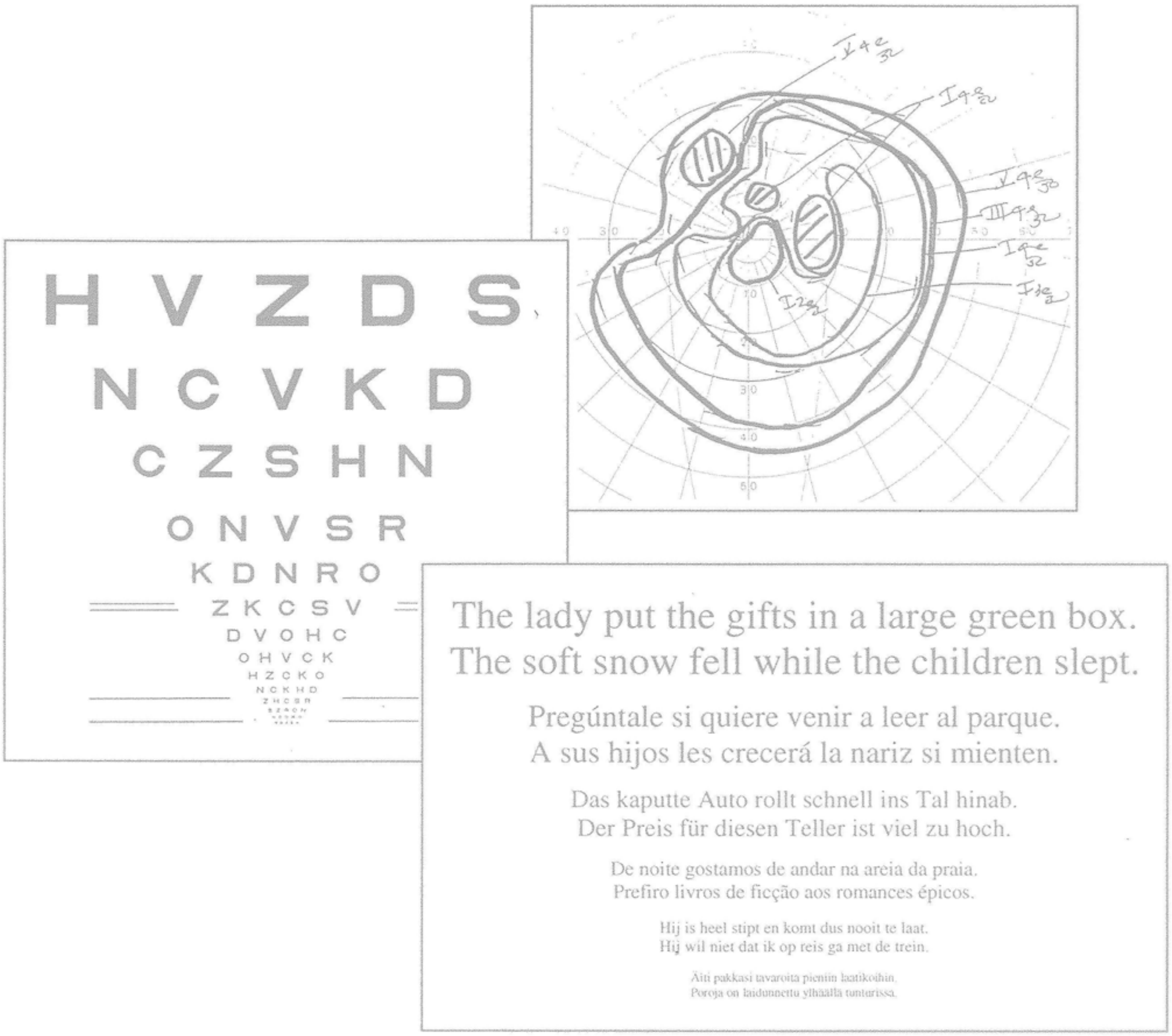
International **S**ociety for **L**ow vision **R**esearch and **R**ehabilitation



GUIDE
for the Evaluation
of VISUAL Impairment

Published through the **Pacific Vision Foundation**, San Francisco
for presentation at the International Low Vision Conference **VISION-99**.

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INTRODUCTION

OBJECTIVE

This GUIDE presents a coordinated system for the evaluation of the functional aspects of vision.

It has been prepared on behalf of the International Society for Low Vision Research and Rehabilitation (ISLRR) for presentation at VISION-99, the fifth International Low Vision conference. The GUIDE is based on currently available standards. This means that some parts, for which standardized measuring tools are still lacking, are not yet developed in as much detail as would be desirable. It is hoped that input received over the next three years will allow presentation of an updated version at the VISION-2002 conference and at future tri-annual conferences thereafter.

The assessment of young children and multiply handicapped individuals is another area where more extensive guidelines may be developed for VISION-2002.

SOURCES

The GUIDE is based on current concepts and insights and conforms to the

Classification of Vision Loss as found in ICD-9-CM (code 369) (1978), based on the recommendations of the World Health Organization (WHO) and the International Council of Ophthalmology (ICO)

International Classification of Impairments, Disabilities and Handicaps (ICIDH), by the World Health Organization (WHO) (1980) and its replacement (ICIDH-2) (in preparation)

Visual Acuity Measurement Standard (1984) of the International Council of Ophthalmology (ICO)

Standard # 8596 – Visual Acuity testing (1994) of the International Standards Organization (ISO)

Measurement Guidelines for Collaborative Studies of the National Eye Institute (NEI), Bethesda, MD

WORK GROUP

The GUIDE was approved by a Work Group including the following members:

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RELATION to the AMA GUIDES

The purpose of PART 2 and PART 3 of this GUIDE is similar to that of the AMA *Guides for the Evaluation of Permanent Impairment.*

However, the scales in this GUIDE differ from those presented in the 4th edition (1993) of the Vision chapter of the AMA Guides.

A new Guide was needed since the Vision section in the 4th edition of the AMA Guides is still based on employability studies from 1925 and has accumulated multiple internal inconsistencies over the course of multiple revisions. These differences are discussed in PART 5 of this GUIDE.

The next, 5th edition of the AMA Guides, which is presently in preparation and is expected to be published in 2000, is expected to conform to the scales in this GUIDE. In the mean time, the scales presented in this GUIDE could be combined with the evaluation guides for other organ systems in the 4th edition of the AMA Guides, when this is desirable.

ASSESSMENT of CHILDREN

This GUIDE is primarily directed at acquired vision loss in adults. Special consideration needs to be given to the assessment of vision in young children and in multi-handicapped individuals.

Preferred-Looking tests and Grating acuity tests are detection tests and may significantly over-estimate the equivalent letter chart acuity, which is a recognition task related to reading. Vision loss in young children may also be a cause of secondary developmental delays, due to insufficient visual input and communication. This can be even more pronounced when several problems interact in multi-handicapped individuals.

ENDORSEMENTS

In addition to incorporation in the upcoming edition of the AMA Guides, endorsements for this GUIDE are being sought from various national and international organizations.

Such endorsements will be included in future printings.

UPDATES

This Guide reflects current standards. This means that it is deficient for aspects of visual impairment other than visual acuity and visual field. *(See the list on page 4).*

Neither have standardized scales been developed for the various activities that constitute functional vision *(see Part 4)*. Such scales are needed for the proper assessment of rehabilitation needs.

The GUIDE does not address the assessment of children and multi-handicapped individuals.

Finally, this GUIDE shows some bias towards conditions in the United States, since detailed comparisons of assessment methods in other counties were not readily available.

It is hoped that the publication of this GUIDE will stimulate others to contribute their experiences and promote continued development in each of the mentioned areas. The next three years will hopefully see continued development of standardized performance scales and assessment practices. When such scales have been developed, a new, updated revision of this GUIDE may be possible for presentation at the next International Low Vision conference: VISION-2002. Publication of further updates may thus become a standard feature of future tri-annual conferences

Comments, suggestions and contributions (including comparisons to various national standards) are requested and should be submitted to:

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PART 1 – OVERVIEW

ASPECTS OF VISION LOSS

The description of visual functions and functional vision can be approached from various points of view. To understand the differences between these points of view, this GUIDE will use as a conceptual framework the four aspects of functional loss that were first introduced in the *WHO Classification of Impairments, Disabilities and Handicaps*. The aspects are distinct, although different publications may use slightly different terms. Some terms are summarized in Table 1.

The first two aspects refer to the **organ system**. The first aspect is that of anatomical and structural changes. Defects are described as diseases, **disorders** or injuries. The second aspect is that of functional changes at the organ level. Defects are described as **impairments.** The next two aspects refer to the **individual**. One aspect describes the skills and **abilities** of the individual. Defects are described as dis-abilities. The last aspect points to the social and economic consequences of loss of abilities. Defects are described as **handicaps**.

TABLE 1 – ASPECTS of VISION LOSS

	THE ORGAN		THE PERSON	
ASPECTS:	Structural change, Anatomical change	Functional change at the Organ level	Skills, Abilities of the individual	Social, Economic Consequences
Neutral terms:	Health Condition	Organ Function	Skills, Abilities	Social Participation
Loss, Limitation	Disorder, Injury	Impairment	Disability	Handicap
ICIDH-80:	Disorder	Impairment	Disability	Handicap
ICIDH-2: (see part 4)	Structural change	Functional change, Impairment	Activity + Performance code	Participation + Performance code
Application to VISION:		"visual functions" measured quantitatively *E.g.: Visual Acuity*	"functional vision" described qualitatively *E.g.: Reading ability*	

For this GUIDE, the impairment and (dis-)ability aspects are most important. The term **"visual functions"** is used often to refer to the impairment aspect. Most visual functions (visual acuity, visual field, etc.) can be assessed quantitatively and expressed in measurement units relative to a measurement standard. They are usually measured for each eye separately. Abilities (reading ability, orientation ability, etc.), on the other hand, refer to the person, not to the eye. Although some aspects, such as reading speed, can be readily quantified, other aspects, such as reading comprehension and reading enjoyment cannot. The term **"functional vision"** is often used to refer to visual abilities.

A statement such as *"the patient can read newsprint (1M, J#6)"* describes a level of functional vision. It tells us that the patient can meet an important daily need. It does not tell us how well or with what help the patient can do this. A statement such as *"the patient can read 1M at 50 cm"* describes the measurement of a visual function, in this case, visual acuity.

Note that eye care professionals typically describe the severity of a case in terms of impairment of visual function *("visual acuity has dropped by two lines")*. The patient, on the other hand, will usually couch the complaint in terms of loss of an ability *("Doctor, I am not able to read anymore")*.

This GUIDE provides means to derive an ability estimate, based on an impairment measurement. Such estimates can be useful for certain purposes. However, they should never be mistaken for a direct description of the skill or ability. They certainly do not replace a direct assessment of the actual impacts of various impairments on the participation of the individual in activities at home, at work, at school or elsewhere (the handicap and participation aspect).

Measuring and rating the impairment is the task of the **eye care** professional. When combined with a professional statement about the diagnosis of the underlying condition and its prognosis, the long-term impact of the condition can be estimated. Such estimates can be helpful for decisions involving disability compensation. The latter decisions are **administrative** decisions, which generally are not in the domain of the eye care professional.

ASSESSMENT of VISUAL FUNCTIONS

PART 2 of this GUIDE provides guidelines and scales for the assessment of:

- **Visual Acuity** – the ability to perceive details presented with good contrast, and
- **Visual Field** – the ability to simultaneously perceive visual information from various parts of the environment.

Measurement techniques for these aspects have been well established and standardized. Losses in these functions have well-recognized effects on Activities of Daily Living (ADL). *(In this GUIDE the term ADL is used to include Orientation and Mobility as well as Educational and Vocational activities. The term vision "loss" is used to include congenital defects.)*

The GUIDE does NOT provide guidelines and scales for numerous other visual functions, such as:

- **Contrast Sensitivity** – the ability to perceive larger objects of poor contrast. Loss of this ability can interfere significantly with many Activities of Daily Living (ADL). It is often, but not always, associated with a loss of visual acuity.
- **Glare sensitivity** (veiling glare), delayed **Glare recovery, Photophobia** (light sensitivity) and reduced or delayed Light and **Dark Adaptation** are other functions that may interfere with proper contrast perception.
- **Color vision** defects are not uncommon, but usually do not interfere significantly with Activities of Daily Living (ADL). Severe color vision defects (achromatopsia) are usually accompanied by reduced visual acuity. In some vocational settings the impact of minor color vision deficiencies can be significant.
- **Binocularity, Stereopsis, Suppression, Diplopia.** These functions vary in their effect on Activities of Daily Living (ADL). Their significance often depends on the environment and on vocational demands.

To-date, standardized measurement techniques upon which uniform standardized scales can be based have not yet been developed for all of these functions. Therefore, and because their impact may vary according to the environment, we recommend that their impact – if significant – be documented separately and handled as an individual adjustment to the (dis-)ability estimate, as described in Part 3.

This recommendation may change in future editions, if standardized measurements and standardized ability estimates become available.

ASSESSMENT of FUNCTIONAL VISION

Whereas *visual functions* refer to the functioning of each eye, *functional vision* refers to the functioning of the individual. Most visual functions can be measured adequately on well-developed and broadly accepted scales. For functional vision, such scales do not yet exist.

Thus, the assessment of functional vision can take place in one of two modes:

- An **ability estimate** can be made, based on the measured visual functions. This GUIDE provides scales for this purpose. The use of these scales has the advantage that the outcome is based on measurements that are fairly objective and should be reproducible. It has the disadvantage that it is only an estimate and that individual factors are ignored.

- A **direct description** of the ability. This approach has the advantage that individual factors can be acknowledged. It has the disadvantage that the disability descriptors may be more subjectively tinted and that there may be greater variation between observers.

A hybrid approach, recommended in this GUIDE, is to use the **ability estimate** as a starting point and to make **individual adjustments** if needed. Individual adjustments, when made, require well-documented observations and proper arguments to support the need for the adjustments. The documentation should be such that other reviewers can repeat the observations, if needed.

USE OF SCALES

PART 3 of this GUIDE discusses scales that can be used to convert a measured impairment value to an estimate of functional vision. Such scales can either count up or count down.

- An **ability scale** stresses the importance of remaining function. On such a scale, "0" will indicate no appreciable function and "100" will indicate normal or standard function. The scale can be extended beyond "100" to indicate better than normal function. E.g. on a reading ability scale, a score >100 could refer to speed-reading ability; on a running ability scale, an Olympic athlete would score >100.

This type of scale stresses that "the glass is half-full". It is the preferred scale for rehabilitation.

- A **dis-ability scale** stresses what has been lost (or never attained in congenital defects). On this scale "0" indicates normal function; a score of "100" indicates that no appreciable ability is left. Better than normal performance *(the speed-reader or the Olympic athlete)* finds no place on this scale.

This type of scale stresses that "the glass is half-empty". It can be useful for calculation of disability benefits and similar applications. The scales in the AMA Guides are presented as disability scales *(i.e. described as % of loss)*; the underlying formulas, however, are based on ability scales.

This GUIDE recommends the use of **ABILITY scales**. For individual cases, an ability scale can document a drop from above normal to normal performance *(from >100 to 100)*. For disability compensation, a loss is generally not considered until the performance drops below the standard *(i.e. below 100)*.

A **disability scale** is obtained by subtracting the ability value from 100.

ABILITY PROFILES

A global ability estimate, expressed as a single number, may be convenient for administrative purposes, and as an *outcome measure* for medical interventions.

For rehabilitative efforts, which typically do not change the underlying impairment, the impairment aspect is the *starting point*. To plan rehabilitative interventions and to assess their effectiveness, more detailed descriptions and direct assessments of various visual abilities before and after intervention are necessary.

PART 4 of this GUIDE discusses how ability profiles could be used for this purpose. This part contains only suggestions, since standardized scales for this purpose have not yet emerged. The activity and participation scales of ICIDH-2 may provide a stimulus for such development.

The Handicap and Participation aspects assess the social context, human rights and equal opportunity aspects of vision loss. A detailed discussion of these aspects is beyond the scope of this GUIDE.

COMPARISONS

PART 5 of this GUIDE discusses the relation of this GUIDE to the 4^{th} edition of the *AMA Guides* and to *ICIDH-2*.

It also provides a bibliography of some of the relevant literature.

PART 2 – ASSESSMENT OF VISUAL FUNCTIONS

VISUAL ACUITY ASSESSMENT

Visual Acuity describes the ability of the eye to perceive details. This ability is important for many Activities of Daily Living (ADL), the most prominent of which is reading. The time-honored clinical way to determine visual acuity is through a letter recognition task. If the subject needs letters that are twice as large or twice as close as those needed by a standard eye (i.e. 2x angular magnification), the **visual acuity** is said to be "1/2". If letters are needed that are five times larger or five times closer, the visual acuity is said to be "1/5", etc.

Visual Acuity Notations

Visual acuity fractions compare the subject's performance to a performance standard. In a **true Snellen fraction,** the numerator indicates the testing distance *(i.e. the distance at which the subject recognizes the symbol)* and the denominator indicates the letter size *(expressed as the distance at which a standard eye recognizes the symbol)*. If metric measurements are used, the test distance is expressed in meters *(symbol "m")* and the letter size in "M-units" *(symbol "M")*. One M-unit *(1.45 mm)* subtends 5' at 1 meter.

True Snellen fractions indicate the test distance, but make it difficult to compare measurements taken at different distances. **Snellen equivalents** are often used to overcome this difficulty; they indicate the value of the Snellen fraction but hide the actual testing distance. **Decimal equivalents** *(often used in Europe)* indicate the decimal value of the Snellen fraction *(e.g. 6/30 = 0.2, 5/25 = 0.2)*. Although the **U.S. notation** *(20/…)* looks like a Snellen fraction, it is most often used as a Snellen equivalent, i.e. a 20/40 fraction is not generally interpreted as indicating that the actual measurement was taken at 20 feet. This is especially true for projector tests, which can be adjusted for any available test distance.

In accordance with its intended international use, this GUIDE will generally use both U.S. and decimal notations. Table 2 provides equivalents for various other Snellen fractions.

Visual Acuity Ranges

Visual acuity values can vary widely. To facilitate discussion, it is useful to sub-divide the visual acuity scale into a number of ranges. At one end of the scale are those with **normal vision**, at the other end are those who are **blind**, i.e. those who have no vision at all. In between, are those who have lost part of their vision. This group is said to have **Low Vision**. Further subdivisions within this group can be made to distinguish those who have lost a little from those who have little left.

Recognition of the fact that there is a Low Vision range and that the population in this range has needs and problems that are different from those who are normally sighted as well as from those who are totally blind, has grown gradually, especially after World War II. Various studies by the World Health Organization (WHO) led to the adoption of the visual acuity ranges shown in **Table 2**. Each of these ranges covers four lines on a visual acuity chart with the standard geometric progression of letter sizes. The WHO, with the support of the International Council of Ophthalmology (ICO), introduced these ranges in ICD-9 (1978), whereas prior editions of the ICD had only made a dichotomous distinction between "sighted" and "blind" individuals. The ranges are part of ICD-9-CM, the official U.S. Health Care classification.

Visual Acuity Measurement for Normal and Near-normal vision

Distance acuity for individuals in the range of normal and near-normal vision (0.3, 20/60 or better), is measured with the familiar letter charts or projector charts. These charts offer several test characters for each acuity level in this range. Test distances vary from 20 ft *(common in the U.S.)*, to 6 m *(common in Britain)*, to 5 m *(common in Europe)*, to 4 m *(used for the ETDRS charts)*, to 3 m *(often used for children whose attention diminishes with greater test distances)*, to 1 m *(recommended for the Low Vision range)*. Snellen fractions for these distances are found in **Table 2**.

TABLE 2 – VISUAL ACUITY RANGES and VISUAL ACUITY NOTATIONS for Distance vision

ICD-9-CM RANGES WHO / ICO CLASSIFICATION		EQUIVALENT NOTATIONS		TRUE SNELLEN FRACTIONS (numerator indicates test distance)						VISUAL ACUITY SCORE
		Decimal	US	10 ft.	1 m	3.2 m	4 m	5 m	6.3 m	
(Near-) Normal Vision	Range of Normal Vision	1.6 1.25 1.0 0.8	20/12.5 20/16 20/20 20/25	10/6.3 10/8 10/10 10/12.5	1/0.63 1/0.8 1/1 1/1.25	3/2 3/2.5 3/3.2 3/4	4/2.5 4/3 4/4 4/5	5/3.2 5/4 5/5 5/6.3	6/4 6/5 6/6.3 6/8	110 105 100 95
	Near-Normal Vision	0.63 0.5 0.4 0.32	20/32 20/40 20/50 20/63	10/16 10/20 10/25 10/32	1/1.6 1/2 1/2.5 1/3.2	3/5 3/6.3 3/8 3/10	4/6.3 4/8 4/10 4/12.5	5/8 5/10 5/12.5 5/16	6/10 6/12.5 6/16 6/20	90 85 80 75
Low Vision	Moderate Low Vision	0.25 0.20 0.16 0.125	20/80 20/100 20/125 20/160	10/40 10/50 10/63 10/80	1/4 1/5 1/6.3 1/8	3/12.5 3/16 3/20 3/25	4/16 4/20 4/25 4/32	5/20 5/25 5/32 5/40	6/25 6/32 6/40 6/50	70 65 60 55
	Severe Low Vision	0.10 0.08 0.063 0.05	20/200 20/250 20/320 20/400	10/100 10/125 10/160 10/200	1/10 1/12.5 1/16 1/20	3/32 3/40 3/50 3/63	4/40 4/50 4/63 4/80	5/50 5/63 5/80 5/100	6/63 6/80 6/100 6/125	50 45 40 35
	Profound Low Vision	0.04 0.03 0.025 0.02	20/500 20/630 20/800 20/1000	10/250 10/320 10/400 10/500	1/25 1/32 1/40 1/50	3/80 3/100 3/125 3/160	4/100 4/125 4/160 4/200	5/125 5/160 5/200 5/250	6/160 6/200 6/250 6/320	30 25 20 15
(Near-) Blindness	Near-Blindness	0.016 0.0125 0.01 ---	20/1250 20/1600 20/2000 ---	10/630 10/800 10/1000 ---	1/63 1/80 1/100 ---	3/200 3/250 3/320 ---	4/250 4/320 4/400 ---	5/320 5/400 5/500 ---	6/400 6/500 6/630 ---	10 5 0 ---
	Total Blindness	No Light Perception								

NOTE regarding the use of "Preferred Numbers":
The tables in this GUIDE use the values of the "Preferred Numbers" series, specified in ISO standard # 3. This geometric progression of numbers is widely used in international standards. Ten steps equal exactly 10x, so that the same numbers repeat in each decimal interval, with only a shift in the decimal position. Each step equals a ratio of 4/5. Three steps equal a 2x ratio. The product or quotient of two preferred numbers is again a preferred number. Thus, if viewing distances and prints sizes follow the preferred numbers series, all resulting quotients (the visual acuity values) will also be preferred numbers.

For the design of tests and for research measurements, the design values (error <1%) should be used, as was done in this table. For the naming of visual acuity levels in clinical use rounded values (error <5%) are acceptable. The largest error when using rounded values amounts to one letter on a standard chart with 5 letters/row, which is well within the clinical measurement error.

Design values:	0.8	1.0	1.25	1.6	2.0	2.5	3.2	4.0	5.0	6.3	8.0	10.0	12.5 … etc.
Rounded values:	0.8	1	1.2	1.5	2	2.5	3	4	5	6	8	10	12 … etc.

Examples: The table lists the decimal acuity value 0.63; clinicians will generally record 0.6. The table lists the U.S. acuity value 20/32; clinicians will generally record 20/30. Using Preferred Numbers, the ideal measurement distances would include 3.2 and 6.3 meters. The table has already rounded these to 3 and 6 in the numerator of the corresponding Snellen fractions.

When measuring letter chart acuity, the patient should be placed at the distance for which the chart was designed and encouraged to read as far down as possible. If errors are made, the line is considered read when more-than-half of the characters *(e.g. 3 of 5)* are read correctly. Most charts will indicate the visual acuity level that corresponds to the ability to read each line. If the visual acuity is not indicated, or if the chart is used at a different distance, the visual acuity should be recorded as a Snellen fraction. In this fraction, the numerator will indicate the viewing distance in meters and the denominator the metric letter size rating *(M-units on newer charts, D=… on older charts).*

Near-vision can be tested with a variety of charts, containing either a reduced size letter chart or continuous text segments in various print sizes. For the evaluation of functional vision, the use of continuous text is more appropriate than the use of letters. Each chart should indicate the distance at which it should be used. These distances may vary from 40 cm (16”) to 14” (35 cm) to 33 cm (13”) to 30 cm (12”) or even 25 cm (10”). Most charts will indicate a distance acuity equivalent for each line. These equivalents are valid **only** if the correct distance is used. If the distance equivalent is not listed or if the card is used at a different distance, the visual acuity should be calculated as explained in the next section.

Visual Acuity Measurement in the Low Vision range

Use of this GUIDE will often involve individuals whose visual acuity has dropped to less than 0.3 (20/60), i.e. to the **Low Vision** range (ICD-9-CM).

Standard **letter charts** often have only one or two letters at the 0.2 (20/100) level, no letters at the 0.16 (20/125) and 0.12 (20/160) level, and only one letter at the 0.1 (20/200) level. This means that they are inadequate for visual acuity measurement in the Low Vision range. Better results can be obtained by bringing the chart closer. Testing at 1 meter can cover the entire Low Vision range, down to 0.02 (1/50, 20/1000). When testing at 1 meter, the resulting Snellen fraction is 1/… .

It is important to maintain the correct testing distance. This can best be done with a ruler or with a 1-meter cord attached to the chart. Charts with a cord attached and labeled for the 1-meter testing are available.

If charts with metric Snellen notations for other distances are used, the numerator should be changed to “1”, as indicated in the previous section. U.S. notations should first be converted to metric notations as shown in **Table 2**.

Many **reading cards** are not well suited for the Low Vision range either. They often do not present large enough print sizes and/or are labeled for viewing distances that are too far for the subject with Low Vision.

As is the case for distance testing, near vision testing requires the specification of two variables: letter size and viewing distance. A statement that lists only the letter size is insufficient to determine the visual acuity value. Distance equivalents, listed on many cards, are a useful shortcut, but only if the card is used at the designated distance. It is utterly confusing to use them if the card is used at any other distance.

Table 3 shows visual acuity values for any combination of letter size and viewing distance. The visual acuity values in Table 3 are expressed as the equivalent values for 1-meter testing (1/…). Equivalents for other distances can be obtained by multiplying numerator and denominator by the same amount (see Table 2).

The **viewing distance** should be measured and recorded carefully. It can be specified in cm or inches (1 inch = 2.5 cm, 1 meter = 40”), using the standard Snellen fraction: **V = m / M**. When visual acuity and distance are itself fractions, it is more convenient to use their reciprocals. The reciprocal of a metric distance is known as the **diopter** *(2 diopters = 1/2 m, 5D = 1/5 m, etc.).* Use of the reciprocal values turns the Snellen *fraction* into a *multiplication*, which is more easily calculated, since it uses whole numbers instead of fractions within fractions. The traditional formula **V = m / M** thus becomes:

$$\mathbf{1 / V} = \frac{M}{m} = M \times \frac{1}{m} = \mathbf{M \times D}$$

(M = letter size in M-units, m = viewing distance in meters, D = viewing distance in diopters,).

Table 3 – Letter Size, Viewing Distance, Visual Acuity Score and Visual Acuity

Letter Size		Viewing Distance (glasses to text, not valid for magnifiers)													ICD-9-CM
		5cm *2"* 20 D	6.3cm *2.5"* 16 D	8cm *3.2"* 12.5D	10cm *4"* 10 D	12.5cm *5"* 8 D	16cm *6.3"* 6.3 D	20cm *8"* 5 D	25cm *10"* 4 D	32cm *12.5"* 3.2 D	40cm *16"* 2.5 D	50cm *20"* 2 D		100cm *40"* 1 D	
3.2p *N=3.2*	**0.4 M**	55 *1/8*	60 *1/6.3*	65 *1/5*	70 *1/4*	75 *1/3.2*	80 *1/2.5*	85 *1/2*	90 *1/1.6*	95 *1/1.25*	100 *1/1*	105 *1/0.8*		**120** ***1/0.4***	Above
4p *N=4*	**0.5 M**	50 *1/10*	55 *1/8*	60 *1/6.3*	65 *1/5*	70 *1/4*	75 *1/3.2*	80 *1/2.5*	85 *1/2*	90 *1/1.6*	95 *1/1.25*	100 *1/1*		**115** ***1/0.5***	
5p *N=5*	**0.63M**	45 *1/12.5*	50 *1/10*	55 *1/8*	60 *1/6.3*	65 *1/5*	70 *1/4*	75 *1/3.2*	80 *1/2.5*	85 *1/2*	90 *1/1.6*	95 *1/1.25*		**110** ***1/0.63***	Normal range
63p *N=63*	**0.8 M**	40 *1/16*	45 *1/12.5*	50 *1/10*	55 *1/8*	60 *1/6.3*	65 *1/5*	70 *1/4*	75 *1/3.2*	80 *1/2.5*	85 *1/2*	90 *1/1.6*		**105** ***1/0.8***	
8p *N=8*	**1 M**	**35** ***1/20***	**40** ***1/16***	**45** ***1/12.5***	**50** ***1/10***	**55** ***1/8***	**60** ***1/6.3***	**65** ***1/5***	**70** ***1/4***	**75** ***1/3.2***	**80** ***1/2.5***	**85** ***1/2***		**100** ***1/1***	
10p *N=10*	**1.25M**	30 *1/25*	35 *1/20*	40 *1/16*	45 *1/12.5*	50 *1/10*	55 *1/8*	60 *1/6.3*	65 *1/5*	70 *1/4*	75 *1/3.2*	80 *1/2.5*		**95** ***1/1.25***	
12p *N=12*	**1.6 M**	25 *1/32*	30 *1/25*	35 *1/20*	40 *1/16*	45 *1/12.5*	50 *1/10*	55 *1/8*	60 *1/6.3*	65 *1/5*	70 *1/4*	75 *1/3.2*		**90** ***1/1.6***	Near-normal
16p *N=16*	**2 M**	20 *1/40*	25 *1/32*	30 *1/25*	35 *1/20*	40 *1/16*	45 *1/12.5*	50 *1/10*	55 *1/8*	60 *1/6.3*	65 *1/5*	70 *1/4*		**85** ***1/2***	
20p *N=20*	**2.5 M**	15 *1/50*	20 *1/40*	25 *1/32*	30 *1/25*	35 *1/20*	40 *1/16*	45 *1/12.5*	50 *1/10*	55 *1/8*	60 *1/6.3*	65 *1/5*		**80** ***1/2.5***	
25p *N=25*	**3.2 M**	10 *1/63*	15 *1/50*	20 *1/40*	25 *1/32*	30 *1/25*	35 *1/20*	40 *1/16*	45 *1/12.5*	50 *1/10*	55 *1/8*	60 *1/6.3*		**75** ***1/3.2***	
32p *N=32*	**4 M**	5 *1/80*	10 *1/63*	15 *1/50*	20 *1/40*	25 *1/32*	30 *1/25*	35 *1/20*	40 *1/16*	45 *1/12.5*	50 *1/10*	55 *1/8*		**70** ***1/4***	Moderate L.V.
40p *N=40*	**5 M**	0 *1/100*	5 *1/80*	10 *1/63*	15 *1/50*	20 *1/40*	25 *1/32*	30 *1/25*	35 *1/20*	40 *1/16*	45 *1/12.5*	50 *1/10*		**65** ***1/5***	
50p *N=50*	**6.3 M**	-5 *1/125*	0 *1/100*	5 *1/80*	10 *1/63*	15 *1/50*	20 *1/40*	25 *1/32*	30 *1/25*	35 *1/20*	40 *1/16*	45 *1/12.5*		**60** ***1/6.3***	
63p *N=63*	**8 M**	-10 *1/160*	-5 *1/125*	0 *1/100*	5 *1/80*	10 *1/63*	15 *1/50*	20 *1/40*	25 *1/32*	30 *1/25*	35 *1/20*	40 *1/16*		**55** ***1/8***	
80p *N=80*	**10 M**	-15 *1/200*	-10 *1/160*	-5 *1/125*	0 *1/100*	5 *1/80*	10 *1/63*	15 *1/50*	20 *1/40*	25 *1/32*	30 *1/25*	35 *1/20*		**50** ***1/10***	Low Vision
100p *N=100*	**12.5M**	-20 *1/250*	-15 *1/200*	-10 *1/160*	-5 *1/125*	0 *1/100*	5 *1/80*	10 *1/63*	15 *1/50*	20 *1/40*	25 *1/32*	30 *1/25*		**45** ***1/12.5***	
		Near-total Visual Acuity Loss							Profound Low Vision				Severe		

Instructions

To find the optimal combination of reading distance and letter size, start at the reading distance which corresponds to the subject's reading add or accommodative power. Increase the reading add (reduce the reading distance) to reach smaller print. Using this table, find the visual acuity (1-meter value) at the intersection of the letter size row and the reading distance column. *The Visual Acuity Score (large numbers) will be explained in Part 3.*

The visual acuity values demonstrate the use of the modified Snellen formula: 1/V = M x D.
If M = 1 (bold row) then 1/V = D *(also known as Kestenbaum's rule)*; if D = 1 (bold column) then 1/V = M *(same column values as in Table 2)*.

Letter sizes are best specified in **M-units** (1 M-unit = 1.454 mm = about 1/16”), the same unit as used for letter charts and distance testing.

Other letter size notations do not allow convenient comparisons to distance vision and are notorious for inconsistent implementation on various cards.

Letter sizes expressed in **Printer’s points** can vary for different typeface designs by almost one letter chart line. For average lower case print 1 M-unit equals about 8 points. The point designation does not allow a comparison with distance vision. In Britain the notation N = … is used to refer to printer’s points.

Jaeger numbers refer to the labels on the boxes in the printing house in Vienna where Jaeger selected his print samples. They have no numerical value and cannot be used to calculate a visual acuity value.

The **distance equivalents**, listed on many cards, cannot be used to indicate letter sizes either. The diagonal bands in Table 3 demonstrate that the same acuity value can apply to many different letter sizes, depending on the viewing distance. Distance equivalents are valid only if the card is used at the designated distance. They are utterly confusing for testing done at any other distance.

Correction of refractive error

Whenever visual acuity is tested, care should be taken that the patient’s **refractive correction** is appropriate for the testing distance. This is especially true for the short reading distances often used for Low Vision subjects.

When visual acuity is mentioned without further specification, it is usually assumed that it has been measured with the optimal refractive correction; this is referred to as “best corrected” acuity.

Measuring the reading distance in diopters has the advantage of easy comparison to the reading addition. Diopter rulers are part of any phoropter and are also available separately.

Near acuity vs. Distance acuity (Reading vs. Letter Chart Acuity)

Distance acuity is usually measured with a letter chart. Near acuity may be measured with a reduced size letter chart or with continuous text. When the objective is to obtain an estimate of retinal function, the use of a reduced letter chart is acceptable. When the objective is the assessment of functional vision – as is the assumption for this GUIDE – continuous text reading should be tested. Because of this difference, it is clearer to specify **letter chart acuity** and **reading acuity**, rather than just distance acuity and near acuity.

Under most circumstances letter acuity and reading acuity – if measured appropriately and with the proper refractive correction – will be similar. However, when measuring letter acuity, subjects are usually pushed for threshold or marginal performance, whereas reading tests may aim at a level of comfortable performance. For this reason, the magnification requirement for reading acuity may be somewhat greater than that for letter acuity. The difference is known as the “magnification reserve”, needed for reading fluency.

If significant differences between reading acuity and letter chart acuity exist, measurement errors, inappropriate refractive correction and/or other complicating factors must be suspected. The nature of these factors needs to be explored. One cause might be that the subject uses a small central island within a ring scotoma for letter acuity, while using a larger, more eccentric area for reading.

PART 4 of this GUIDE will discuss how letter chart acuity and reading acuity ratings can be combined. If no separate measurements for reading acuity are available, reading acuity should be assumed to be the same as letter chart acuity.

Monocular vs. Binocular Acuity

For a functional evaluation, visual acuity should be measured for each eye separately as well as binocularly, since binocular viewing represents the most common viewing condition in daily life.

Under most circumstance, best-corrected visual acuity measured binocularly will be determined by the acuity of the better eye. There are exceptions, however. Patients with latent nystagmus may have better eye stability and hence better acuity when viewing binocularly than when one eye is occluded. Some patients with diplopia or with distortions in one eye may see better when the poorer eye is occluded.

Realistic Conditions

The evaluation of visual functions should be based on the function obtained under optimal conditions. An exception can be made, however, when the best possible conditions are not feasible in daily life. Examples might include:

A patient would see better with contact lenses, but cannot tolerate contact lenses.

A patient with a large inter-ocular difference in refractive error cannot tolerate full correction of both eyes.

A patient can achieve better acuity with an extremely high or low illumination level, that cannot be achieved under daily living conditions or in the workplace.

Under these and similar conditions, the evaluation should be based on the measurements obtained under realistic daily living or workplace conditions. The reason why the viewing conditions required for better performance are not feasible under daily living conditions should be documented.

Tests for young Children and for Multi-handicapped Individuals

The disability estimates in this GUIDE are based on the determination of letter chart acuity and its significance for reading and other adult, detail-oriented tasks. In these tests, objects must be recognized when surrounded by other objects. It should be recognized that recognition of single, isolated letters, as often used for young children, does not represent the same task, and can overestimate visual acuity significantly.

Testing of Grating acuity and Preferred Looking tests are further simplifications that can lead to further overestimation. When used in young, pre-verbal children with possibly incomplete visual development, further caution is warranted.

When testing multi-handicapped individuals, a further distinction must be made whether failure to perform reflects a failure to see, or a failure to respond.

VISUAL FIELD ASSESSMENT

Visual acuity measurement describes the function of one small central retinal area that has the highest resolving power. Visual field measurement, on the other hand, seeks to describe the function of the entire, central and peripheral retina and the lateral extent of vision. Visual field findings are complex since they must ideally describe the sensitivity for a variety of stimuli at each peripheral point. Even though in practice only a limited number of points is tested with a limited number of stimuli, one must bear in mind that reducing this complex array of findings to a single number – as will be done in Part 3 of this GUIDE – represents a significant over-simplification.

Various testing modes can be used. The following list is not exhaustive.

Confrontation Visual Field

This method uses only the examiner's hands. Seated in front of the subject, the examiner moves his/her hands from the periphery inward, to test for the peripheral field limits. Finger movements may be used to find gross scotomata. This method is too gross for evaluation in the context of this GUIDE, but it provides a quick way to detect significant abnormalities that may effect the subject's mobility.

Tangent Screen Testing

This method uses a black screen on which variously sized objects may be moved. Prior to the advent of standardized testing equipment, this was the most objective way of visual field testing. The original definition of "legal blindness" in the U.S.A. was based on the use of a 1 cm white object, presented at 1 meter. The problems of this method are that it is hard to standardize the illumination level and that the actual testing distance increases as the target moves towards the periphery. Beyond 45° the measurements loose accuracy.

Goldmann-type testing

The Goldmann visual field equipment provided the first standardized measurement technique. For many decades it was considered the "gold standard". Testing is done in a bowl, so that all testing distances are equal while the background and stimulus luminances can be tightly controlled. The usual mode of testing is known as **kinetic perimetry**, since a test stimulus of constant size and intensity is moved by an operator. The use of an operator introduces the potential for operator bias, but has the advantage that certain areas of interest can be explored in more detail.

The test results are reported as "isopters", contour lines that outline the areas where stimuli of various intensity can be perceived. The functional implications of certain isopter patterns are relatively easy to interpret. Agencies *(such as the Social Security Administration in the U.S.A.)* often require Goldmann type testing for eligibility determinations.

Automated Perimetry

In recent decades, there has been a move from manual to automated perimetry. *(Commonly used equipment includes Humphrey, Octopus, Dicon and other brands.)* Since kinetic perimetry is not easily automated, this move has been accompanied by a move to **static perimetry**. In static perimetry (which is possible, but quite laborious in the manual mode), the stimulus size and intensity are varied, while presentation is limited to various fixed locations. The sensitivity found in each point can be presented in a matrix of numbers, or as a gray scale pattern with interpolation for the points that were not tested.

Automated perimetry reports are better suited for automated statistical analysis, but less intuitive for human interpretation with regard to functional vision. It is possible to convert the plots to an isopter representation, but doubts have been voiced whether these are always equivalent, since the perception of moving stimuli sometimes differs from that of static stimuli (referred to as static-kinetic dissociation).

While it is possible to test up to 60° from the center, most automated clinical tests are limited to the central 30°, since this is the most interesting area for medical diagnostic purposes. For the functional assessment of visual field loss, however, testing to 60° or beyond is necessary.

Macular Perimetry

The advent of the Scanning Laser Ophthalmoscope (SLO) has made it possible to present stimuli under direct control of the macular image. This type of testing has provided important information about the effects of para-foveal scotomata and about the use of eccentric viewing in patients with macular degeneration or macular scars. By itself it is not sufficient for a functional field evaluation, since it does not test peripheral vision.

Monocular vs. Binocular fields

Since intact visual field areas in one eye may compensate for field loss in the other eye, the binocular field of view may be substantially better than the field of view of either eye alone. Therefore, considering both monocular and binocular function is even more important for a functional assessment of the field of vision than it is for visual acuity.

Direct testing of the binocular visual field presents problems, however. Binocular testing of the central field might be possible on a tangent screen at 1 m or 2 m. Binocular testing of the peripheral visual field in the standard bowl perimeter is not possible, since the fixation monitoring devices will not work when the head, rather than the eye, is centered. Secondly, the small bowl diameter would require a significant amount of convergence. This convergence may not occur in the absence of fusional landmarks other than the single central fixation mark and cannot be monitored.

For the purposes of this GUIDE, it is recommended that the fields of each eye are measured separately and that an estimate of the binocular visual field is derived from the superimposition of the two monocular field plots.

PART 3 – ESTIMATING FUNCTIONAL VISION BY CALCULATING ABILITY ESTIMATES

THE USE OF ABILITY ESTIMATES

A true assessment of functional vision should be based on direct observation of how well various vision-related activities can be preformed. Unfortunately, there is no consensus, as yet, about which activities should be assessed and how they should be scored.

For administrative purposes (such as the assignment of disability benefits) it is often desirable to reduce the complexity of a full assessment to a single number that provides a global estimate of the resulting visual ability.

This part of the GUIDE will discuss how such estimates can be made. It will discuss:

- The development of a **General Ability Scale**.
- Using this scale to derive a **Functional Acuity Score** and a **Functional Field Score.**
- Combining the scores from each eye to derive the **Functional Vision Score** as a global visual ability estimate for the person.
- Making individual adjustments, if needed, for significant factors that are not reflected in the above calculations.

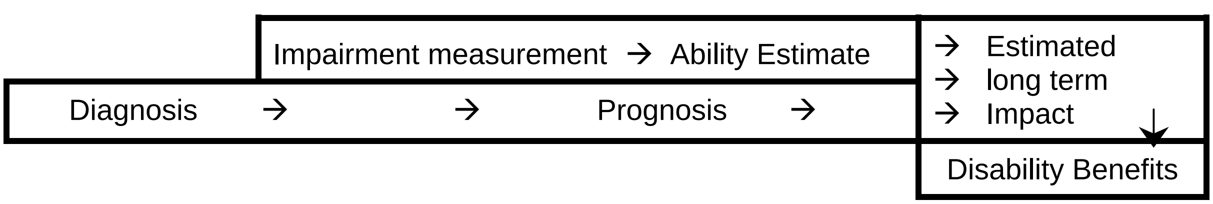
In parallel with these calculations, the **diagnosis** and **prognosis** of the condition should be reported. This involves medical judgements, which are beyond the scope of this GUIDE.

The next step may involve using the above information to establish **Disability Benefits.** This is an administrative step, which is also beyond the scope of this GUIDE.

It should be recognized that ability estimates necessarily represent an **over-simplification**. They cannot be used to assess the actual need for rehabilitative services.

TABLE 4 – USE OF ABILITY ESTIMATES

THE ORGAN		THE PERSON	
Structural change, Anatomical change	Functional change at the Organ level	Skills, Abilities of the individual	Social, Economic Consequences



A GENERAL ABILITY SCALE

For the assessment of functional vision, scales are needed on which the ability to perform various activities can be expressed and compared. Since different functions are measured in different units, such scales cannot be based on any one type of measurement units.

A generalized **ability scale** that can be applied across various visual and non-visual activities can be created as a **point scale** on which **0 points** indicates the absence of any ability to perform, while **100 points** indicates normal or standard performance. Such a scale is sometimes referred to as a "percentage" scale. It should be clear, however, that the point score in itself is an abstract concept that has no direct mathematical relationship to any particular measurement unit or to percentages thereof. E.g.: a point value of "50" for a certain visual acuity loss or a certain visual field loss does not imply that half of all vision is lost. Neither is the point scale capped at “100” as a percentage scale would be. The point scale can and does extend beyond 100 to indicate better than standard performance.

The ability scale must be divided into ranges, as was done for the visual acuity and visual field scales in PART 2. The number of ranges should be practical; two ranges *(E.g. ‘can do’ vs. ‘can’t do’)* would be too simplistic, while a dozen ranges would make the scale too cumbersome.
To develop a set of ability ranges, one may consider:

- whether performance of the task is near-normal, restricted, or impossible,
- whether performance requires the use of certain adaptive aids or devices,
- whether the emphasis is on aids that enhance the residual function, or on aids and techniques that substitute another function for the impaired function.

These considerations result in the set of ranges indicated in **Table 5**. These ranges can be conveniently converted to a 100-point scale by assigning 20 points to each range.

These ranges are the basis for the ranges of vision loss in this GUIDE and in ICD-9-CM.

TABLE 5 – GENERAL ABILITY RANGES

RANGE descriptors	PERFORMANCE / ABILITY RANGES		**POINT SCORE**	TYPE of AIDS for REHABILITATION
Above normal	*Exceptional ability*		*>100*	
Normal	Normal or Near-normal performance	Has reserves	**100** ± 10	No aids required
Mild loss		Lost reserves	**80** ± 10	↓
Moderate Loss		Needs aids	**60** ± 10	Enhancement aids
Severe Loss	Restricted performance	Restricted with aids	**40** ± 10	Enhancement aids
Profound Loss		Marginal with aids	**20** ± 10	↓
(Near-)total Loss		(Near-)impossible	**0** – 10	Substitution aids

If smaller numbers are preferred, the ability scale can be used as a 10-point scale (see Table 12).
If a scale of ability loss (disability) is preferred, the above scale values can be subtracted from 100.

Ability scale:	0	10	20	30	40	50	60	70	80	90	100	110	120
Disability scale:	*100*	*90*	*80*	*70*	*60*	*50*	*40*	*30*	*20*	*10*	*0*	*///////////////////*	

Note that a disability scale cannot deal with performance that exceeds the standard.

These ranges can be applied to any ability, as is demonstrated in the following discussion with examples from the mobility and locomotion domain.

Exceptional Performance
Some individuals have exceptional abilities.
E.g.: the person is an Olympic runner.

Range of Normal Performance
Most human functions have a reserve capacity;
E.g.: the person can run and walk.

Mild Ability Loss
In this range the reserve is lost, but everyday performance is not yet significantly compromised.
E.g.: the person can walk, but not run.

Moderate Ability Loss
In this range the disabling effect can still be overcome with appropriate performance enhancing aids.

E.g.: the person needs the support of a cane.

Severe Ability Loss
In this range performance is below normal and endurance is limited, even with assistive devices.

E.g.: the person can move with a walker.

Substitution skills may be used as an adjunct.

E.g.: the person sometimes uses a wheelchair.

Profound Ability Loss
In this range, the options for enhancement are limited. Performance must rely equally on substitution skills.

E.g.: the person can still move actively by using a wheelchair, substituting arm power for leg power.

Near-total or Total Inability
In this range, the person must rely on substitution skills while the original skills, if any, are unreliable and may at most serve as an adjunct.

E.g.: the person must be wheeled around.

VISUAL ACUITY SCORES

The internationally accepted standard for visual acuity charts requires a chart with proportionally spaced lines in a geometric progression (10 steps = 10x) and 5 letters on each line. This layout was introduced by Bailey and Lovie and popularized through its use in the Clinical Trials of the National Eye Institute. These charts are often referred to as ETDRS charts (Early Treatment Diabetic Retinopathy Study).

When using such a chart, it is simple to score the visual acuity level as the total number of letters read. This scoring method assigns five points to each line. If counting is started at the 0.01 (20/2000) level, the score for standard visual acuity (1.0, 20/20) will be 100. The score can be continued beyond that level to account for better than standard performance. In this GUIDE this scale is referred to as the **Visual Acuity Score** (VAS) for each eye. This score was included in **Tables 2** and **3** and is repeated in **Table 6**.

The performance of individuals in each visual acuity range may vary, based on training and practice. Indeed, no rehabilitation would be possible if the connection between impairment and ability were unalterably fixed. Nevertheless, some general statements can be made about reading performance expected in each visual acuity range. The right side of **Table 6** demonstrates that these expectations fit well with the General Ability Scale, outlined earlier. The Visual Acuity Score, therefore is a reasonable estimate of acuity related visual abilities.

VISUAL FIELD SCORES

The **Visual Field Scores** (VFS) used for this GUIDE have been designed to closely parallel the Visual Acuity Scores (VAS). Significant considerations include the following:

- Traditionally, visual acuity loss to 0.1 (20/200) has been considered equally disabling as a visual field loss to a 10° radius. Since the visual acuity score for 0.1 (20/200) is 50 points, the visual field score for the central 10° is also 50 points. This fits well with the finding that this area corresponds to about 50% of the primary visual cortex.
- ICD-9 and ICD-9-CM define Severe, Profound and Near-total visual field loss as concentric restriction to a 10°, 5° and 2.5° field radius. These categories fit the VFS scale.
- A complete hemianopia receives a 50 point score. This implies that it is considered equally disabling as a field restriction to a 10° radius or a visual acuity loss to 0.1 (20/200).
- Inferior field loss is considered more disabling than superior field loss. Accordingly, the lower field receives 50% more weight than the upper field.

The right side of **Table 6** provides estimates of Orientation and Mobility skills. These fit well with the General Ability Scale, outlined earlier. The Visual Field Score, therefore is a reasonable estimate of the field related visual abilities.

The VFS scale is implemented by drawing **10 meridians** and assigning **10 points** to each meridian. <u>Two</u> meridians are drawn in each of the upper quadrants and <u>three</u> in each of the lower quadrants. By avoiding the vertical and horizontal meridians the need for special rules for hemianopias is avoided. See **Table 8.**

TABLE 6 – THE VISUAL ACUITY SCORE (VAS)

ICD-9-CM RANGES WHO / ICO CLASSIFICATION		EQUIVALENT NOTATIONS Decimal	EQUIVALENT NOTATIONS US	VISUAL ACUITY SCORE	Letter recognition can read 1 M print at	ESTIMATED READING ABILITY
(Near-) Normal Vision	Range of Normal Vision	1.6 1.25 1.0 0.8	20/125 20/16 20/20 20/25	110 105 100 95	160 cm 125 cm 100 cm 80 cm	Normal reading speed Normal reading distance *Reserve capacity for small print*
	Near-Normal Vision	0.63 0.5 0.4 0.32	20/32 20/40 20/50 20/63	90 85 80 75	63 cm 50 cm 40 cm 32 cm	Normal reading speed Reduced reading distance *No reserve for small print*
Low Vision	Moderate Low Vision	0.25 0.20 0.16 0.125	20/80 20/100 20/125 20/160	70 65 60 55	25 cm 20 cm 16 cm 12 cm	Near-normal with reading aids *Uses low power magnifier or large print books*
	Severe Low Vision	0.10 0.08 0.06 0.05	20/200 20/250 20/320 20/400	50 45 40 35	10 cm 8 cm 6 cm 5 cm	Slower than normal with reading aids *Uses high power magnifiers*
	Profound Low Vision	0.04 0.03 0.025 0.02	20/500 20/630 20/800 20/1000	30 25 20 15	4 cm 3 cm 2.5 cm 2 cm	Marginal with reading aids *Uses magnifiers for spot reading, but may prefer talking books*
(Near-) Blindness	Near-Blindness	0.016 0.0125 0.01 ---	20/1250 20/1600 20/2000 ---	10 5 0 --	1.6 cm 1.25 cm 1 cm --	No visual reading *Must rely on talking books, Braille or other non-visual sources*
	Total Blindness	No light perception				

TABLE 7 – CALCULATING the FUNCTIONAL ACUITY SCORE for the PERSON

	Snellen values		**Visual Acuity scores**		
OD:	letter chart acuity: ___	→	VAS_{OD}: ___	x1 =	___
OS:	letter chart acuity: ___	→	VAS_{OS}: ___	x1 =	___
OU:	letter chart acuity: ___	→	VAS_{OU}: ___	**x3** =	___

Add and divide by 4, the resulting value -------------- +, **/5**

is the **Functional Acuity Score** (FAS) = ___

Optionally, calculate a Visual Acuity Score for reading acuity (either monocular or binocular, depending on which is more effective). If the outcome is significantly different from the letter chart acuity score, document the differences and calculate the average:

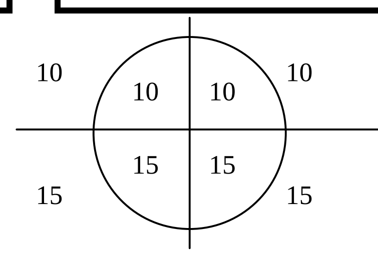
$$\mathbf{FAS_{global} = (FAS_{letter\ chart} + FAS_{reading}) / 2}$$

TABLE 8 – THE VISUAL FIELD SCORE (VFS)

ICD-9-CM RANGES WHO / ICO CLASSIFICATION		Special conditions	Average radius (if loss is concentric)	VISUAL FIELD SCORE	ESTIMATED ABILITY for Visual Orientation and Mobility ("O+M") Tasks
(Near-) Normal Vision	Range of Normal Vision		60°	110 105 100 95	Normal Visual Orientation Normal Mobility skills
	Near-Normal Vision	Loss of one eye	50° 40°	90 85 80 75	Normal "O+M" performance Needs more scanning *Occasionally surprised by events on the side*
Low Vision	Moderate Low Vision	Lost upper field	30° 20°	70 65 60 55	Near-normal performance *Requires scanning for obstacles*
	Severe Low Vision	Hemianopia Lost lower field	10° 8°	50 45 40 35	Visual mobility is slower than normal *Requires continuous scanning* *May use cane as adjunct for detection*
	Profound Low Vision		6° 4°	30 25 20 15	Must use long cane for detection of obstacles *May use vision as adjunct for identification*
(Near-) Blindness	Near-Blindness		2°	10 5 0	Visual orientation unreliable *Must rely on long cane, hearing, guide dog, other blind mobility skills*
	Total Blindness	No visual field			

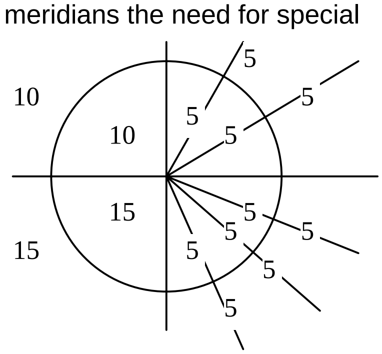
The following diagram summarizes the point assignments:

- the central 10° represent 50 points
- the left and right hemi-fields represent 50 points each
- the lower field half represents 60 points
- the upper field half represents 40 points



To calculate the exact point score, **10 meridians** are drawn: two in each of the upper quadrants and three in each of the lower quadrants. By avoiding the vertical and horizontal meridians the need for special rules for hemianopias is avoided.

Along each meridian, points are assigned:
1 point per 2° up to a 10° radius,
1 point per 10° beyond a 10° radius.
Thus, a 60° radius will represent 10 points.
The nasal meridians may not reach 60°,
but the lateral field will extend further.
Thus, the average normal field will score about 100 points.



CALCULATION RULES for the FUNCTIONAL ACUITY SCORE

Ideally, best-corrected **letter chart** acuity should be determined for binocular vision (OU) and for the right eye (OD) and left eye (OS) separately. Various agencies may require this as a minimum.

All measurements should be made using the best available refractive correction.

Visual acuity measurement should not be truncated at the 1.0 (20/20) level. It has been reported that up to age 50 most healthy eyes have acuities in the range of 1.5 – 1.25 (20/12 – 20/15), up to age 75 most healthy eyes are in the 1.25 – 1.0 (20/15 – 20/20) range. This is why the VAS is not truncated at 100 and the ICD-9-CM ranges are not truncated at 1.0 (20/20).

If insufficient data are available – as may be the case for calculations from chart review – some assumptions may be made. Binocular acuity, if not provided, may be assumed to be equal to the acuity of the better eye. Acuity of the lesser eye, if not provided, should be considered to be equal to the acuity of the better eye.

Count fingers (CF) and Hand Motions (HM) notations should be avoided, since actual visual acuity measurements can be made with a chart at 1 meter. If no better information is available,
CF … ft should be interpreted as: … / 200,
CF … m should be interpreted as: … / 60,
HM … ft should be interpreted as: … / 1000,
HM … m should be interpreted as: … / 300.

The **Functional Acuity Score** (for the person) is the weighted average of the Visual Acuity Scores for OD, OS and OU. In this calculation the binocular score is given three times the weight of the monocular scores. See **Table 7.**

Determination of **reading acuity** is optional. If binocular reading is possible, this value should be used. If binocular reading is not possible the reading acuity score of the eye that is preferred for actual reading must be used. The global acuity score will be the average of the letter chart acuity score and the reading acuity score. *(See Table 7)*

If reading acuity is significantly worse than letter acuity, the probable reason should be explained.

In summary:

1. Determine the best corrected **letter chart acuity** (distance acuity) for OD, for OS and for OU. Use Table 2 or Table 6 to determine the corresponding Visual Acuity Scores. Calculate the person's **Functional Acuity Score** as a weighted average:

$$FAS = (3x\ VAS_{OU} + VAS_{OD} + VAS_{OS}) / 5$$

2. If a reliable **reading acuity** value is available, determine the corresponding Visual Acuity Score, using Table 3. The reading acuity score may be a monocular or a binocular score, depending on the subject's preference for actual reading.

3. If the reading acuity score differs significantly from the letter acuity score, adjust the Functional Acuity Score (FAS) to the average of the letter acuity and reading acuity score:

$$FAS_{OD} = (FAS_{letter} + FAS_{reading}) / 2$$

Provide an explanation why reading and letter chart acuity are significantly different

CALCULATION RULES for the FUNCTIONAL FIELD SCORE

1. If Goldmann visual field plots are available, determine the **III4e isopter** for each eye.

If only automated visual field plots are available, determine a pseudo-isopter by drawing a line surrounding all points with a sensitivity of 10dB or better, excluding points with <10dB sensitivity.

2. Determine a Visual Field Score, using the pattern explained in **Table 8**. This pattern can be used in several ways.

2a **Using Paper and Pencil**

- Starting with a visual field plot of the III4e isopter (or equivalent), draw the 10 meridians (two in each upper quadrant, three in each lower quadrant) at: 25°, 65°, 115°, 155°, 195°, 225°, 255°, 285°, 315°, 345°.
- Determine the extent of each meridian. Convert the extent to a sub-score, using the values in Table 9.
- Add the ten sub-scores to obtain the **Visual Field Score** (VFS) for that eye.

2b **Using an Overlay Grid**

- Create an Overlay Grid with the 10 meridians and grid points on each meridian at:

1°, 3°, 5°, 7°, 9°, 15°, 25°, 35°, 45°, 55°, 65°, 75°, 85°

- Place the overlay grid over the field plot. Count the grid points enclosed by the III4e isopter; this is the **Visual Field Score** (VFS).

This procedure is recommended when there are scotomata (areas where the stimulus is not seen) within the III4e isopter. Grid points within scotomata should not be counted

3. Repeat this procedure for the other eye.
4. Create a representation of the **binocular field of view**, by superimposing the visual fields for the right and the left eye. Count the points that are seen by either eye. This will eliminate deficits that exist in one eye only, leaving only deficits that exist in both eyes. *(See page 23 for examples.)*
5. Calculate the Visual Field Score for the Binocular Field of View as indicated in step 2.
6. Combine Visual Field Scores for OD, OS and for OU to obtain the **Functional Field Score** (FFS) for the person, using the formula:

$$FFS = (3x\ VFS_{OU} + VFS_{OD} + VFS_{OS}) / 5$$

ADDITIONAL CONSIDERATIONS

The ten meridians should be evenly spaced within each quadrant. This can be achieved by using the meridians at: 25°, 65° (upper right quadrant), 115°, 155° (upper left), 195°, 225°, 255° (lower left), 285°, 315°, 345° (lower right).

If automated field plots are used, these should be full-field plots (Humprey 60-2, or equivalent). Only if confrontation testing has determined that there are no peripheral islands of vision and if a 30° central field plot (Humprey 30-2, or equivalent) shows that there is no vision beyond 20°, then the 30° plot may be used.

FULLY AUTOMATED TESTING

A pilot study in 1992, conducted with a Humphrey Field Analyser, controlled by an IBM-PC, has shown the feasibility of a fully automated test sequence using the points of the overlay grid as stimulus positions. Such a program is presently not available commercially.

The next section will discuss how the Acuity Score and the Field Score can be combined to a global Vision Score.

TABLE 9 – CALCULATING the VISUAL FIELD SCORE

A1. Draw 10 meridians: two in each upper- and three in each lower-quadrant. Using 25°, 65° (upper right), 115°, 155° (upper left), 195°, 225°, 255° (lower left), 285°, 315°, 345° (lower right).

2. For the III4e Goldmann isopter or equivalent, assign a sub-score for each meridian:

Extent:	1-3°	3-5°	5-7°	7-9°	9-14°	15-24°	25-34°	35-44°	45-54°	55-64°	65-74°	75-84°	≥85°
Score:	1	2	3	4	5	6	7	8	9	10	11	12	13

3. If a meridian is interrupted by scotomata, reduce its sub-score as follows:

Scotoma size:	0, 1°	2, 3°	4, 5°	6, 7°	8, 9°		***if*** *inside the central 10° area*
	0-4°	5-14°	15-24°	25-34°	35-44°	45-54°	***if*** *outside the central 10° area*
Subtract:	**0**	**1**	**2**	**3**	**4**	**5**	**points**

4. Add the sub scores.

B. Alternatively, create an overlay grid with grid points on each meridian at:

1°, 3°, 5°, 7°, 9°, 15°, 25°, 35°, 45°, 55°, 65°, 75°, 85°

Count the grid points within the field.

CALCULATION RULES for the FUNCTIONAL VISION SCORE

The **Functional Vision Score** (FVS) is calculated by combining the Functional **Acuity** Score (FAS) and the Functional **Field** Score (FFS).

The Functional Vision Score represents an abstraction, which may be useful for the assignment of disability benefits. It cannot replace direct assessment of visual abilities, which is needed to assess rehabilitation needs and will be discussed in Part 4 of this GUIDE.

BASIC RULE

- **To calculate the Functional Vision Score, the Functional Acuity Score and the Functional Field Score are multiplied as if they represented percentage scores.**

Functional Vision Score = FAS x FFS

Example: If the FAS is 80 (a 20 point loss) and the FFS is 75 (a 25 point loss), the FVS is calculated as 80% x 75% = 60% (a 40 point loss).

This is the same rule as used in the AMA Guides to combine functional estimates from different organ systems.

ADDITIONAL RULES

Some additional rules are needed to avoid unrealistic calculations.

- **For the purpose of this calculation, Functional Acuity and Functional Field Scores that are >100, are treated as if they were 100.**

In other words: losses are counted only if the performance drops below the performance standard. Better than standard acuity does not compensate for a visual field loss, or vice versa.

- **If visual field data are not available and if there is no clinical reason to suspect visual field loss, the Functional Field Score may be assumed to be 100.**

In this case the Functional Vision Score is the same as the Functional Acuity score.

RULE FOR CENTRAL SCOTOMATA

The dense array of points in the central 10° area of the visual field grid means that peri-central scotomata will be counted, even if they do not affect the central acuity. This is appropriate, since SLO micro-perimetry has shown that such scotomata can interfere significantly with reading ability and with other activities of daily living.

The side effect of this arrangement is that central scotomata that do affect visual acuity might be counted twice: once through their effect on visual acuity and once through their effect on the central field. Therefore, an additional rule is needed:

- **If visual acuity is reduced, some central visual field losses will not be counted.**

If the Visual Acuity Score is:	100-90	89-80	79-70	69-60	59-50	49 or less
Ignore central field loss up to:	--	2°	4°	6°	8°	10°

In other words: for every 10 points of VAS loss, field losses in one ring of 10 grid points are ignored. This means that these points are counted as if they were seen. This adjustment is made for each eye separately.

This rule means that patients with a small island of good acuity within a peri-central scotoma will get credit for this scotoma, but that patients with a central scotoma that affects visual acuity will not get double benefits. The adjustment does not affect peripheral field losses. Thus, a patient with central loss due to Macular Degeneration and peripheral field loss due to Glaucoma will get credit for the visual acuity loss as well as for the peripheral field loss.

INDIVIDUAL ADJUSTMENTS

Although visual acuity loss and visual field loss represent significant aspects of visual impairment, they are not the only factors that can lead to a loss of functional vision. As stated in the introduction, this GUIDE does not provide detailed scales for other functions, such as:

- **Contrast Sensitivity** – the ability to perceive larger objects of poor contrast. Loss of this ability can interfere significantly with many Activities of Daily Living (ADL). It is often, but not always, associated with a loss of visual acuity.

- **Glare sensitivity** (veiling glare)**,** delayed **Glare recovery, Photophobia** (light sensitivity) and reduced or delayed Light and **Dark Adaptation** are other functions that may interfere with proper contrast perception.
- **Color vision** defects are not uncommon, but usually do not interfere significantly with Activities of Daily Living (ADL). Severe color vision defects (achromatopsia) are usually accompanied by visual acuity loss. In some vocational settings the impact of minor color vision deficiencies can be significant.
- **Binocularity, Stereopsis, Suppression, Diplopia.** These functions vary in their effect on Activities of Daily Living (ADL). Their significance often depends on the environment and on vocational demands.

For most of these functions standardized measurement techniques upon which standardized scales can be based have not yet been developed. Furthermore, their effect may be partially accounted for by a loss of visual acuity and may vary significantly according to environmental demands.

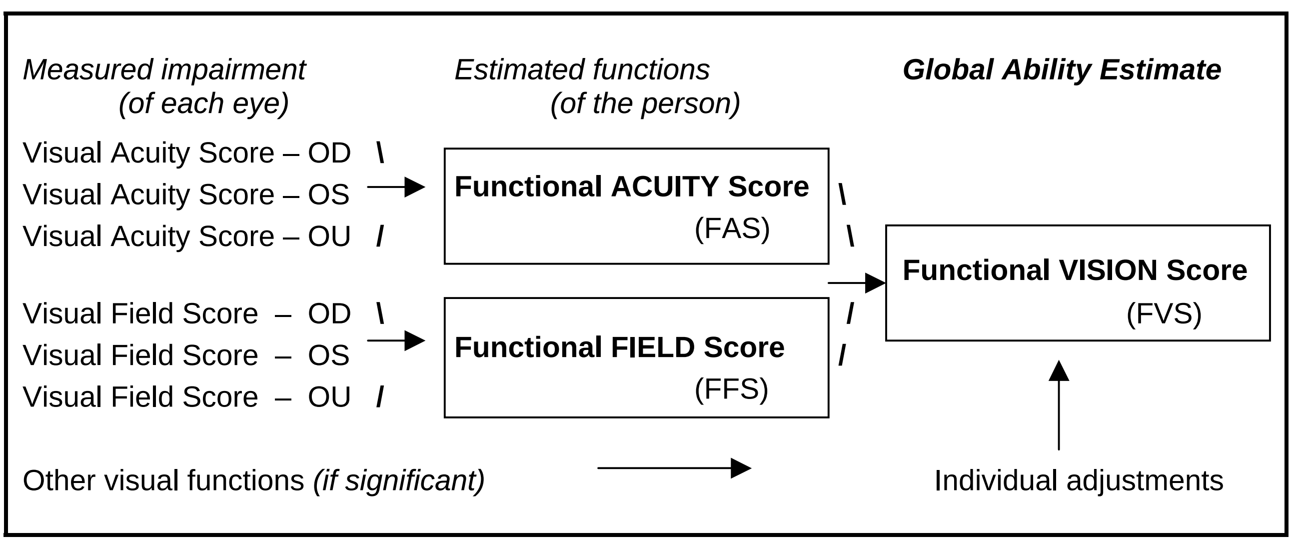
ADJUSTMENT RULES

If significant factors remain which affect functional vision and which are not accounted for through visual acuity or visual field loss, a further adjustment of the Functional Vision Score may be in order.

- **The need for the adjustment should be well documented.**
- **The adjustment should be limited to a reduction of the Functional Vision Score by at most 15 points.**

As noted under visual acuity, if clinical measurement conditions result in visual acuity values that cannot be achieved under daily living conditions, the visual acuity values achievable under daily living conditions should be used as the basis for the estimation of functional vision.

TABLE 10 – CALCULATING the FUNCTIONAL VISION SCORE



Note that the prefix "visual" refers to the function of each eye. The prefix "functional" refers to the functioning of the person. The word "vision score" combines acuity-related and field-related functions and may include an individual adjustment for additional functional losses.

CALCULATION EXAMPLES

Calculating Functional Acuity Scores

1. A patient's best-corrected acuities are:
VOD 20/50, VOS 20/100, VOU 20/50

Use Table 6 or 2 to determine the Visual Acuity Score (for each eye). Use Table 7 to combine the values to a Functional Acuity Score (for the person):

VOD	20/ 40	85 x 1 =	85
VOS	20/100	65 x 1 =	65
VOU	20/ 40	85 x 3 =	255

Functional **A**cuity **S**core 405 / 5 = **81**

This places the person in the range of <u>*near-normal*</u> *vision or mild vision loss. Note that the visual ability estimate is influenced much more by binocular function than by the function of the lesser eye.*

2. A patient's best-corrected acuities are:
VOD 20/60, VOS 20/500, VOU 20/60

Use Table 6 or 2, then Table 7, as above:

VOD	20/ 60	75 x 1 =	75
VOS	20/500	30 x 1 =	30
VOU	20/ 60	75 x 3 =	225

Functional **A**cuity **S**core: 330 / 5 = **66**

Although 20/60 is still in the near-normal range, the poor condition of the other eye drops the person to the range of <u>*moderate*</u> *vision loss. Persons in this range may receive some benefits, such as educational assistance.*

3. A patient's best-corrected acuities are:
VOD 20/250, VOS 20/200, VOU 20/200

Use Table 6 or 2, then Table 7, as above:

VOD	20/250	50 x 1 =	45
VOS	20/200	50 x 1 =	50
VOU	20/200	50 x 3 =	150

Functional **A**cuity **S**core: 245 / 5 = **49**

This person is at the upper end of the range of <u>*severe*</u> *vision loss (formerly "legal blindness" in the U.S.A.) and will hence be entitled to a broader range of disability benefits.*

4. A patient's uncorrected visual acuities are:
VOD 20/200, VOS 20/200, VOU 20/200

We cannot calculate a visual ability estimate, since the best-corrected acuity values are not available.

5. A patient's best-corrected acuities are:
VOD 20/60, VOS 20/500, VOU not avail.

We will assume that VOU equals VOD and will proceed as in example 2.

NOTE: All of the above examples assume normal peripheral visual fields in both eyes.

6. A patient lost one eye:
VOD 20/50, VOS NLP, VOU 20/50

Use Table 6 or 2, then Table 7:

VOD	20/15	105 x 1 =	105
VOS	NLP	0 x 1 =	0
VOU	20/15	105 x 3 =	315

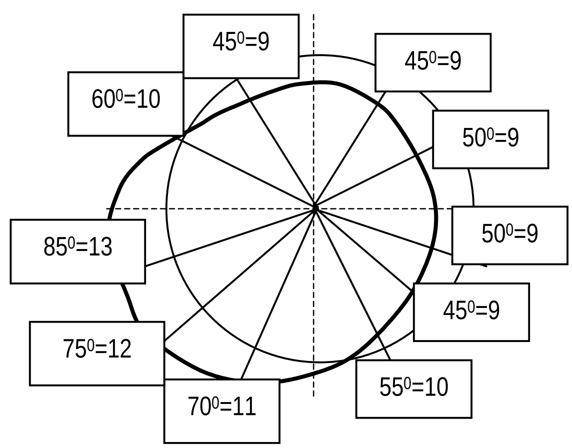
Functional **A**cuity **S**core: 420 / 5 = **84**

Based on visual acuity alone, this person is in the <u>*near-normal*</u> *range. However, since the visual field in the left eye is also lost, the* **F**unctional **V**ision **S**core *is lower, and the person drops to the range of* <u>*moderate*</u> *loss. (See example 11).*

Calculating a Visual Field Score

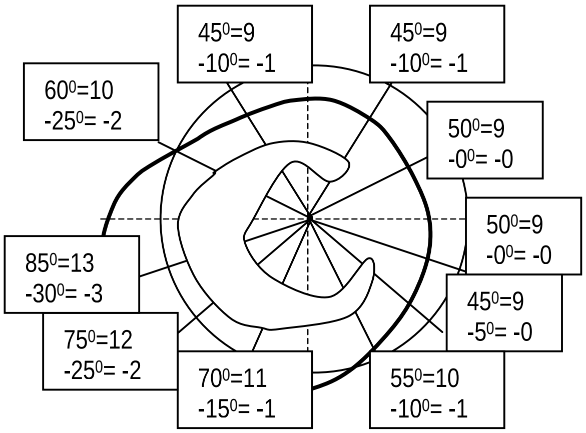
(Visual Field Scores refer to each eye.)

7. The Goldmann III4e isopter is as shown:
Draw ten meridians and measure the extent in degrees of each meridian. Use the scale in Table 9 to convert the extents to sub-scores.



Add the sub-scores: (9+9) + (9+10) + (13+12+11) + (10+9+9) = 101. The **V***isual* **F***ield* **S***core is* ***101.*** *Note that the nasal sub-scores may not reach a value of 10, but that the lateral sub-scores provide compensation.*

8. This patient has a mid-peripheral ring scotoma, due to early RP. The central field is not affected.
The diagram shows the amounts subtracted for the scotoma. (For simplicity, the peripheral score is kept the same as in example 7.)



*The **V**isual **F**ield **S**core is reduced by 11 points to **90**, which is in the near-normal range.*

9. A static field test yields the following sensitivities. *Construct a pseudo-isopter around the points with better than 10 dB sensitivity.*

			4	0	0	0			
		0	16	18	0	5	0		
	0	6	14	22	18	18	16	11	
0	0	12	21	18	24	25	20	0	0
0	0	12	14	18	28	22	22	18	16
0	0	0	0	0	23	0	0	16	18
0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	
		0	0	0	0	0	0		
			0	0	0	0			

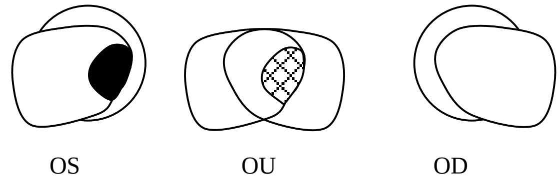
Measure the extent in the 10 meridians. If this is a Humphrey 30-2 plot, the test points are 6°apart. The sub-scores are:

	24°=7	15°=6	
17°=6			17°=6
0°=0			0°=0
0°=0	0°=0	6°=3	0°=0

*The total score is: **28**, which is in the range of <u>profound</u> loss.*

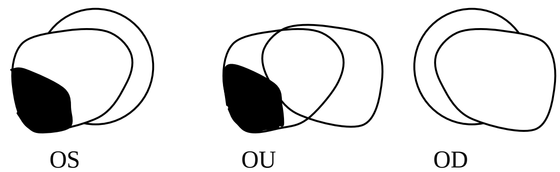
Calculating the Binocular Field

9. A patient has a <u>nasal</u> defect in one eye.



The defect has no effect on the binocular field. The Functional Field Score is affected little.

10. A patient has a <u>temporal</u> defect in one eye



The binocular field is significantly affected.

Combining Acuity and Field Scores

11. A patient lost the left eye, OD is normal.
The **F**unctional **A**cuity **S**core is **84** *(Example 6)*.

Field OD	full	100 x 1 =	100
Field OS	no field	0 x 1 =	0
Field OU	full	100 x 3 =	300
	Functional **F**ield **S**core:		400 / 5 = **80**

This would be in the <u>near-normal</u> range.

The **F**unctional **V**ision **S**core is:
FAS x FFS /100 (80 x 84) / 100 = **67**
This is in the range of <u>moderate</u> loss.

12. A patient has a peri-foveal scotoma. The fovea is spared; visual acuity is 20/20.
The grid points at 3° and 5° are missed in all 10 meridians. The Visual Field Score is: 100 – 10x2 = 80. The Visual Acuity Score = 100.
Functional **V**ision **S**core = 80 x 100 / 100 = **80**.

13. The patient in example 12 has lost the central island. Visual acuity is now 20/400.
The grid points at 1°, 3°, 5° are lost. The Visual Field Score, considered alone, is: 100 – 10x3 = 70. The Visual Acuity Score, considered alone, is: 20/400 = 35.
When considered in combination, field losses in the central 10° are ignored *(see rule for Central Scotomata, page 20)*, therefore, the Functional Vision Score equals the Acuity score: 35 x 100 / 100 = 35 *(not 35 x 70 / 100 = 24)*.

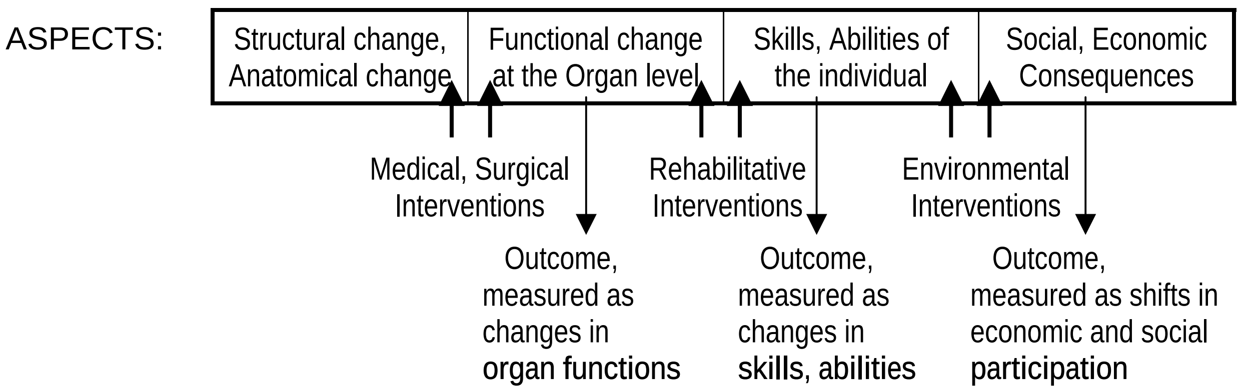
PART 4 – DIRECT ASSESSMENT OF FUNCTIONAL VISION

Part 2 of this GUIDE described how to measure various *visual functions*. Part 3 described how to calculate an *ability estimate*, based on these measurements. Such estimates, although useful for administrative purposes, are a simplification of reality. The assessment of actual rehabilitative service needs must be based on the direct assessment of *functional vision*.

Table 11 shows how different interventions affect the various aspects of vision loss *(see Table 1)*.

Measurement of visual functions can be an outcome measure for medical and surgical interventions; for rehabilitative interventions it is a starting point. To plan rehabilitative interventions and to evaluate their effectiveness, a direct assessment of the various aspects of functional vision (visual skills and visual abilities) is needed. Since there is no established consensus on these issues, this part of the GUIDE will contain only suggestions.

TABLE 11 – VARIOUS INTERVENTIONS and OUTCOME MEASURES



TERMINOLOGY

In the *International Classification of Diseases (ICD)* the WHO has provided a classification of all diseases and disorders that can affect various organ systems. In its companion publication, the *International Classification of Impairments, Disabilities and Handicaps (ICIDH)* the WHO provided a classification system for skills and abilities that a person may have or may have lost. The ICIDH aspects are used in Tables 1 and 4.

A successor to the original 1980 publication *(ICIDH-80)* is currently being prepared and is referred to as *ICIDH-2*. In the revision, an attempt is made to shift to positive, or at least neutral, terminology. These two types of terminology were compared in Table 1. It should be recognized that both groups of terms are valid and that usage should depend on the context. In ICDH-2, the term impairment is maintained, but the aspects of disability and handicap have been renamed to Activities and Participation. The introduction to ICIDH-2 repeatedly speaks about disablement, but never mentions enablement, i.e. rehabilitation.

The terminology used has an effect on the scales that are selected. On an impairment / disability scale '100' is likely to stand for total impairment / total disability. On an organ function / ability scale '100' is likely to stand for normal function / normal ability.

VISION-RELATED ACTIVITY CODES in ICIDH-2

The draft of ICIDH-2 contains a list of **activities (**including vision-related activities), that are to be combined with qualifiers on which to rate the **ability to perform** these activities.

The currently available vision-related activity codes in the ICIDH-2 draft are rather broad, scattered and not comprehensive. They seem to reflect the fact that major input for ICIDH-2 came from the fields of physical disabilities and from mental health.

a0 01 10	Seeing	things in the far distance
a0 01 20		things in the middle distance
a0 01 30		things in the near distance
a0 01 40		things in poor light
	(The cognitive activity of)	
a0 03 10	Recognizing visual input	
	Knowledge acquisition and use	
a1 09 10	through reading	
a1 09 20	through handwriting	
a1 09 30	through using a keyboard	
	Understanding communication	
a2 03 10	through visual reading	
a2 03 20	through Braille reading	
	Writing messages	
a2 07 10	by hand	
a2 07 20	on a mechanical device, computer	
a2 07 40	in Braille	
a2 08 80	other communication devices	
	Moving around	
a4 04	as a pedestrian	
a4 05	using transportation	
a4 06	as a driver	
	Using assistive devices	
a9 04 00	for personal mobility	
a9 06 00	adapted home appliances	
a9 07 00	communication devices (reading, Braille, voice, etc.)	

This list does not seem to be designed for use in vision rehabilitation settings.

It is not easy to provide a list of vision-related activities that is comprehensive, yet manageable. Many lists have been proposed, but none have gained universal acceptance. The fact that no consensus exists about a categorization of vision-related activities explains why a disability estimate based on measured visual impairment is often preferred over direct disability descriptors.

CREATING AN ACTIVITY PROFILE

To plan a rehabilitation process and to follow through on its effectiveness, it can be helpful to create an **Activity Profile** for the individual. Since vision plays a role in almost all human activities, the list of activities that may be affected by vision loss is very long. Since the list is so long, it is important to select only the most relevant items. The selection may not be the same for all individuals, but should contain enough common elements so that comparative studies of different rehabilitation plans are possible.

Once a list of vision-related activities has been selected, several items should be reported for each activity:

- The **need** for the activity.
  E.g. the need for independent Orientation and Mobility training may be low for an elderly person who cannot leave the house because of severe arthritis. The need for reading skills may be low for an illiterate client.
- The **vision-related ability** to perform the activity and to use the appropriate **vision enhancement aids.**
  The General Ability Scale in Table 5 can provide a convenient rating mechanism.
- The ability to use **vision substitution skills.**
  In the context of vision rehabilitation, it is not sufficient to limit the documentation to the visual skills that have been lost. It is equally important to assess how well these losses have been compensated for through vision substitution skills. (See Table 12.)

Highest priority in any rehabilitation plan should be given to activities that have the greatest need and the greatest potential for improvement.

Sequential ratings over time can provide a measure for the effectiveness of the rehabilitative interventions. A suggested reporting form and scales are presented in **Table 12.**

SIMPLE vs. DETAILED PROFILES

A simple, yet effective, visual ability profile is used by Lea Hyvärinen, MD.

Her model contains only four activity groups:

Visual Communication
Daily Living skills,
Orientation and Mobility and
Sustained near vision (incl. reading)

The model recognizes three performance levels:

Performs like a 'S'ighted person
Performs like a 'L'ow Vision person
Performs like a 'B'lind person.

For more detailed vision rehabilitation plans, the activities and performance levels will need to be specified in more detail. At the Vision-93 International Vision Rehabilitation conference, Colenbrander proposed a more detailed profile with ten activity groups:

Self care personal care, clothing, health care
Meals preparation, cooking, appliances, eating
Home management housework, gardening, small repairs
Reading personal, informational, recreational
Communication handwriting, typing, word processing, telephone
Financial management handling cash, checks bill paying, banking
Consumer interactions retail services, public services
Orientation, Mobility orientation, walking, driving
Leisure active, passive, social interactions
Education / Vocational blackboard, notes, tests, reading assignments,
or: specified vocational tasks.

Combined with a ten-point performance scale, this list could provide a 100-point global rating.

Other groups have devised numerous other lists. No matter which list is used, Table 12 could provide a suggested reporting form.

TABLE 12 – SUGGESTED FORM for an ABILITY PROFILE

Activity	Need for the activity	Use of visual skills	Use of non-visual skills	Comments

Performance levels could be coded based on the ranges developed in Table 5.

Ability Score	**Ability to use Vision** (with vision enhancement, as needed)	**Use of Vision Substitution**	***Overall assessment***
10	Meets needs, has reserve	Meets needs with reserve	*9 Acts like **S**ighted*
9			
8	Meets needs, lost reserve	Meets needs, no reserve	
7			*5 Acts like **L**ow Vision*
6	Meets needs with effort	Meets all needs with effort	
5			
4	Does not meet some needs	Meets many needs (not all)	
3			
2	Does not meet many needs	Meets only some needs	*1 Acts like **B**lind*
1			
0	Does not meet any needs	Meets no needs	

Alternative ICIDH-2 based List of Vision-related Activities

The following alternative list is offered, based on the major activity groups (a2 - a9) in ICIDH-2. It obviously needs further elaboration. Being tied to ICDH-2, this list might offer easier coordination with other rehabilitation fields than a list designed exclusively for vision rehabilitation.

	Examples (not exhaustive)
Using Vision for Communication (a2)	
reading	print, handwriting, images
writing	handwriting, keyboard use
body language, eye contact	
sign language	
Using Vision for Movement activities (a3)	manipulating objects, fine hand movements
Using Vision for Moving around (a4)	(Orientation and Mobility)
pedestrian mobility	
using public transportation	
using private transportation	
Using Vision for Daily Living Skills (a5)	
self care	body care, eating, dressing
Using Vision for Domestic activities (a6)	shopping, laundry, meals
Using Vision for Interpersonal Behaviors (a7)	social skills
Using Vision for Dealing with Particular Situations (a8)	environment, job, school
Using Vision Enhancement devices (a9)	magnification, lighting, contrast

In the current ICIDH-2 beta version, two qualifiers are provided to rate performance: DIFFICULTY *(0-no difficulty, 1-slight, 2-moderate, 3-severe difficulty, 4-inability)* and ASSISTANCE *(0-no assistance used, 1-non-personal assistance (devices), 2-personal assistance (helpers), 3-personal and non-personal assistance)*.
The qualifiers may be used in pairs. E.g.:
.30 = severe difficulty without assistance;
.21 = moderate difficulty with devices, and
.12 = slight difficulty with a helper.
In the scales used in Tables 5 and 12, the need for assistance at the lower performance levels is implied.

PARTICIPATION (formerly Handicap)

The fourth aspect of vision loss refers to the social and economic consequences for the individual.

The National Eye Institute has developed a **Visual Function Questionnaire** (VFQ) with 50 or 25 items to assess Quality of Life issues in the context of clinical trials.

ICIDH-80 recognized the following "Survival Roles":

1 Orientation
2 Physical
3 Mobility
4 Occupation
5 Social integration
6 Economic self-sufficiency

The ICIDH-2 draft lists the following main groups of "Participation" (with many sub-groups):

p0 Participation in Personal Maintenance
p1 Participation in Mobility
p2 Participation in Exchange of Information
p3 Participation in Relationships
p4 Participation in Education, Work, Leisure, Spirituality
p5 Participation in Economic Life
p6 Participation in Civic and Community Life

In general, vision loss will affect most of the listed categories. Whether one category is more significantly affected than another, may depend on personal and societal expectations and on the adaptability of the individual and the environment. The presence of multiple problems may complicate the picture, as it often does in multi-handicapped children and in the elderly.

The ICIDH-2 draft describes the following levels of Participation.

		<u>*Compare Table 10*</u>
1 -	Full participation	*8, 10*
2 -	'At risk' participation *(i.e. participation would be restricted without facilitators)*	*6*
3 -	Participation with restrictions	*2, 4*
4 -	No participation	*0*

A further elaboration on the Participation aspect is beyond the current scope of this GUIDE.

PART 5 – DISCUSSION and BACKGROUND

COMPARISON TO THE AMA GUIDES

In the U.S.A. the most widely used system for calculating disability estimates is found in the *Guides for the Evaluation of Permanent Impairment* published by the American Medical Association (AMA). This GUIDE aims at maintaining continuity with the useful aspects of the *AMA Guides*, while correcting its deficiencies with regard to vision. The 5th edition of the *AMA Guides* (expected in 2000) is expected to conform to the scales in this GUIDE.

GENERAL ABILITY SCALE

The AMA "visual efficiency" scale (still used in the 4th edition) is one of the oldest examples of an impairment and disability rating. It is based on an employability study by Snell in 1925. Snell's scale placed 20/200 at "20%", reflecting an 80% loss of employability in 1925.

Snell's visual efficiency scale reflects the thinking of a time when children with Low Vision were often placed in Schools for the "Blind", where they were blindfolded, told to disregard their remaining vision and taught blind skills. Today, the emphasis has shifted to the rehabilitation of remaining vision. Children with Low Vision are mainstreamed and encouraged to use whatever vision they have. Accordingly, there is a need for differentiation in the ranges of Severe and Profound Low Vision. Snell's scale, with only 20 points between 20/200 and total blindness, does not allow much differentiation in this range. The scale, proposed in this GUIDE, places 20/200 at "50", providing as much room for differentiation above as below the 20/200 level.

The 4th edition of the *AMA Guides* does not provide an explicit guideline for the assignment of loss levels across organ systems. However, when such a comparison was made, the General Ability Scale, proposed in this GUIDE *(see Table 5)*, was found to fit better with the AMA scales for most other organ systems, than did the visual efficiency scale. This is important when losses for different organ systems are to be combined.

It should also be noted that the AMA scales are presented on the basis of *ability-lost*, although the calculations are based on the *ability-retained*. This necessitates the use of imposing tables that hide the underlying logic. Since the advent of pocket calculators, the use of a formula based on the *ability-retained* is simpler and easier to understand.

VISUAL ACUITY SCALES

Snell devised a mathematical formula that would fit his visual acuity findings. Later revisions replaced Snell's formula with arbitrary numbers. In 1958 a scale for near vision was added that is incompatible with the scale for distance vision.

Using the distance scale, a drop of visual acuity to 20/200 is needed to qualify for "legal blindness" benefits (20% visual efficiency), but using the near vision scale a drop to 20/90 already qualifies.

The 4th edition of the AMA scales assigns a significant extra loss for "unilateral aphakia". This was justified when unilateral aphakia posed significant problems of aniseikonia (different image sizes in the two eyes). Unfortunately, this was carried over to "unilateral pseudophakia" (the presence of an implant lens), even though an important purpose of implant lenses is to avoid this aniseikonia. This leads to the anomalous situation that a patient who receives a second implant lens would be considered less disabled, even if the second implant lens did not improve the vision.

This GUIDE does not recognize the exceptions for unilateral aphakia or unilateral pseudophakia. In the rare circumstances where problems might exist, these can be handled under the "individual adjustments".

VISUAL FIELD SCALES

The situation for visual field assessment in the 4th edition was even more confusing. Over the years, several alternative ways of calculating visual field scores have been added.

In the U.S.A., the common definition of "legal blindness" due to field loss is a visual field of **10° radius** (20° diameter) or less.

The "AMA formula" calculates a score by adding the extent in eight meridians and dividing by five. Using the AMA formula, a 10° scotoma in the far periphery has the same weight as a 10° scotoma next to fixation. According to this formula a field of **12.5° radius** qualifies for "legal blindness" status since (8 x 12.5) /5 = 20.

In 1967 Esterman introduced a method of visual field scoring using an overlay grid. His method gives different weights to different areas. He designed three grids, for tangent screen use, for Goldmann perimetry and for Binocular fields. The three grids are incompatible. Using the Goldmann grid, a concentric field loss to a **15° radius** qualifies for "legal blindness". Using the binocular adaptation, even a field of **20° radius** qualifies, twice the radius of the legal definition !

In the Esterman grids, scotomata within 5° from fixation (which are important for reading) are ignored, while 25% of the weight is in the Bjerrum area (which is important for glaucoma detection, but less important for functional vision). Also, the area between 70° and 80° carries more weight than the area between 60° and 70°. The Esterman grids assign the lower field twice the weight of the upper field.

Since the criterion level for "legal blindness" is at 20%, a homonymous hemianopia does not qualify for "legal blindness" status under any of the formulas. Only a loss of more than three quadrants would meet the criterion.

The **Functional Field Score** (FFS) offers a system that can be implemented with pencil and paper (like the AMA formula) or with an overlay grid (like the Esterman method). The results are the same for either implementation and conform to the standard definition of "legal blindness".

In the FFS, the central 10° field carries half of the weight, which is consistent with the fact that this area corresponds to 50% of the primary visual cortex. Since the criterion level is moved to "50", a homonymous hemianopia will now qualify for "legal blindness" status.

In the FFS, the lower field carries 50% more weight than the upper field. This seems a realistic compromise between the AMA formula where the weights are the same and the Esterman method where the lower field has double the weight of the upper field.

OTHER FACTORS

The 4th edition of the *AMA Guides* contains an extra scale for diplopia. This scale is not included in this GUIDE. It is suggested that ocular motility problems, if present and significant, be handled under the individual adjustment clause. This solution is the same as the one used for other vision problems for which no scale exists.

COMBINING VALUES

The *AMA Guides* have two ways to combine values. Similar values are averaged (as for letter chart and reading acuity). Dissimilar values are combined by multiplication (as for visual acuity and visual field). Multiplication is also used to combine values from different organ systems. These methods have also been adopted for this GUIDE.

The current *AMA Guides* combine values for right and left eye using the formula: (3x better eye + lesser eye) /4. In this GUIDE, this has been modified to (3xOU+ OD+ OS)/ 5. This change emphasizes the fact that the visual system is one system, whose normal function is binocular vision. If the binocular function is equal to the function of the better eye, there is very little change. The new formula accounts better for those situations where the binocular function is not identical to the function of the better eye. This can be particularly important for dissimilar field losses.

The current *AMA Guides* treat the two eyes as separate organs by first combining acuity loss and field loss for each eye, and then combining the two eyes. This GUIDE changes this sequence. It first calculates a combined acuity value for OD, OS and OU as well as a combined field value for OD, OS and OU. Then the acuity and field values are combined. This method gives better consideration to the interaction between the eyes.

"LEGAL BLINDNESS" (USA)

In the depression years, this term replaced the earlier, more descriptive term "Industrial Blindness". It reflects the thinking of the time that a person with 20/200 acuity or less (or with a field loss to 20° diameter or less) "might as well be blind". Today, changed societal attitudes and the Americans with Disabilities Act (ADA) have modified this picture. The term "legal blindness" should no longer be used but replaced by the term "Severe Visual Impairment", used in ICD-9-CM.

Such a change will not affect any of the benefits associated with this level of vision loss, but will be more acceptable and less stigmatizing for patients.

Use of this GUIDE will change the name of the criterion from **"20 percent"** to **"50 points"**, but will not change any eligibility rules. It will avoid the many internal inconsistencies that have crept into the current AMA Guides.

In the context of current visual acuity standards, the common definition of "Legal Blindness" as "20/200 or less" is confusing. On older charts (with no lines at the 20/125 and 20/160 level) the definition effectively was "less than 20/100". On newer charts the definition becomes "less than 20/160", as it is for "Severe Vision Loss" in ICD-9-CM. On older charts the better definition can be implemented by changing the test distance to 10 ft. where "less than 20/160" becomes "less than 10/80".

CONVERSION

When needed, the following conversion table can be used to convert the current AMA Visual Acuity ratings to Visual Acuity Score (VAS) ratings and vice versa.

The conversion is most meaningful for distance visual acuity, which is the predominant factor in the AMA ratings. The current AMA near acuity ratings are more irregular.

A conversion cannot be given for Visual Field ratings, where the current AMA Guides allow several inconsistent alternatives.

Comparison of the Visual Acuity Score (VAS) to the current AMA Visual Efficiency scales

ICD-9-CM ranges	**Visual Acuity**	**Ability scale**			**Disability Scale (loss)**		
		VAS	AMA distance values	AMA near values	100 — VAS	**AMA distance scale**	AMA near scale
Normal vision	20/20	**100**	100	100	0	**0**	0
Near-normal vision	20/30 20/50	**90** **80**	90 75	95 50	10 20	**10** **25**	5 50
Moderate Low Vision	20/80 20/125	**70** **60**	55 40	20 10	30 40	**45** **60**	85 90
Severe Low Vision	20/200 20/300	**50** **40**	20 15	2	50 60	**80** **85**	98
Profound Low Vision	20/500 20/800	**30** **20**	10 5		70 80	**90** **95**	
Near-total loss	20/1250	**10**			90		

STATISTICAL USES OF THE VISUAL ACUITY SCORE

This GUIDE describes the use of the Visual Acuity Score (FAS) as an ability estimate for individuals.

The Visual Acuity Score (FAS) can also be useful when visual acuity data are gathered on groups of people, as in clinical studies, where it is often desirable to calculate differences between visual acuity values, to calculate averages, and to plot trends.

For these purposes direct visual acuity scales are not suited, since similar numerical steps have unequal functional significance. If the numerator steps are equal, the lower steps (e.g. 0.1, 0.2, 0.3) are too big, while the upper steps (e.g. 0.9, 1.0, 1.1) are too small. The opposite is true when the denominator steps are equal; in that case the upper steps (e.g. 20/10, 20/20, 20/30, 20/40) are too big compared to lower steps with the same interval (e.g. 20/100, 20/110, 20/120). The clinical solution has long been to speak of "lines of vision loss".

The mathematically proper way to achieve equal steps is to replace the geometric progression of visual acuity values with a linear or logarithmic scale. Several such scales have been proposed and are interchangeable. Bailey and Lovie proposed the logMAR scale (log Minimal Angle of Resolution), Bailey later used the VAR (Visual Acuity Rating), the NEI uses the ETDRS scoring method.

LogMAR is a scale of vision loss: 1 logMAR unit represents 10 lines of loss. The VAS and VAR scores are identical: a 5-point loss equals 1 line. The ETDRS score is similar, but starts at a different level: ETDRS = VAS (or VAR) – 15.

Decimal:	1.0,	0.6,	0.4,	0.25,	0.16,	0.1,	…
U.S.:	20/20,	20/30,	20/50,	20/80,	20/125,	20/200,	…
VAS:	100,	90,	80,	70,	60,	50,	…
VAR:	100,	90,	80,	70,	60,	50,	…
ETDRS:	85,	75,	65,	55,	45,	35,	…
logMAR:	0,	0.2,	0,4,	0.6,	0.8,	1.0,	…

Of these scales the VAS and VAR scores appear to be most "user friendly" and best integrated with other measurement scales, as indicated in this GUIDE.

COMPARISON to ICIDH-2

The publication of ICDH-80 made an important contribution by providing a conceptual framework based on the four aspects of vision loss (or any other loss): disorder, impairment, disability and handicap. This framework has been used far more in Europe than in the U.S.A. The successor, ICIDH-2, has maintained this framework, but has changed the labels for "disability" and "handicap" to "activities" and "participation". The contents of the various sections have been rewritten completely.

The current ICIDH-2 draft reflects a strong influence from the fields of physical disability and mental health. Where scales are used, they are not ability scales, but scales of loss. The introduction repeatedly uses the term "disablement", but never mentions "enablement". This may reflect an influence of disability rights activists and a tendency to consider disability as a more or less permanent condition. The rehabilitation community, on the other hand, considers disability as a problem to be solved. In this spirit, this GUIDE uses ability scales, rather than disability scales, and promotes the terminology of ICD-9-CM, using "severe vision loss" to replace the term "legal blindness".

It is hoped that the suggestions offered in Part 4 may provide a stimulus towards the further development of uniform, standardized and useful descriptors of visual abilities.

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Test chart

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Precision Vision, 944 First Street, LaSalle, IL 61301, USA. Telefax: 1-815-223-2224.