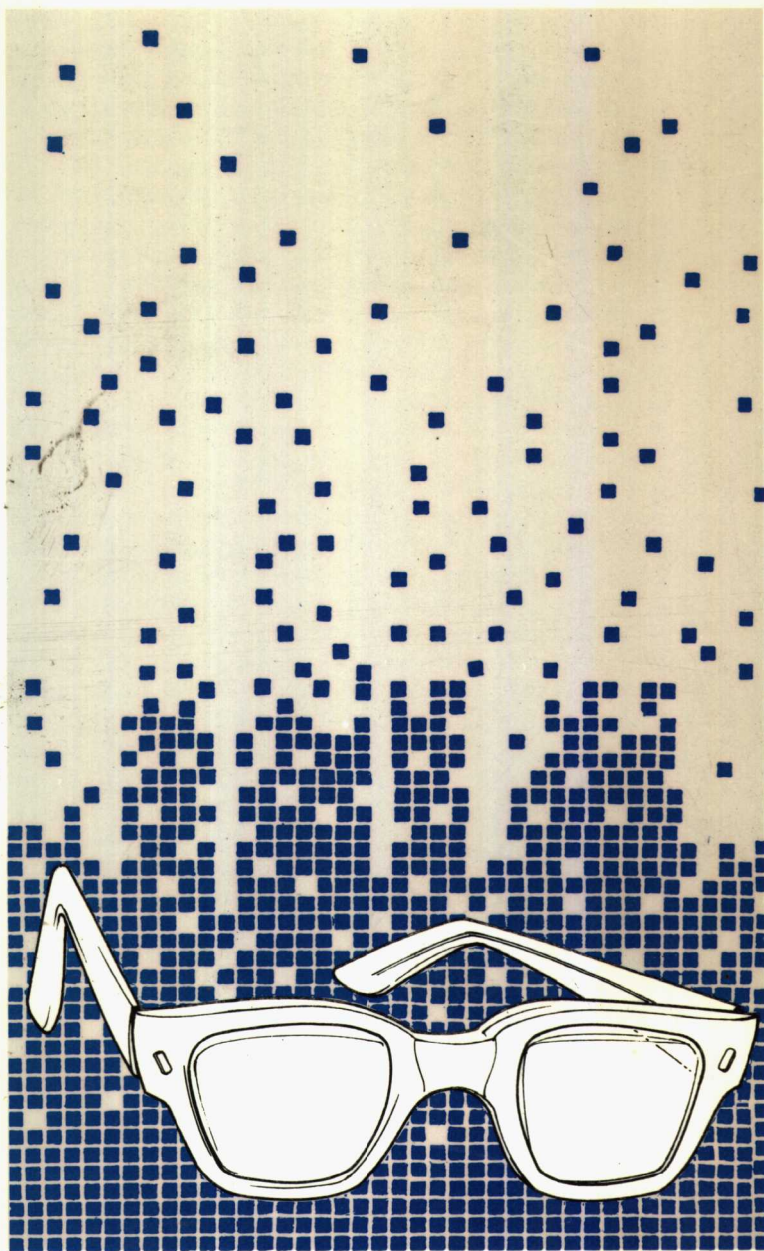


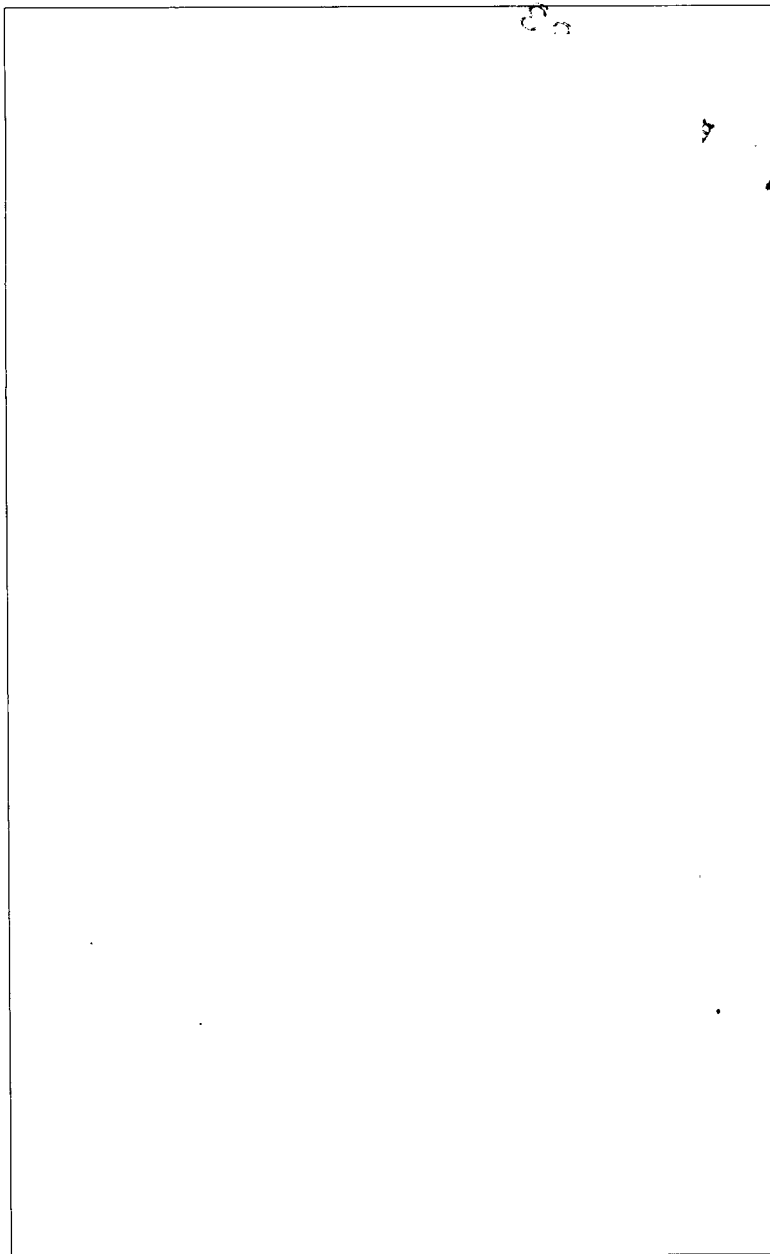
# The provision of spectacles at low cost



WORLD HEALTH ORGANIZATION GENEVA 1987

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## Preface

**T**he provision of spectacles is of great importance for the correction and improvement of many people's vision, since this will help to prevent unnecessary loss of sight.

Spectacles are widely used and easily available in developed countries, but the situation is different in many developing countries, where spectacles are sometimes difficult to obtain, and where they are often too expensive for the majority of the population.

The provision of spectacles at low cost is one of the activities included in the World Health Organization's Programme for the Prevention of Blindness. The objective of this endeavour is to make spectacles more easily available in developing countries, particularly for schoolchildren and people operated on for cataract. Relatively simple techniques exist for the production and assembly of spectacles and may be used in developing countries to improve the availability of simple spectacles at moderate cost.

A working group was convened in Geneva in 1985,<sup>1</sup> by the World Health Organization, to review the various issues involved in the provision of spectacles at low cost. This booklet is based on the group's discussions and is intended to provide general information in this field, including some of the experience gained in certain countries, which may be of interest to others.

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<sup>1</sup> A list of participants is given in Annex 1.

## Glossary of terms used in this booklet

<b>amblyopia</b>	— impairment of vision involving the nervous system; it is generally uni-ocular
<b>aphake</b>	— one who has aphakia
<b>aphakia</b>	— absence of the lens of the eye as after removal in cataract surgery
<b>cataract</b>	— opacity of the crystalline lens or its capsule
<b>diopter</b>	— the unit of measurement for refractive power; a convergent lens with a focal power of one metre is said to have a power of + 1 diopter
<b>hypermetropia</b>	— a refractive error in which rays of light entering the eye parallel to the optic axis are brought to a focus behind the retina
<b>myopia</b>	— short- or near-sightedness; a refractive error in which rays of light entering the eye parallel to the optic axis are brought to a focus in front of the retina
<b>presbyopia</b>	— impairment of near vision with advancing years; caused by a diminution in the power of accommodation of the crystalline lens
<b>presbyope</b>	— one who has presbyopia
<b>refraction</b>	— (1) the deviation of a ray of light in passing obliquely from one medium to another of different density — (2) the act of refracting; specifically the determination of the refractive errors of the eye and their correction with spectacles
<b>refractive error</b>	— when light passing through the lens of the eye is not brought to a focus on the retina
<b>refractive services</b>	— services to determine refractive errors and assess the need for correction with spectacles
<b>spherical correction</b>	— correction achieved by a spherical lens
<b>spherical lens</b>	— lens bounded by spherical surfaces



## Why are low-cost spectacles needed?

Good eyesight is vital in most situations in daily life, particularly in education and at work. Defective vision is an obstacle to learning, both for school-children and for adults — participating in adult literacy campaigns for example — and can lead to occupational and road accidents. It can also reduce a worker's productivity if the job requires good sight. Thus impaired vision may constitute an avoidable obstacle to social and economic development, quite apart from the obvious negative influence it has on the quality of life.

The potential demand for spectacles is considerable since it has been estimated that the sight of at least one-fifth of the population could be improved by their use.

Experience gained in several countries indicates that about 10% of schoolchildren would benefit from using spectacles,



The provision of spectacles can dramatically improve vision

because they are either hypermetropic or near-sighted (myopic). This is equivalent to saying that the investment made in one out of ten schools is not being utilized to the full. If these visual defects persist unremedied into adulthood, they will not only prevent children from realizing their full potential but also increase the risk of accidents. A child's mental development and psychosocial adjustment, both at home and

elsewhere, can be adversely affected by sensory impairment. Thus the early detection and correction of visual defects is an important measure, preventing the development of more serious and permanent problems (amblyopia and squint) and improving school performance.



Because of loss of focusing power (presbyopia), most people over the age of forty require spectacles for reading or close work, such as sewing or operating machinery. Even in countries where the population is predominantly young, presbyopes will form at least 10% of the overall population.

Additionally, patients who have undergone cataract surgery with removal of the lens of the eye (aphakes) require appropriate spectacles to restore their useful vision and hence their independence. The provision of spectacles to such patients makes cataract surgery more acceptable.

Unfortunately, in many countries, particularly in the developing world, spectacles may not be available to the majority of those in need of them for several reasons:

- high cost — which may exceed the average annual per capita income in some developing countries
- inaccessibility of examination centres
- reluctance to wear spectacles in some cultures
- ignorance of many people about the existence or the nature of any sight defect and of the possibilities of correction.

It is clear that the availability of spectacles can be a critical factor in the promotion of education and development and is a problem requiring urgent attention. In most countries, some health service resources are already being made available for the provision of spectacles, and in order to ensure more efficient use of these resources the production and provision of spectacles at low cost might be an appropriate solution in many cases. Experience has shown that it is possible to produce spectacles at a cost of about US\$2.50– 3.50 per pair, with a relatively small investment and using local labour and a minimum of imported material. This process can be adapted to a variety of local conditions in developing countries.



A significant proportion of these children may be in need of spectacles

## Who would benefit from low-cost spectacles?

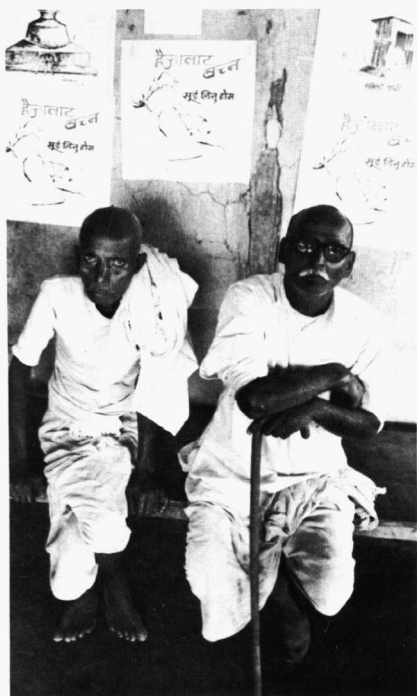
The people who could benefit from spectacles can be divided into three groups:

- (1) those who can afford the spectacles and eye care services available within their countries;
- (2) those who might be able to purchase spectacles if they were available at low cost; and
- (3) those who could not purchase spectacles at any cost.

People in the first category can obviously take care of their own needs, while those in the third group will require particular social services. Those in the second group would benefit immediately from the provision of low-cost spectacles.

Ideally, everyone with any significant refractive error should receive appropriate spectacle correction. Until such time as this becomes possible, efforts should be directed to children, presbyopes, and aphakes, three groups that have special needs, as outlined above.

In children, refraction is often different in each eye, and therefore where refractive services are limited these should be reserved for children. Most presbyopes can manage to select spectacles that permit reading and other close work. However, more satisfactory results may be obtained if refractive services are used. Aphakes can often obtain significant improvement by choosing glasses from among a limited range of refractive strengths of +10.0 to +13.0 diopter (D).



The elderly often suffer from visual loss due to cataract, but spectacles can restore vision completely after appropriate surgery

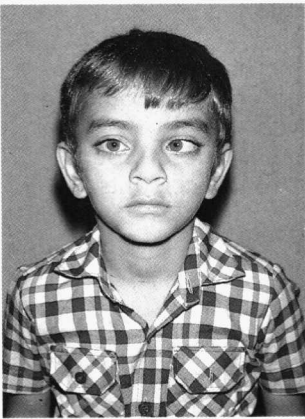


As the first objective is to achieve useful improvement in vision in the above target groups, it is usually best initially to sacrifice refractive precision in order to achieve the widest possible coverage. With this in mind, it is recommended that the range of lenses made available should be in steps of only 0.5 D or 1.0 D. In the vast majority of patients, spherical correction alone will yield acceptable and useful improvement in vision.

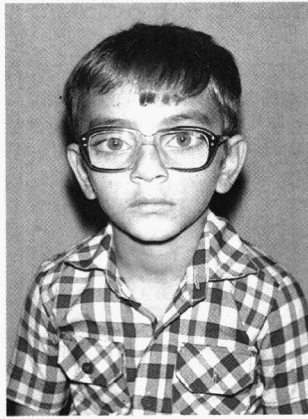
In expanding the spectacle programme beyond the three initial target groups, particular consideration should be given to industrial workers and drivers with visual impairment. Correction of refractive errors in these groups will improve job safety and help prevent road accidents.

## Identification and motivation of those in need of spectacles

**I**t is desirable to identify all children at risk at the earliest possible stage. In many cases, only those going to school can be examined adequately. Extra efforts will be required to reach other children — possibly through primary health care systems.



Many cases of squint in children can be easily and completely corrected if spectacles are provided at an early age



While most presbyopes and aphakes are aware of their need for spectacles, it may be necessary to identify some persons belonging to these groups. Identification, or screening for impaired vision, can be carried out through educational institutions, voluntary organizations or within health care systems.

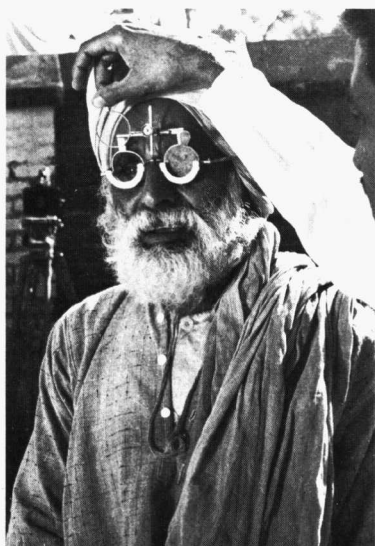
In many societies there is reluctance to use spectacles, and in those places special attention should be paid to increasing motivation. Suitable methods of informing and educating the public — for example, through the mass media or through schools — will need to be developed. The benefits of improved vision, such as improved performance and safety at school or work, should be emphasized.



## Provision of services for refraction and for prescription of spectacles

**I**t is important that appropriate services for the detection and assessment of refractive errors and for the provision of low-cost spectacles should be available to those in need, in conjunction with educational efforts. Otherwise, the demands generated may not be satisfied, giving rise to frustration and loss of confidence in the system.

Refraction and prescription of spectacles are usually carried out by ophthalmologists, medical officers, optometrists or opticians. However, they are sometimes undertaken by less qualified personnel, often without formal training.



The provision of services for refraction is just as important as the production of lenses

The numbers of trained personnel are usually inadequate to meet the needs of the people, particularly in developing countries and the development of a low-cost spectacle programme will undoubtedly increase the demands. Appropriate programmes for training in refraction, prescription of glasses, identification and motivation of those in need of referral will have to be developed according to local needs and available resources.

Consideration should be given to the possibility of providing these services in the context of primary health care.

## Production technology

The technology is currently available to produce frames and lenses at low cost and to assemble finished spectacles in most situations encountered in developing countries. It will be necessary to import several indispensable items, such as ophthalmic glass, plastic sheets for frame production, metal components, and, in some cases, temples (sides) for frames. There are, however, several ways of keeping the cost down and of conserving foreign exchange. These include:

- using only spherical lenses
- using larger power increments (steps of 0.5 or 1.0 D)
- using a standard range of frame sizes and styles
- manufacturing as much as possible locally.

The manufacturing process employed will vary with the technology available within different countries. Spectacles may be made completely by hand in a cottage industry in some countries, while elsewhere, the use of power-driven machines for some or all of the manufacturing processes may be possible. Existing manufacturing facilities should be assessed to determine whether they could be used as they are, or with some strengthening or modification. Manufacturers of spectacles and their components should be encouraged to collaborate in efforts to minimize the cost of spectacles.

The production of spectacles using local resources will require consideration of questions in four different fields:

- frame manufacture,
- lens production,
- assembly, and
- training.

### (1) *Frame manufacture*

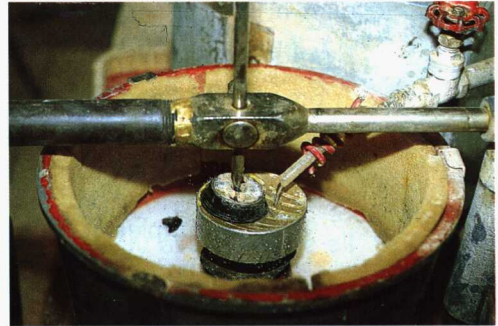
The two most common methods used in frame production are:

*Injection moulding.* This technique may require some elaborate machinery that is not always available in developing countries.





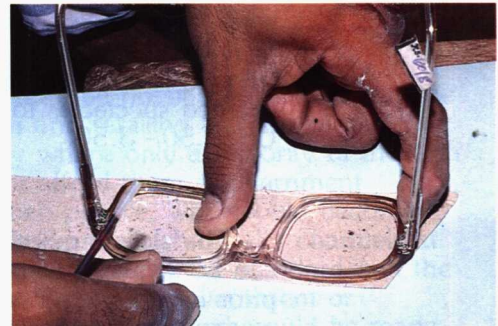
The cutting and shaping of lenses in a small optical workshop



The polishing of lenses can be achieved with simple machinery which can be produced locally (see also page 16)



Making spectacle frames — sheet plastic method



Mounting the lenses



*Sheet method.* This involves cutting a frame, with temples, by hand or machine from a sheet of plastic. The frame is then shaped, assembled, and polished. This method allows for greater manufacturing flexibility and has considerable potential for technical development.

Both methods require the importation of sheet plastic and metal hinges, screws, rivets and temple cores.

## (2) *Lens production*

It is possible to produce lenses from inexpensive, “non-optical” glass but it is better to import high quality lens blanks made from ophthalmic glass. These can be ground and polished on both surfaces using machines that can either be imported or made from locally available components. Polishing compound will also be required.

A small workshop, employing two or three workers, can produce 2000–3000 pairs per year, with a capital investment of US\$2000–2500, which should make it possible to produce a pair of lenses to correct presbyopia, for example, at a cost of approximately US\$0.80.

## (3) *Assembly and edging*

The assembly of spectacles includes the process of cutting the ground and polished lenses (edging) to fit into the finished frames. This requires very limited resources and facilities. With the aid of two electric edging machines and some hand tools, one person can assemble over 3000 pairs of finished spectacles per year. The capital investment is between US\$600 and US\$900, and will allow the cost of finished spectacles to be kept within the range of US\$2.50–3.50.

## (4) *Training*

The skills required for production, assembly and fitting can be acquired with 2–3 months of training. No special prior education is needed for such training. There is evidence that experience of manufacturing and dispensing at a relatively simple level can provide a solid base for the subsequent development of a more sophisticated system.