey showed that concentration, eye strain and physical discomfort problems could be directly linked to equipment and furniture design. Several factors within the screening environment have also been shown to predict reported discomfort in particular body areas. Only 6.6% of respondents indicated that they felt no eye fatigue. Those who did report this problem were more likely to report problems with their microscope and computing equipment. A relation between these problems and subject age and length of time working in cytology screening was also indicated.

- Even if an individual does not report discomfort problems, poorly designed furniture and equipment can lead to premature fatigue and deterioration of concentration. Consequently, the importance of meeting all the requirements in the standard which aims to ensure comfortable working conditions for cytology screeners should not be underestimated.

APPENDIX 3: POSTURAL ADVICE FOR CYTOLOGY SCREENERS

A3.1 Introduction

The following information is intended to give individuals who perform cytology screening some general advice concerning their posture while working. It covers advice for both sitting and standing postures as well as advice concerning some of the specific types of work being performed, ie microscopy, computing and administration. It is important to realise that these guidelines may vary according to individual needs and individual working environments. If an individual feels uncomfortable in adopting the recommended postures, they should seek advice from another qualified professional, such as their own occupational health department or the Applied Vision Research Unit, University of Derby.

The following advice is divided up into three sections: how to achieve a good working posture, work breaks and a trouble shooting guide to help if you are experiencing discomfort.

A3.2 Achieving a good working posture

Why is my working posture important?

Your working posture is very important as it can place strain on your body which may result in pain and discomfort. We use a variety of postures in everyday life and some of these place more stress on the body than others. Some postures may constrict nerves and tissues, whereas others may cause the body to tire more quickly. A good posture will ensure an adequate blood supply is maintained to all parts of the body, thus enabling the muscles to work efficiently and minimise both fatigue and discomfort.

In daily activities we do not notice the effect of such postures, as we do not perform them repetitively or hold them long enough to cause noticeable discomfort. At work, however, people may be required to sit or stand in fixed positions for long periods of time, which are often repeated every working day.

What are the effects of postural stress?

In the short term, postural stress may result in pain and discomfort which disappears quickly when the stress is reduced. If you continue to adopt stressful postures while working, it is possible that the pain experienced will extend beyond the working period and more long-term symptoms, such as joint inflammation and muscle strain, may develop. If such symptoms are not treated and the body continues to be exposed to strain then more longer term problems may occur. As well as being painful, such discomfort may distract you from your work and may make you feel tired. Your working posture is therefore important not only to your own long term health, safety and comfort but also to your work efficiency, particularly your concentration and accuracy.

What can affect your posture?

Your posture can be affected by many factors. These include your location in relation to the tasks that you perform, the physical design of the equipment and furniture that you use and your own individual characteristics and working techniques. Less obvious things such as room temperature, draughts and lighting may also affect your posture as, for example, you may try to avoid glare or draughts by leaning to one side or slouching.

What is a good posture?

Postures which are good to adopt are those which keep the natural alignment of the body, ie those which involve very little bending or twisting.

If I adopt a good posture will it prevent me from experiencing pain and discomfort?

Adopting one good posture for a long period of time will not necessarily prevent you from experiencing fatigue and discomfort. Maintaining the same posture for long periods of time requires some muscles to work constantly without a rest. Blood flow and oxygen to your muscles may also be restricted, thus increasing the effects of fatigue. You should therefore aim to change your posture regularly even if just slightly. This will enable different muscles to work and allow others to rest. You should also ensure that you take your allocated rest breaks, ideally away from the workstation.

Examples of small postural changes you can make are:

- slightly adjusting your chair height or the angle of the seat or chair back
- standing up and walking around for a couple of minutes or stretching
- moving closer or further from your desk
- slightly altering the height of the computer screen or keyboard
- slightly altering the angle and height of the microscope.

Like the rest of your body, your eyes will also become tired focusing at one distance. You should, therefore, periodically look up from the microscope and look around.

How do I use this advice?

The following postural information is straightforward and mainly common sense. If you have been working in cytology for a while, however, it is possible that you may have adopted poor postural habits or particular working patterns without realising it. You should read the following information and see if there are any changes that you can make to improve your posture. It may be helpful if you ask someone to help you, as it is not always easy to observe your own posture. Each of the sections below has a figure to help illustrate some of the points made. The numbers on these correspond to the numbering of the points in the text. For example, for the first section entitled 'when sitting', number 1 on the diagram corresponds with point 1 given in the text, which is 'find a comfortable seat height'.

*A3.2.1 When sitting you should...
(see Figure A3.1)*

1) Find a comfortable seat height

Adjust your seat to a height that enables you to work comfortably. For microscopy and computer work you should aim to work with your elbows at approximately the same height as your work surface. This will enable you to keep your lower arms in a horizontal position and prevent the desk edges from causing discomfort. However, working with your work surface at elbow height may not be appropriate for all tasks, depending on the design of the equipment that you are using and the precise task being performed. You may therefore need to experiment with different chair or bench heights to find which is the most comfortable for you.

2) Rest both your feet on the floor or footrest

Once you have found a comfortable seat height, you should be able to rest both of your feet flat on the floor. This will reduce the pressure placed on the back of your thighs by the seat. If you cannot rest your feet comfortably on the floor then you should ask for a suitable footrest to be provided. You should *not* lower your chair just so that you can rest your feet on the floor as this will mean that you are sitting at a lower height than is comfortable; this may cause you to adapt your posture in other ways, such as raising your arms.

3) Try to keep your back fairly straight

Make sure that you are not leant or bent over things or working in a twisted position. You should not place anything under your desk which may restrict your movement or leg room. To reduce strain on your neck, your head should not be tilted in one direction for long periods of time. Try to avoid slouching as this may place stress on the intervertebral discs in your spine and overstretch certain muscles. You should ensure that you are not:

- overreaching for things
- twisting regularly to reach items.

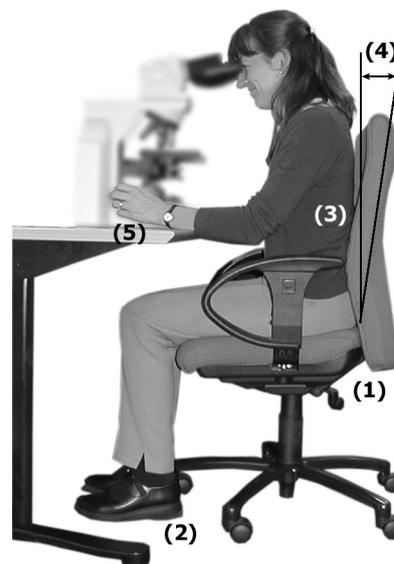


Figure A3.1 Factors for sitting more comfortably.

4) Ensure that your back is supported by your backrest

This should ideally be one that provides comfortable lumbar support. This will help to maintain the natural shape of your spine and reduce fatigue of your back muscles. The backrest should be adjusted to a height and angle which is comfortable for you.

5) Ensure that there is space for you to rest your arms

If you are working with your arms in a fixed position for long periods of time then you should ensure that your arms can rest in a comfortable position on the bench or that they are supported by an arm rest. This will reduce the strain placed on your shoulders and upper arms. Ideally, your lower arms should be horizontal and your wrists should be straight (not bent in any direction) when working.

*A3.2.2 When standing you should...
(see Figure A3.2)*

1) Try to work at a suitable height

If the height of the bench is adjustable, you should ensure that it is adjusted to a suitable height for you and the work that you are performing. Delicate precise work will require a higher bench height than heavy manual work. If this is not possible and you are working at the bench for a period of time, you should try to find a more suitable alternative. If the bench is too low, you may end up bending or stooping. As an alternative, you could try sitting at the bench. However, the seat that you use would have to adjust to a suitable height for you to obtain a comfortable working posture.

2) Ensure the layout of the bench/surrounding equipment allows you to work comfortably

The equipment layout should enable you to work without too much bending, twisting or overreaching. The most frequently used items should be positioned within easy reach. Leaning over or twisting around items will cause you to adopt a bent posture and place stress on your spine. You



Figure A3.2 Factors for standing more comfortably.

should therefore remove (or have removed) anything which blocks your access to the work that you are performing.

3) Ensure that there is space for you to rest your arms

This is particularly important if you are performing detailed or precise work for a long period of time.

4) Ensure that you work in an area that has suitable lighting

If the lighting of the room is low or casts shadows on the task that you are performing it may cause you to stoop closer to your work in order to see it. Lighting may also cause glare, which may prevent you from viewing your task clearly.

*A3.2.3 When using a microscope you should...
(see Figure A3.3)*

1) Place your microscope in a comfortable position

If your microscope is the main piece of equipment you use, this should be placed directly in front of you. This is important to prevent you working in a twisted position.

2) Adjust the height and angle of the eyepieces

Your eyepiece should be positioned at or just slightly below eye height to limit the bending of the neck when viewing slides. If your microscope does not have any height adjustment features, you may need to raise or angle it by placing it on a suitable stand to reduce the strain placed on your neck.

3) Ensure that your hands are comfortable

If you are operating the microscope for long periods of time you should try to rest your arms on the bench. If your controls are located high on your microscope, you may need a suitable arm rest to minimise the strain placed on your shoulders. It is important to realise that arm rests work for some people but not for others, and so you should monitor how you think they affect you.

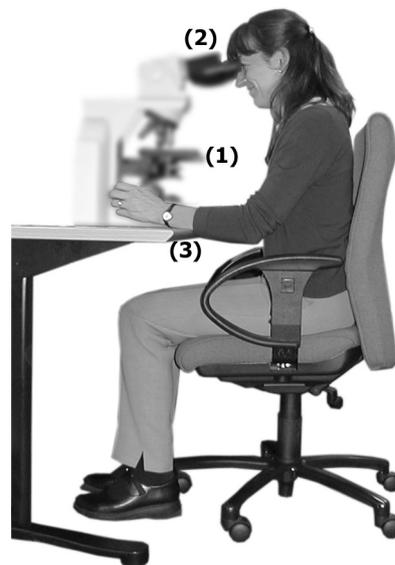


Figure A3.3 Using a microscope more comfortably.

A3.2.4 When using computing equipment you should... (see Figure A3.4)

1) Place your computing equipment in a comfortable location

Ideally, this should be positioned directly in front of you as twisting to see and operate computing equipment can place strain on the spine. If you are using both a microscope and computing equipment at the same workstation, then it will be impossible for you to work with them both directly in front of you. In this case, you should decide which of these you use the most frequently and for the greatest length of time and place that in front of you. The second item should then be placed either as close as possible to minimise the potential twisting distance or on a separate workstation. L-shaped desks may be used to help address this problem, but care should be taken to ensure that they are used correctly. This is because the person using them often fails to adequately rotate or reposition their chair, which results in the person twisting and over-reaching to operate the computing equipment. The screen should be located at approximately arm's length from you (approx 70 cm). If you cannot read the screen from this distance, then you may need to have your eyes tested.

2) Adjust the height and angle of screen

Your screen should be positioned at a height and angle that is comfortable for you to view it. The top of your screen should be no higher than eye height as this may cause you to extend your neck upwards. If reflections from windows or lighting obscure the information presented on your computer screen, this may be affecting your posture as you may twist or bend accordingly to see it. You should therefore try to alter the angle or position of the screen to avoid it. If you cannot comfortably position the screen to avoid such reflections, you should talk to your laboratory manager as you may need a filter screen.

3) Position your keyboard and mouse in a comfortable location

The keyboard and mouse can be located anywhere that is in a comfortable reaching distance. You should allow some space in front of the keyboard to rest your arms and hands. If you use a mouse, determine which hand you would prefer to operate it with, ie left or right. You should then try to ensure that the mouse is positioned on this side of the microscope. Your



Figure A3.4 Using computing equipment more comfortably.

arms should remain in a horizontal position and your wrists should be as straight as possible while operating the mouse and the keyboard.

A3.3 Work breaks

Work breaks are essential in order to ensure that a user's mental, visual and physical ability to complete the work task are not affected significantly by the duration of time spent at that task. Breaks away from an activity, as outlined in section 3 of the *NHSCSP Ergonomic Working Standards*, may be required to rest from concentration and to relax and stretch muscles which may have accumulated tension or to relieve eye fatigue.

If work breaks are not taken regularly and users continue to work, they will gradually become fatigued, both mentally and physically. Muscular and visual discomfort will develop and concentration may lapse.

Breaks can be in three forms: first, a complete rest from work; second, a change in the work task; and third, a 'microbreak', which involves small changes of posture, such as stretching, glancing away from the microscope and very short periods of rest.

Complete work break

Cessation of work, such as for coffee breaks, enables the user to take a complete break from imposed activities. It is an opportunity to relax both mentally and physically and to move around, dispelling any muscular tension in the body.

Changes in task

Changes in task require the user to keep working, but also to change their position or posture (relaxing and stretching muscles). These breaks are intended to incorporate a change in the intensity of concentration required for the work task and to give the user some change of visual focus.

It is recommended that a non-intensive mental task, such as preparing slide trays, should be substituted as a break from a period of a mentally intensive task, such as screening. This change in work task places less emphasis on the level of concentration required to complete the task, thereby reducing the intensive mental and visual requirements placed on the user. It may require a completely different working posture to be adopted, thereby allowing relaxation and stretching of the muscles.

'Microbreaks'

'Microbreaks' are breaks where the user shifts their position or posture briefly. These constitute small but important changes in the work posture which relax and stretch the muscles and give the user time to rest before continuing work. These can be taken at the workstation and do not necessarily disrupt the screener's flow of work.

Examples of 'microbreaks' are:

- rotating the neck to ease the neck muscles
- looking away from work to relax the eyes

- arching the back to stretch the back muscles and adjust the posture, which may have slumped into the chair
- shrugging the shoulders to release any tension building up in the neck and shoulder muscles
- relaxing the arms to the side, letting the shoulders fall to release any tension
- stretching the legs out to relax the muscles
- stretching to relieve muscular tension; stretching the arms in particular helps to release tension not only in the arms but also in the neck, shoulders and back
- if the eyes feel tired, closing them or looking at a distant object for a few seconds may help to rest them.²³

A3.4 Troubleshooting

This guide is designed to suggest changes which could be made in the working environment to help alleviate problems of discomfort and concentration. It is not an exclusive list of solutions, but contains advice which a user can employ to identify problems which may be present in their own working environment. It is important that any discomfort experienced while working is reported to the appropriate line manager and occupational health advisor, so that a detailed investigation of the workplace can be performed. A medical practitioner should be consulted if persistent or severe muscular discomfort is experienced.

Visual discomfort

Check that:

- the user is not located in draughts from open windows or unsuitable ventilation; a flow of air that is too rapid may leave the eyes feeling dry and tired
- the correct level of humidity is maintained
- the correct level of room lighting is maintained for the task performed; the room should have a uniform level of lighting, with no sharp contrasting dark and bright areas
- the user is not sitting directly in front of a window or other source of bright light
- external windows have blinds
- if a computer is used, no reflections from windows or overhead lights are present on the screen; the computer screen should also be free from perceived flicker and have adjustment controls for the user to alter brightness and contrast
- glare in the room is minimised by having matt non-reflective surfaces on items such as equipment, bench tops, ceilings and floors
- the users take their rest breaks and vary their viewing distance by looking away from close work such as a computer monitor.

Neck discomfort

Check that:

- the neck is held upright and relaxed; any prolonged bending and stretching of the neck will cause tension in the muscles, leading to discomfort
- the shoulders are not hunched, either through tension or through

resting the elbows in a manner which pushes the shoulders up; work should be conducted at elbow height to avoid the elbows being raised and the shoulders being hunched

- there is regular relaxation of the shoulders during the work task to ensure that tension does not develop in the muscles and begin to affect the neck
- the neck is not subject to draughts from open windows or unsuitable ventilation; cold air around the neck will create tension in the neck muscles, leading to discomfort
- the microscope height and the microscope eyepiece angle are suitable for the user. Eyepiece height should be equivalent to the seated eye height of the screener. To prevent excessive extension and flexion of the neck, the binocular head of the microscope should be adjustable. A comfortable position is when the user is looking slightly below eye-level. The eyepiece should be angled between 0° and 30° above the horizontal
- the information required to complete a task can be seen without requiring twisting, bending or stretching of the neck. For computer entry, position the keyboard directly in front of the user; the monitor should also be positioned in front of the user at a viewing angle of 0–30° below the horizontal. If required, a document holder should be provided to raise the height of the paperwork level to the computer monitor and so avoid repeated inclination of the neck
- all equipment is positioned so as to minimise any inclination or twisting of the neck.

Shoulder discomfort

Check that:

- the shoulders are not held in a hunched or tense position; poor posture may have been adopted to allow the screener's hands to reach the microscope controls
- the shoulder muscles are regularly relaxed to relieve tension
- the head is held upright with the neck in relaxed posture. Ensure that the user can view information without having to incline the head excessively; bending forward creates tension in the shoulder muscles
- the arms are supported by a suitable surface, so that the weight of the arms is not carried by the shoulders, which can create tension, fatigue and pain. Ensure that the bench is at elbow height, so that the arms can rest on the bench surface; if the arms cannot rest on a bench surface, ensure that they are supported by an appropriate aid
- the equipment can be operated within easy reach of the user. Overextension or prolonged extension of the arms will create tension in the shoulder muscles.

Back discomfort

Check that:

- the neck is relaxed and straight, the shoulders are not hunched and the arms and wrists are relaxed while performing the task
- the arms and upper body are not overreaching to operate the equipment

- the user sits back into the chair to support the lower back; the chair should provide lumbar support to promote a good working posture
- a task involving long periods of standing is conducted on a supportive floor surface (eg antifatigue matting); long periods of standing should be minimised as they may create discomfort in the feet, knees, legs and thighs/hips as well as the lower back.

Arm and hand discomfort

Check that:

- the forearms or elbows rest comfortably on the bench surface to support the weight of the arms; if they do not, an appropriate arm support could be provided
- the edge of the table is rounded and not sharp to prevent pressure on the arm muscles when the arm rests against the edge of the bench
- frequent breaks are taken from repetitive or prolonged microscope control operation to allow the muscles to rest and relax
- the angle of the wrists is kept as straight as possible, especially for tasks involving repetitive hand or finger movements.

Leg discomfort

Check that:

- there is adequate chair padding
- the seat is large enough to support the width and depth of the hips and thighs; in addition, the seat should not be too long and the user should be able to use the backrest to support themselves without the seat touching the backs of their knees
- there is adequate clearance between the underside of the bench and the chair seat
- the feet are supported; dangling feet may create discomfort, so a footrest should be provided if required
- a task involving long periods of standing is conducted on a supportive floor surface (eg antifatigue matting); long periods of standing should be minimised as they may create discomfort in the feet, knees, legs and thighs/hips as well as the lower back
- when seated, ensure that the knees are bent comfortably; acute flexion of the knees may cause discomfort. There should be enough room in front of the user for them to be able to stretch their legs out and relax the muscles.

Concentration problems

Check that:

- the user is not experiencing any pain or discomfort while working
- noise is minimised as much as possible; telephones and other items that may cause distraction should be placed outside the screening room
- the correct levels of room temperature and humidity are maintained for the user to be comfortable while working
- the workspace available is adequate to allow the screener to perform their job

- pedestrian traffic through the department does not pass too closely to the user's workstation; the continuous flow of external staff through the department should be minimised
- if laboratory coats are worn, they do not restrict movement
- the user's work schedule is designed to minimise boredom and repetitiveness as much as possible
- users are not expected to carry out extraneous duties while engaged in screening slides
- quiet work periods could be introduced into the working day. Certain times could be allocated during the day for staff to converse and to work in silence; this maintains social interaction between staff, but may help to limit the effect of open discussion on concentration.

Where to go to obtain further advice?

If you still have problems or queries regarding your posture, you can:

- contact your occupational health department
- contact us at The Institute of Behavioural Sciences, University of Derby, Kingsway House, Kingsway, Derby DE22 3HL. Tel/Fax: 01332 593131. E-mail: ibs@derby.

APPENDIX 4: NHSCSP EQUIPMENT GUIDANCE NOTES ON FURNITURE FOR CYTOLOGY LABORATORIES UNDERTAKING CERVICAL SCREENING

A4.1 Introduction

These equipment guidance notes are intended to assist prospective purchasers in drawing up their purchasing specifications for laboratory furniture. They provide assessors with a common set of user requirements against which different manufacturers' products can be evaluated. They also serve to inform laboratory furniture suppliers of users' needs.

The importance of the use of properly designed desks and chairs to the achievement and maintenance of a correct posture throughout the working day is emphasised in the standard.

Muscular discomfort arising from the use of non-ergonomic equipment and furniture can lead to the work task being carried out inefficiently and inaccurately. This may lead to a slower work rate and increased risk of incorrect diagnosis by cytology screeners. In the longer term, this can cause illness, low morale and work related injuries to all grades of personnel.

The measurements given in these guidance notes are those given in the *NHSCSP Ergonomic Working Standards* (NHSCSP Publication No 17) and are based on current ergonomic and anthropometric data, British Standards and Health and Safety legislation. The following European and British standards (BS) apply:

- BS EN ISO 9241-6:2000. *Ergonomic Requirements for Office Work with Visual Display Terminals (VDTs)*
- BS EN 527-1:2000. *Office Furniture – Work Tables and Desks. Part 1. Dimensions.* 2000
- BS EN 1335-1:2000. *Office Furniture – Office Work Chair. Part 1. Dimensions.* 2000

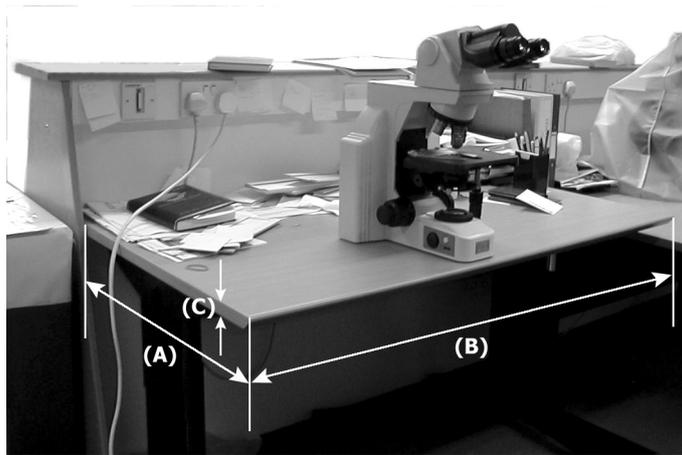
A4.2 Bench for cytology screeners

The bench should be stable, robust and able to support the load of the operator's arms and the equipment to be placed on it. When preparing a purchasing specification, the maximum anticipated equipment weight should be stated.

A4.2.1 Bench surface)

The minimum linear length of a bench containing a microscope and slide tray is 1500 mm (Figure A4.1 (B)). This length may need to be longer (up to 2000 mm) if computing equipment is placed on the bench or a large surface area is required for paper work.

For a rectangular bench, the minimum depth (Figure A4.1 (A)) should be 800 mm; however, if access to the rear of the bench is required, the depth should not exceed 850 mm.



- Bench depth (A)
- Lateral leg room (B)
- Bench thickness (C)

Figure A4.1 Bench measurements.

The bench surface thickness (Figure A4.1 (C)) should not exceed 40 mm and the edges accessible to the operator should be smooth and rolled. The surface should be a matt non-polished finish and should not be cold to the touch.

If work surfaces of non-rectangular shapes (eg L-shaped, curved, semi-circular or combinations of these) are provided, the usable work surface area should be more than 1.2 m² for a bench containing a microscope and slide tray.

Bench shape and layout configuration is a matter of individual choice. A rectangular shape is satisfactory for a bench containing only a microscope and slide tray because the operator's paperwork, microscope and all peripheral equipment required to complete the work task can be comfortably reached from one seated position.

There must be a minimum clearance of 650 mm from the floor to the underside of the bench (Figure A4.2 (D)).



- Bench clearance (D)

Figure A4.2 Bench measurements.

The laboratory layout shown in Figure A4.3 allows the operators access to both a microscope and computer with adequate space for both. It is necessary that clear space for the operator's legs should be provided under the bench (Figure A4.2) so that the operator can access either by simply moving the chair. If the bench and chair heights are correct for each operator's leg length so that the feet are resting comfortably on the floor, a comfortable posture should be achievable in both positions.

When the work task includes the use of a computer monitor, keyboard and mouse as well as a microscope, a larger bench surface area is required. Alternative bench shapes and configurations may be used to limit operator movement so that the additional equipment can be accessed without discomfort. To ensure this, there must be adequate clearance under the bench to permit the user to be able to rotate and move their chair in order to adopt a correct posture when using the computer monitor, keyboard, mouse (if used) and the microscope. All equipment must be positioned so that bending and twisting is minimised. Figures A4.3 and A4.4 show bench arrangements which may help to achieve this end.

The bench illustrated in Figure A4.4 is rectangular with a curved front edge providing greater bench depth at one end. This allows the bench to accommodate both a microscope and a computer with monitor, keyboard and mouse mat. Adequate space is available for slide container and any other peripheral equipment. It will be seen that the operator can access

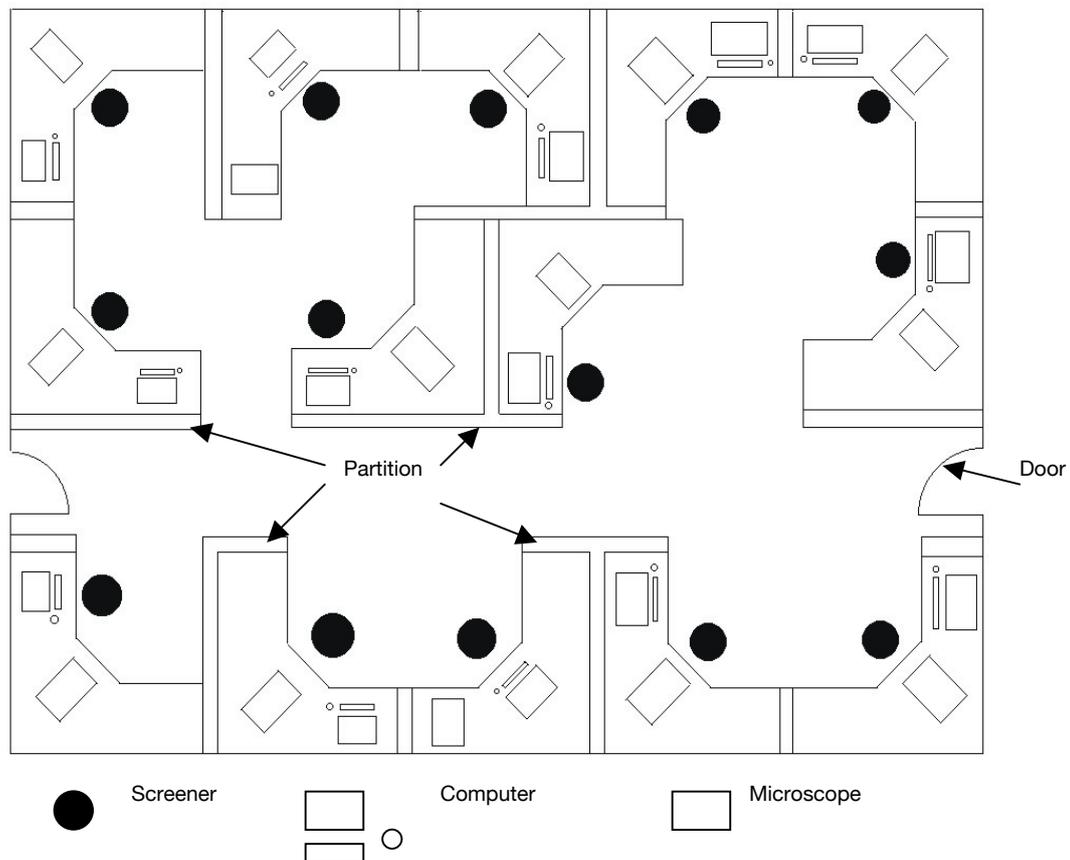


Figure A4.3 A possible screening room layout.



Figure A4.4 An example of an S-shaped bench being used.

either the computer or the microscope by rotating their seat. If the bench and chair heights are correct for the operator's leg length so that the feet are resting comfortably on the floor, a comfortable posture should be achievable in both positions.

A4.2.2 Bench height

The distance from the floor to the underside of a fixed height bench should be a minimum of 650 mm (Figure A4.2 (D)). The recommended fixed bench height for seated work is 720 ± 15 mm.

A height adjustable bench for seated work should have a minimum height adjustment range of 660 to 770 mm.

A4.2.3 Leg room

Lateral leg room should be a minimum of 600 mm to allow a chair to be pulled under the bench, with space provided to allow the operator to rotate the chair in order to access freely the bench surface on either side.

Unencumbered clearance of at least 600 mm is required under the bench to provide forward leg room for the operator.

Drawers should be separate from the bench and should have castor wheels to enable them to be positioned at the side of the bench and well clear of the operator.

A4.3 Bench or desk for clerical tasks

The bench should be stable, robust and able to support the load of the operator's arms and the equipment to be placed on it. When preparing a purchasing specification, the maximum anticipated equipment weight should be stated.

A4.3.1 Bench surface

A computer, monitor and keyboard require a recommended linear bench length of 1600 mm and a depth of 800 mm. If access to the rear of the bench is required, the depth should not exceed 850 mm.

If work surfaces of non-rectangular shapes (eg L-shaped, curved, semi-circular or combinations of these) are provided, the usable work surface area should be more than 1.2 m².

A rectangular bench shape is satisfactory, but when the work task includes other functions that require a larger bench surface area, such as mailing, there must be adequate clearance under the bench to permit the user to be able to rotate and move the chair to adopt a correct posture for each task so that bending and twisting is minimised.

The bench surface thickness should not exceed 40 mm (Figure A4.1 (C)), and the edges accessible to the operator should be smooth and rolled.

The surface should be a matt non-polished finish and should not be cold to the touch.

A4.3.2 Bench height

The distance from the floor to the underside of a fixed height bench should be a minimum of 650 mm (Figure A4.2 (D)). The recommended fixed bench height for seated work is 720 ± 15 mm.

A height adjustable bench for seated work should have a minimum height adjustment range of 660 to 770 mm.

A4.3.3 Leg room

Lateral leg room (Figure A4.1 (B)) should be a minimum of 600 mm to allow a chair to be pulled under the bench with space provided to allow the operator to rotate the chair in order to access freely the bench surface on either side.

Unencumbered clearance of at least 600 mm is required under the bench to provide forward leg room for the operator.

Drawers should be separate from the bench and should have castor wheels to enable them to be positioned at the side of the bench and well clear of the operator.

A4.4 Chairs for cytology screeners and clerical staff

The chair must be stable and robust.

A4.4.1 Chair dimensions

The seat height (Figure A4.5(A)) should be adjustable within a minimum range of 400 to 510 mm.

The backrest should be adjustable within a minimum range of 0° to 20° from the vertical (Figure A4.5 (B)).

The width of the chair seat (Figure A4.5 (D)) should be a minimum of 400 mm.

The depth of the chair seat (Figure A4.5 (C)) should not exceed 420 mm.

The chair should have a lumbar support that can be adjusted in height to suit the postural requirements of the user. Point 'A' in Figure A4.6 should adjust in height between 170 and 220 mm above the seat surface.

The user must be able easily to adjust the chair seat height and also the angle and height of the seat back from a seated position.

A4.4.2 Upholstery

The front seat edge should be rounded to minimise pressure on the legs and knees.

The chair must be made from a durable, non-flammable, cloth material suitable for the working environment.

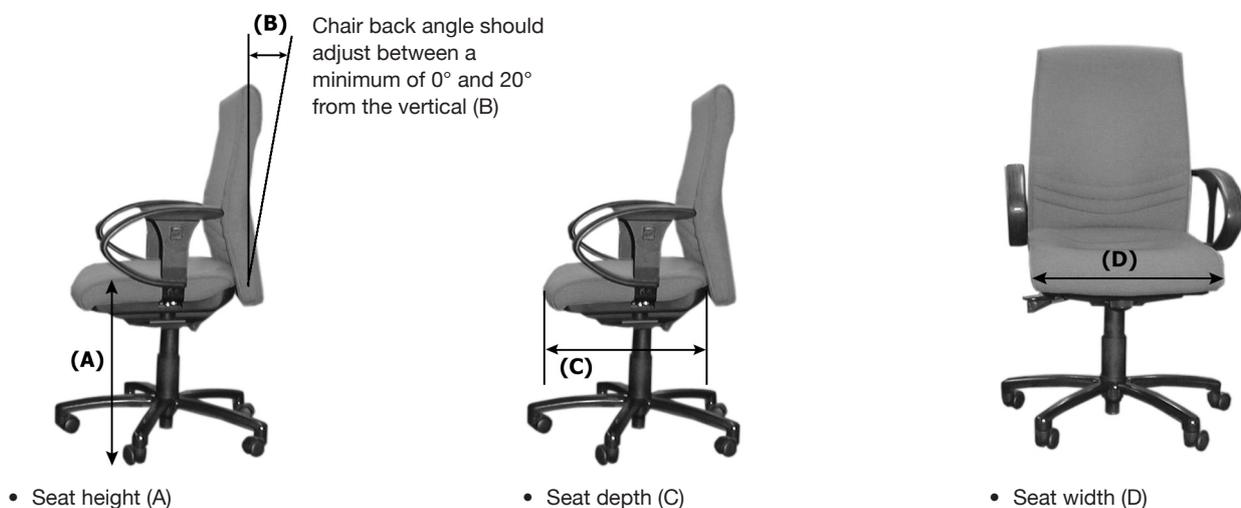


Figure A4.5 Chair dimensions.



- Point A is the widest part of the lumbar back rest

Figure A4.6 Height of lumbar support above seat.

The chair padding should be on a solid base and be of a sufficient thickness to comfortably support the user.

A4.4.3 Chair base

When used on a carpeted floor, the chair base should have castors to enable movement around the workstation. When used on a solid floor, glides should be used.

The chair must have a five star base with a minimum floor contact diameter of 600 mm.

A4.5 Footrest for cytology screeners and clerical staff

A4.5.1 Purpose of the footrest

When considering the design features of a footrest, the following postural requirements for sitting comfortably should be taken into consideration. The requirements are outlined in the *NHSCSP Ergonomic Working Standards* (NHSCSP Publication No 17) and *Postural Advice for Screeners* (Appendix 3 to NHSCSP Publication No 17):

- the chair height should be adjusted to enable a comfortable position in relation to the work task to be achieved
- ideally, the feet should rest flat on the floor with minimum pressure from the seat surface on the back of the thighs
- if the feet are not properly supported on the floor, a footrest should be used
- the footrest height should be set so that a right angle is formed between the upper and lower leg (at the knee joint) and between the foot and lower leg (at the ankle joint)
- at the correct height, the feet should be comfortably supported without raising the underside of the thighs off the seat and adequate support should be provided by the chair backrest.

A4.5.2 Footrest design features

The footrest should be a minimum of 350 mm deep and 450 mm wide to ensure that the whole of the foot is supported.⁵ To be suitable for the chair height given in section 6.2.2 of the *NHSCSP Ergonomic Working Standards* (NHSCSP Publication No 17), the footrest should be adjustable in height between 40 and 200 mm from the floor.¹ Where height dimen-

sions of the bench and seat are outside those prescribed in section 6.2.2 of the standard, a footrest of an appropriate height should be provided. The user should be able to adjust the footrest without rising from the seat.

The surface of the footrest should be parallel to the floor at all height settings. If the surface angle is adjustable, the minimum setting must be parallel to the floor and the adjustment should raise the back of the footrest to an angle not greater than 25°. It should be possible to adjust the angle of the footrest while the user is seated.

APPENDIX 5: NHSCSP EQUIPMENT GUIDANCE NOTES ON MICROSCOPES FOR CYTOLOGY LABORATORIES UNDERTAKING CERVICAL SCREENING

A5.1 Introduction

These NHSCSP equipment guidance notes are intended to assist prospective purchasers in drawing up their purchasing specifications for microscopes for cervical cytology. They also provide assessors with a common set of user requirements against which products from different manufacturers can be evaluated. Additionally, they serve to inform microscope suppliers of users' needs.

The importance of using ergonomically designed microscopes to the achievement and maintenance of a correct posture throughout the working day is emphasised in the *NHSCSP Ergonomic Working Standards* (NHSCSP Publication No 17). Muscular discomfort arising from the use of non-ergonomic equipment and furniture can lead to the work task being carried out inefficiently and inaccurately. This may lead to a slower work rate and increased risk of incorrect diagnosis by cytology screeners and, in the longer term, can cause illness, low morale and work related injuries to all grades of personnel.

The image quality, in terms of resolution, contrast and colour over the whole field of view and the range of controls provided, must meet the requirements of the users.

A5.2 Ergonomic factors

- The angulation of the eyepiece should be adjustable over a minimum range of 30° up from the horizontal. The interpupillary distance between the two eyepieces must be adjustable between a minimum range of 53 to 70 mm.
- It must be possible to lift the eyepiece assembly by rotation of a knob or by adding inserts in steps of up to 25 mm to a total of 100 mm or greater.
- The eyepiece length must be extendable from the closed up position, by a minimum of 45 mm.
- It should be possible to focus each eyepiece over a range of ± 5 dioptries.
- The focus and stage controls must be located equidistant from the operator's body on opposite sides of the microscope main frame so that the operator's arm extension is balanced.
- The controls for stage X/Y movement, coarse and fine focus, lamp brightness and diaphragms should be positioned so that they can be operated with the lower arms resting on the bench.
- The coarse focusing control should provide not less than 12 mm movement for each revolution, the fine focus torque should be set to give precise control with a movement of 0.1 mm for each revolution. A pre-set stop should be provided so that the coarse focus can be returned to the pre-set position after defocusing to provide clearance to change the specimen.

A5.3 Image quality

The quality of the image viewed by the observer depends on every part of the chain that extends from the smear through the microscope optics to the observer's eye being as perfect as physically possible. Any imperfection in any one part of the chain will impair the image quality no matter how good the other parts are.

A5.3.1 The observer

- The observer's eyesight should meet the occupational health requirements for cervical cytology microscopy.
- The observer must not be fatigued (see section 3 of the *NHSCSP Ergonomic Working Standards*).

A5.3.2 Environmental conditions

- Dry eyes that lead to irritation can be caused by low humidity and excessive air movement. Glare and unsuitable lighting conditions can lead to eye fatigue. Suitable environmental conditions should therefore be provided (see section 8 of the *NHSCSP Ergonomic Working Standards*).

A5.3.3 The microscope

- Users must be trained in the use of their microscope so that they fully understand all its features with best effect for cervical smear examination. Image quality can be degraded by contact of the exposed lenses with the user. They should be cleaned regularly in accordance with the manufacturer's instructions.
- The ergonomic features of the microscope must enable the operator to work with their hands correctly positioned when using the controls.
- Adjustments must be provided to the height and angle of the eyepiece so that the correct working posture can be achieved (see Postural advice for cytology screeners (Appendix 3 to NHSCSP Publication No 17)).
- The optics on the microscope must be appropriate to the requirements of the work task and the visual capability of the user.

A5.3.4 Optical requirements for cervical cytology microscopes

The pointers that follow were provided by a specialist advisory group on microscopes:

- objective lenses should be chosen to give the required resolution, colour rendition and flatness of field with minimum aberration over the field of view
- the higher the numerical aperture (NA) of the lens, the better the theoretical resolution, but the higher the cost
- lens colour correction and flatness of field with minimum aberration over the field of view is dependent on whether achromatic, fluorite or plan apochromatic lenses are used
- consequently, the price/image quality balance must be given careful consideration when selecting the lenses
- the minimal requirement for achromatic lenses is:
 - $\times 4/NA\ 0.10$
 - $\times 10/NA\ 0.25$
 - $\times 20/NA\ 0.40$ or $25/NA\ 0.40$
 - $\times 40/NA\ 0.65$
- benefit will be obtained from using apochromatic objective lenses especially for $\times 20/NA\ 0.75$ and $\times 40/NA\ 0.95$

- the eyepiece should be $\times 10$ with a field of view of 20 or 22 mm. A 25-mm field of view $\times 10$ eyepiece lens may be used if the larger area can be comfortably accommodated by the eye of the observer
- the condenser should be capable of illuminating the full field of view of the lowest magnification objective lens and have a maximum NA of at least 0.9.

A5.3.5 Coverslipping

- The use of coverslipping tape as an alternative to glass has important improved safety implications. Since the tape is appreciably thinner than the glass coverslip for which large aperture dry objectives are designed, image quality will be affected. Further study is required on this.

A5.3.6 Smear taking

- Smear taking, preparation and processing all play a vital role in the imaging chain and, without effective quality control, can seriously prejudice the screener's visual perception.
- Advice on best practice for smear taking is given in the *Resource Pack for Training Smear Takers* (NHSCSP Publication No 9).²⁸
- Thin layer technology will have benefits owing to better regulation of the preparation and staining processes.

A5.4 Illumination

- A pre-centred and prefocused halogen lamp of not less than 30 watts should be provided to illuminate the field of view uniformly.
- The lamp should be easily accessible for maintenance purposes.

A5.5 Spotting of cells

- The objective lens turret must be angled away from the operator so that access to the slide for hand marking is unimpeded.
- The objective lens turret should have provision for accommodating a slide marker in addition to the objective lenses.
- The microscope should provide a means of marking suspect cells with spots of size, colour and shape specified by the user. The ink must be rapid drying with a permanency of at least 10 years.