LEA GRATINGS™ Low Contrast Grating Acuity Test

Part Number: 253400

0.5 cpcm 8.0 cpcm

10% Contrast Level

0.5 cpcm 4.0 cpcm

2.5% Contrast Level

Low contrast grating tests have been used to measure contrast sensitivity since the 1960s. These computer-controlled tests showed that the contrast sensitivity curve of visually impaired people with changes in the central visual field often differs in its structure from the norm: when the stimulus decreases in size, the slope of the curve moves to the left and the maximum value decreases dramatically (Figure 1). The central scotoma "eats up" some of the stimulus and, thus, the effective stimulus is smaller than the physical stimulus.

As seen in Figure 1, small grating stimuli often give a misleading picture of visual function at low contrast. Therefore, this LEA Low Contrast Grating Acuity Test is designed to facilitate measurements with a large grating stimulus to learn about the subject's ability to see low contrast information in the environment, and on the other hand, evaluate the function of the fixation area by using smaller stimuli. This is possible by using the test gratings at different distances. At a greater distance the test grating is seen smaller and its lines are seen thinner; i.e., there are more lines within a degree of visual angle, the frequency of the grating is perceived higher.

When assessing vision of a child or an adult for the first time, it is important to know that some individuals perceive gratings as irregular patterns and not as straight lines and, therefore, cannot define the orientation of the lines. It is also possible that the person does not perceive the finer gratings at all, which is rare but will be found in individuals with brain lesions. Therefore, it is wise to demonstrate the gratings by showing the 0.5 cpcm, 4 cpcm, and 8 cpcm gratings at 10% contrast at a close distance when beginning the test and asking how the child or adult sees the gratings. If the person answers that "the broad lines are rather regular straight lines but the other ones are not, and they wiggle", then you have made an important observation at the beginning of the test and know that the test might be difficult to the testee.

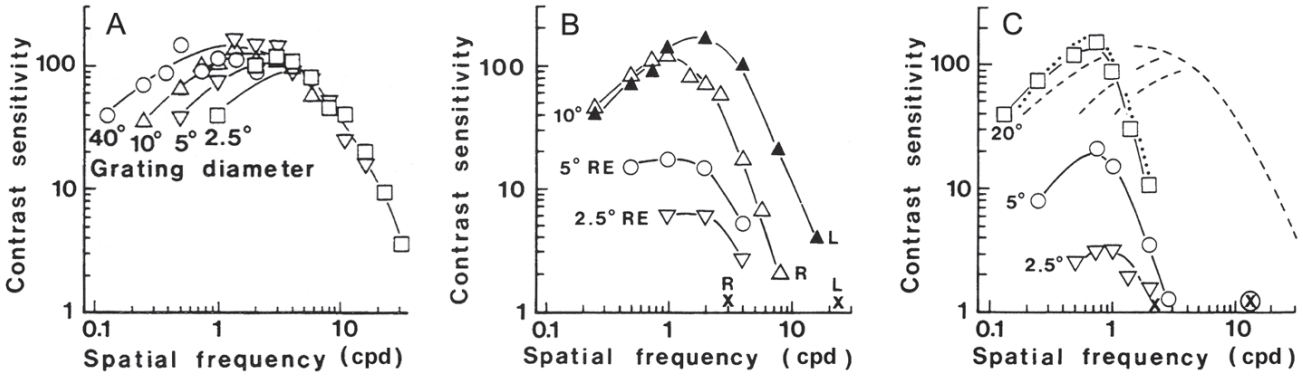

Figure 1. A. Contrast sensitivity as a function of stimulus size in normally sighted subjects: The larger the grating, the higher the contrast sensitivity values at low spatial frequencies. B. Contrast sensitivity curves in a case of macular degeneration, L = the normal left eye, R = the right eye with dry macular degeneration. Contrast sensitivity measured with 10 degree stimulus is nearly as good as in the normal left eye, whereas when measured with 5 degree stimulus, it is one fifth of the maximum value of the 10 degree curve and when measured with 2.5 degree stimulus, the maximum value is only one twentieth of the 10 degree maximum. C. Contrast sensitivity curves of a person with optic atrophy in both eyes. With the 2.5 degree stimulus, contrast sensitivity is barely measurable; yet, with the 20 degree stimulus, the values at low spatial frequencies are normal.

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Testing Procedure

If the testee has difficulties perceiving the finer gratings at 10%, show the 0.5 cpcm gratings at the lower contrast levels and ask how the broader lines are perceived. If the broad lines at low contrast are perceived as straight lines, use only the 0.5 cpcm gratings during testing.

- The measurement is easiest if you have a tape measure taped on the floor and you walk along it. Then you can check the distance every time when the person/child correctly reports the orientation of the lines.
- Children may need to train (explanation: with their therapist usually) to show the orientation of lines with their hand or using the keycard-grating. If a child's responses are irregular, it is possible that the child perceives the lines moving and, thus, their orientation is difficult to define.
- Based on your observations during the demonstration of the gratings, choose the first test grating seen at a distance longer than 120 cm (4 ft.) if the distance is within the visual and cognitive sphere of the testee.
- Move the test grating to a distance where the testee can no longer discriminate the direction/orientation of the grating lines. When testing a child, say something similar to "Now I walk a bit farther until you no longer see the lines. Do you see them now? No, then we can start."
- Bring the grating slowly closer to the testee until he can perceive the orientation of the grating.
- Use the 4 different orientations when defining the threshold distance. To turn the grating, turn the evenly grey surface toward the subject. When you show the grating, avoid turning it. Ask the testee to respond by showing the orientation of the lines with his hand or with the keycard grating. Some children can use only horizontal and vertical orientations.
- The direction of the lines should be varied randomly. However, it is wise to not show the same direction a second time immediately after the first presentation or to show the lines in a direction that the person has just used in his (wrong) answer because people tend not to repeat an answer. Therefore, the use of two presentations of the same orientation of the lines is likely to lead to a wrong answer to the second presentation.
- The threshold distance is defined when at least three out of five presentations lead to the correct response at that distance. Children may not tolerate five measurements, so we often have to be happy with 2 to 3 measurements, especially if they are at nearly the same distance.
- Record the threshold distance and the grating used.

The grating acuity value as cycles per degree (cpd) that corresponds to the distance of the threshold measurement is read on the nomogram that corresponds to the grating used (Figure 2, nomogram A, B, or C).

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Figure 2. Nomogram I. Grating acuity (cpd) as a function of testing distance.
A. 0.5 cpcm grating

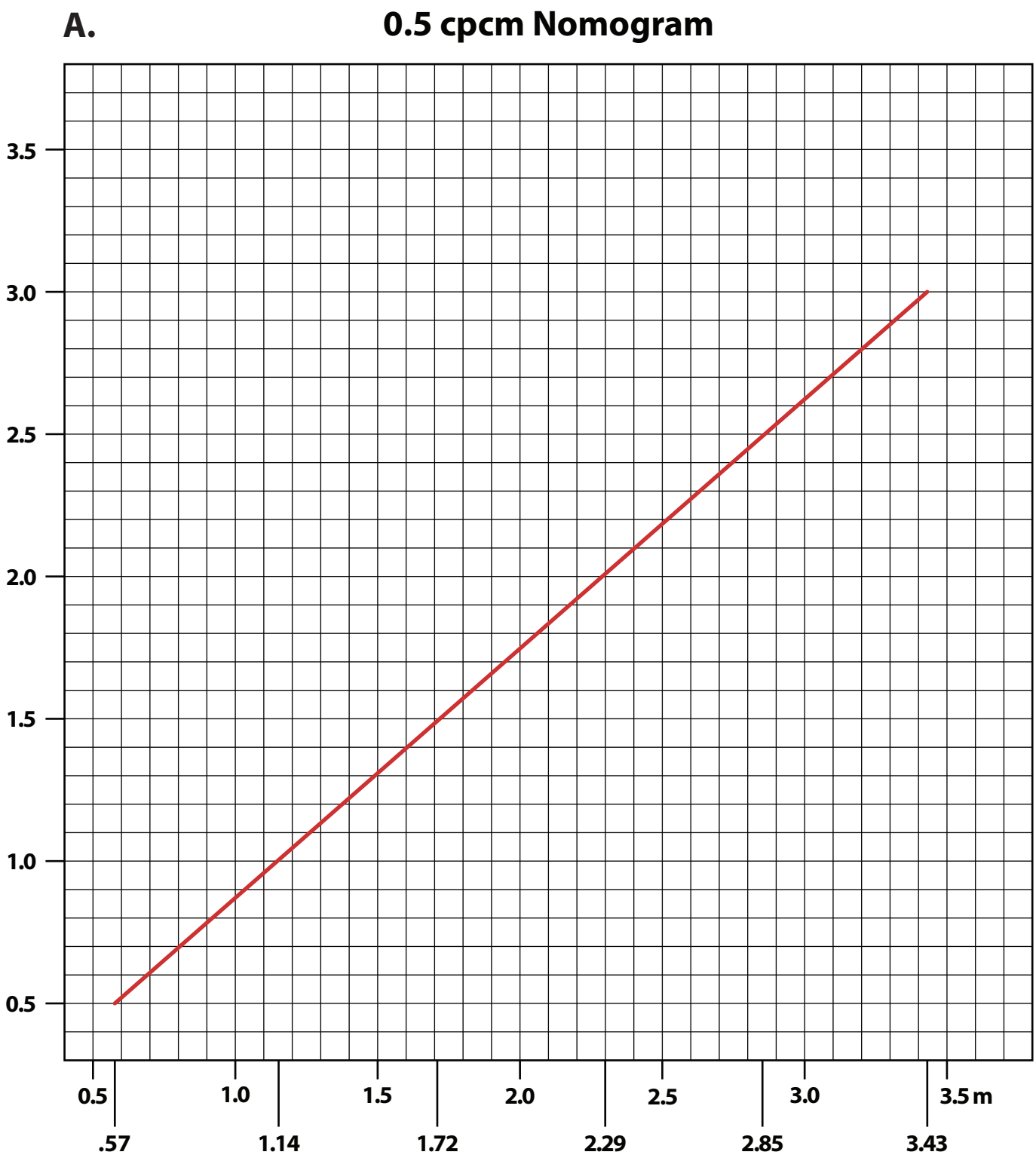

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Figure 2. Nomogram I. Grating acuity (cpd) as a function of testing distance.
B. 4.0 cpcm grating

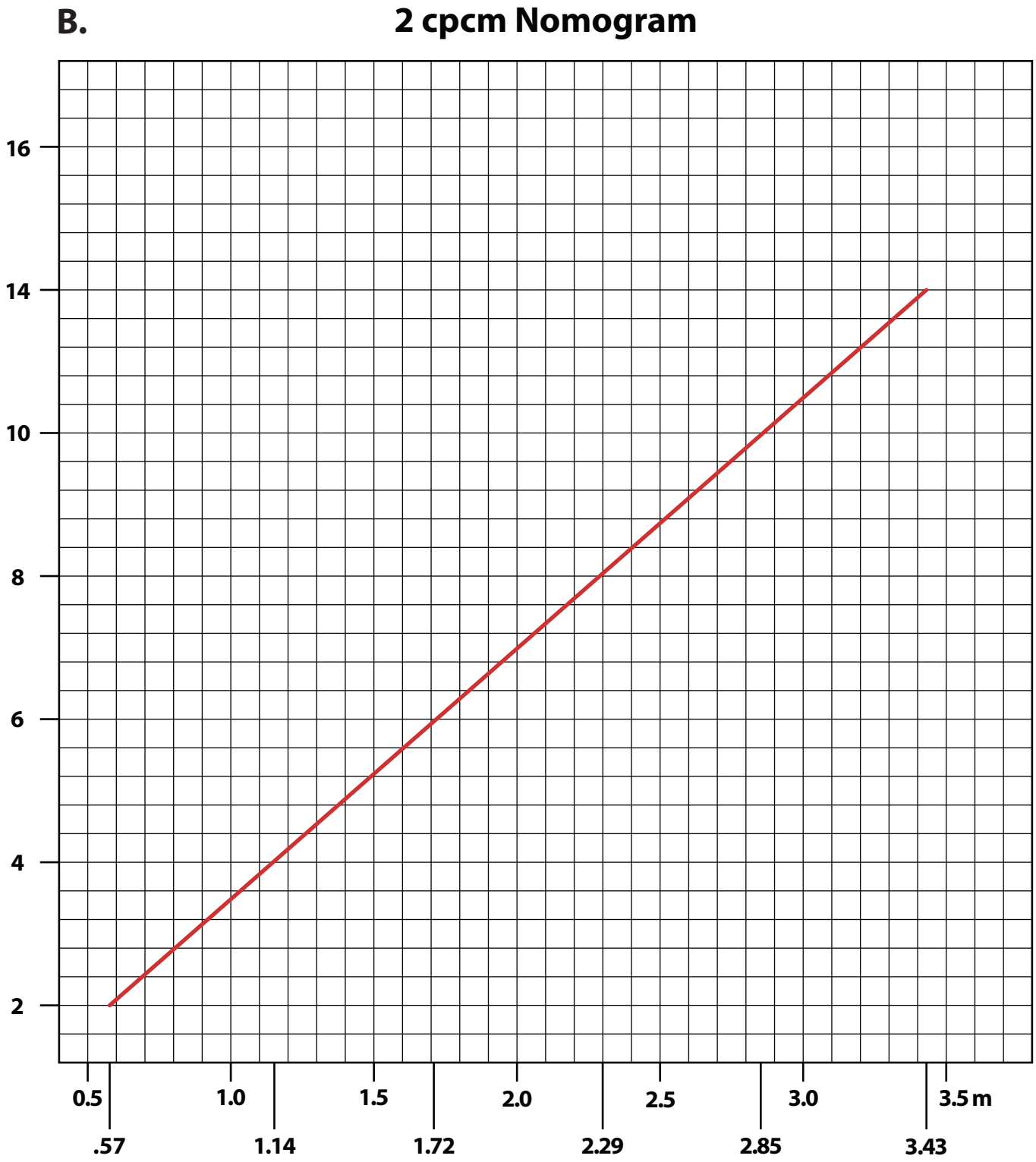

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Figure 2. Nomogram I. Grating acuity (cpd) as a function of testing distance.
C. 8.0 cpcm grating.

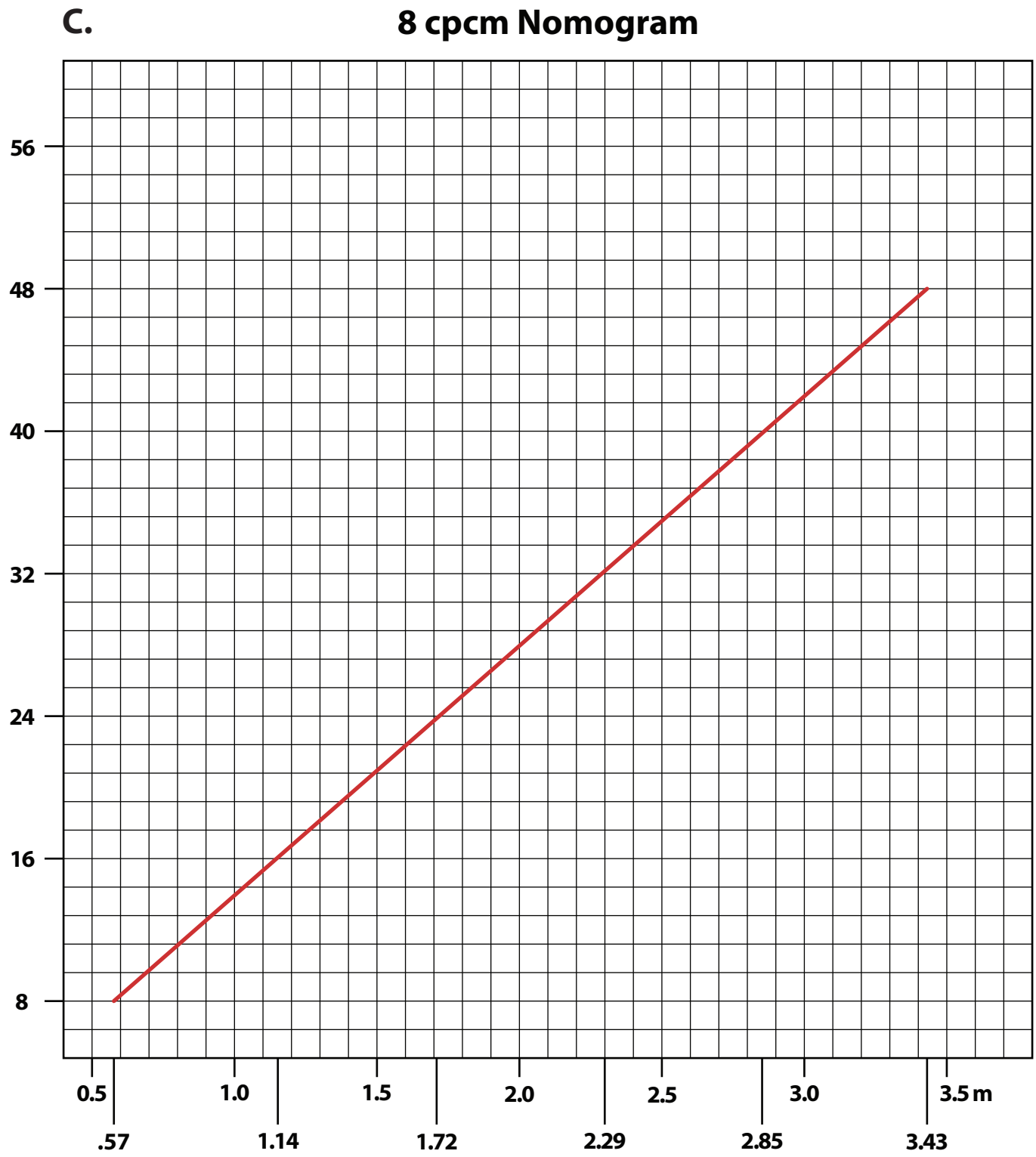

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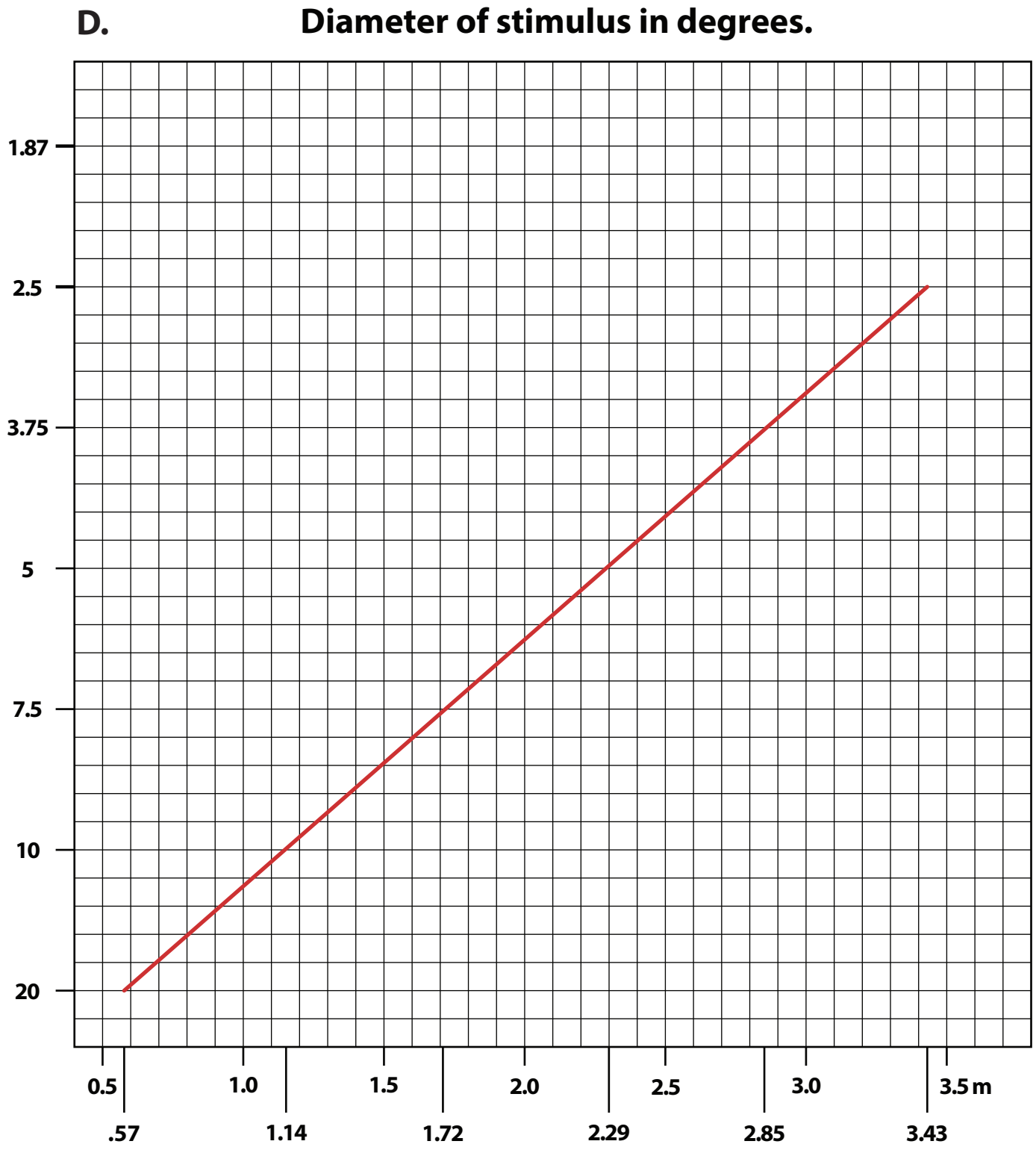
Figure 2. Nomogram I. Grating acuity (cpd) as a function of testing distance.
D. The size of the stimulus at different distances.



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For each contrast level there are two different gratings (Figure 3) so that threshold values can be measured at distances that are possible in usual examination rooms and within the visual sphere of most children and adults.

Figure 3. LEA Low Contrast Grating Acuity Test measures contrast sensitivity at 2 contrast levels and 3 grating frequencies: 0.5 cpcm and 8 cpcm gratings at 10% contrast and 0.5 cpcm and 4 cpcm gratings at 2.5%.

On the Recording Form in Figure 4, the distances are marked where each grating gets a certain cycle-per-degree value (cpd). Because the threshold is seldom exactly at these distances, the nomograms in Figure 2 give the cpd values of each grating at different distances. Nomogram I also includes the grating size in degrees of visual angle at the distance used.

For example, if a person saw the 4 cpcm grating at 1.15 m distance, grating acuity is 8 cpd with a 10 degree stimulus: [4 cpcm corresponds to 4 cpd at 57 cm and 8 cpd at 115 cm (≈2x57 cm). Because the grating is 20 cm in diameter, it is 20 degrees at 57 cm and 10 degrees at 115 cm distance. The size of the stimulus can be read from the Nomogram D.]

Record the threshold distances at 2.5% contrast using the distances at the 1.2% contrast; they are equal.

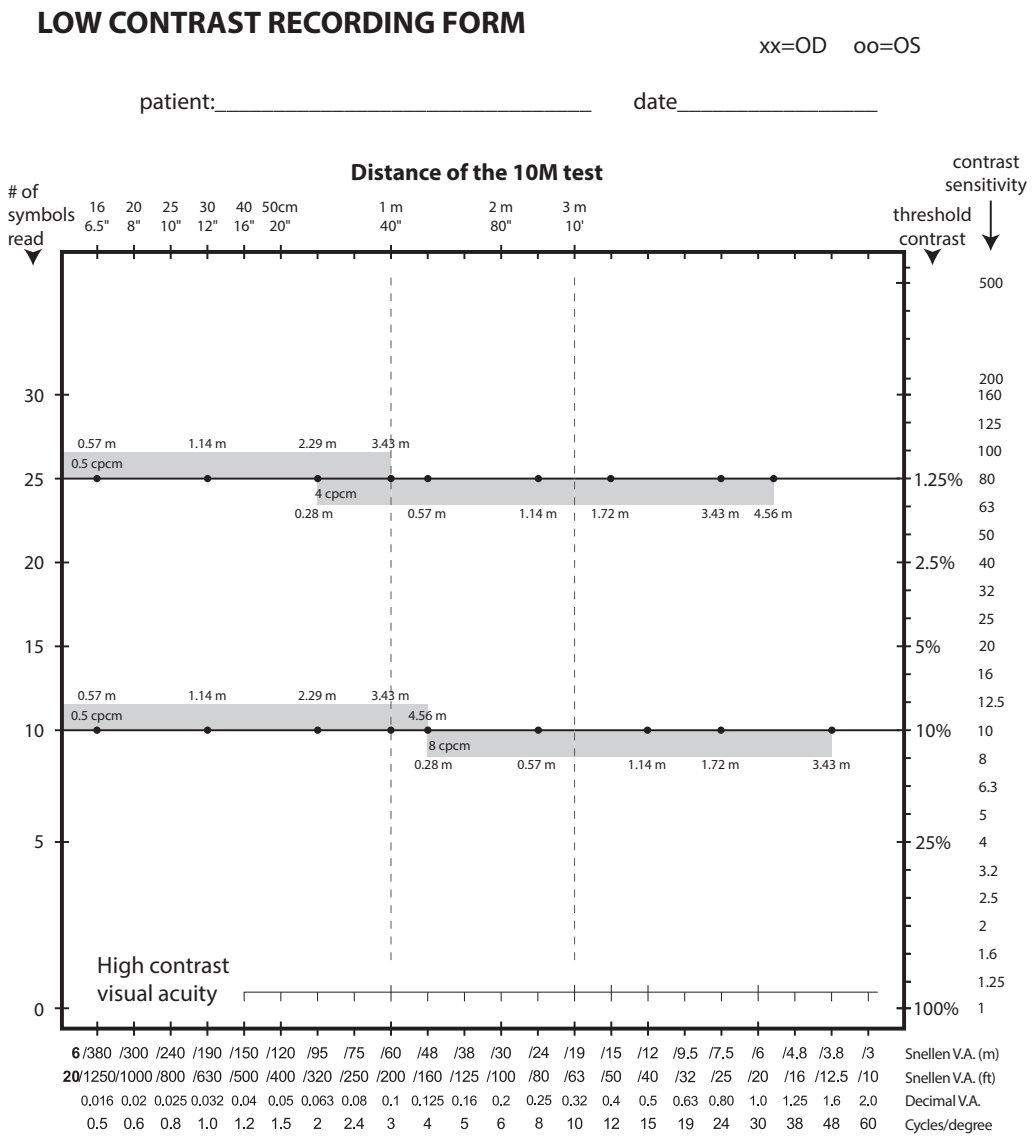

Figure 4. For the measurements of the grating acuity at each contrast level there are two gratings. At the 10% contrast level, the gratings are 0.5 cpcm and 8 cpcm. At the 2.5% contrast level, the gratings are 0.5 cpcm and 4 cpcm.

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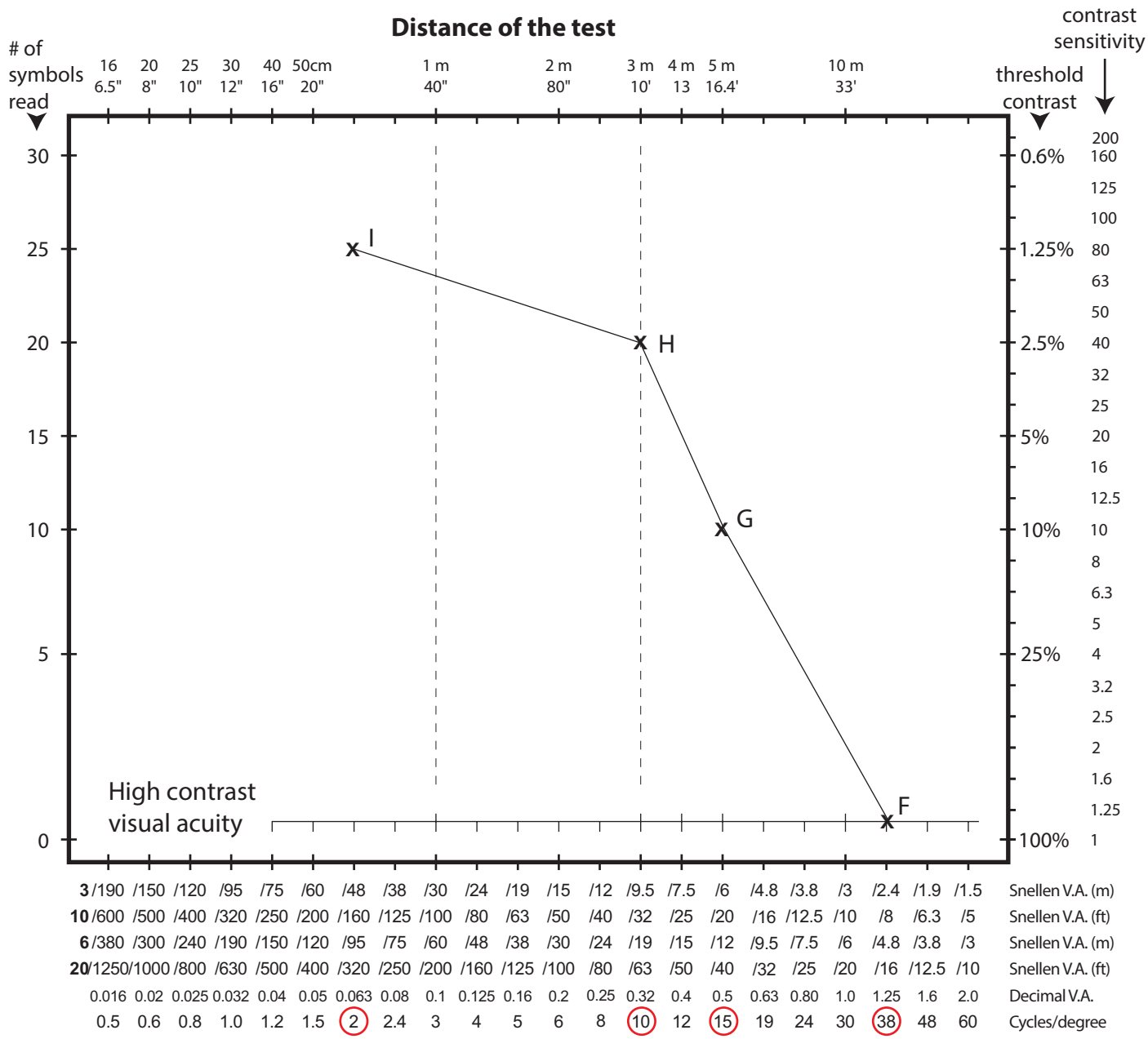

Figure 5. The result of measurements at four contrast levels. The patient saw the 8 cpcm grating at 270 cm at full contrast, which corresponds to 38 cpd (F). The 10% contrast 4 cpcm grating was seen at 220 cm distance, which corresponds to 15 cpd (G). The 2.5% contrast 4 cpcm grating was seen at 145 cm distance, which corresponds to 10.5 cpd (H). The 1.2% contrast 0.5 cpcm grating was seen at a distance of 225 cm, which corresponds to 2.4 cpd (I). The line I-H-G-F depicts the slope of the contrast sensitivity curve.

Note that the slope is close to a straight line between full contrast and 2.5% contrast. Thus, if the testee becomes tired easily, measure the 2.5% threshold first, followed by the 1.2% threshold and then the threshold at 10% contrast as the last measurement. The size of the grating at the different distances is 270 cm – 4 deg; 225 cm – 5.5 deg; 145cm – 8.5 deg.

If a testee has several preferred retinal loci (PRL) and shifts fixation between them, you may be measuring points on two or three contrast sensitivity curves at once. This can lead to an irregular and varying form of the curve. It describes the changes in the quality of image, which, however, is usually not perceived by the person because we "edit" the image on top of the previous image combining information from all preferred loci.

The contrast sensitivity curve depicts the transfer function of the visual pathways at different contrast levels and spatial frequencies. It shows that there is rather little information moving at the highest frequencies close to the grating acuity value. The visual system is most sensitive at intermediate and low spatial frequencies.