The Mars
Letter Contrast Sensitivity Test

USER MANUAL

mars perceptrix

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Description

The Mars Letter Contrast Sensitivity Test is a set of charts for testing peak visual contrast sensitivity. While the more familiar visual acuity test assesses resolution of the eye and visual system and the processing of *high* retinal image spatial frequencies, this test instead assesses processing of relatively *low* retinal spatial frequencies. Low spatial frequency processing can be diminished by a host of retinal disorders and by ocular media opacities and other optical disorders, often with minimal or no diminution of visual acuity. As such it is a useful instrument in the clinician's toolbox. The test can be used for establishing baseline contrast sensitivity prior to an intervention (such as cataract extraction), for identifying functional losses in low contrast perception (often associated with glare sensitivity), or for functionally monitoring disease progression. Its small format test makes it ideal for near testing and for use in small office or laboratory spaces, and atypical locations such as mobile eye clinics and patients' homes. It follows the design practices recommended by the Committee on Vision of the U.S. National Academy of Sciences and National Research Council (*Advances in Ophthalmology*, 41, 103-148, 1980) in terms of luminance, font, and optotype spacing. The test system is a set of three printed charts, supplied in three **forms** for independent left eye, right eye and binocular testing. The three forms, whose number is identified at the bottom of each chart, are identical except for the sequence of letters. A sample score sheet can be found on the back cover of this manual. This score sheet may be photocopied for use by owners of the test.

Each chart form consists of 48 letters, each subtending 2 deg at a 50 cm test distance (or 2.5 deg at 40 cm), arranged in eight rows of six letters each. The contrast of each letter, reading from left to right, and continuing on successive lines, decreases by a constant factor (0.04 log unit). The patient simply reads the letters across lines and down the chart, as in standard letter acuity measurement. (Instead of the letters decreasing in size, however, they decrease in contrast.) The contrast of the final letter before which the patient misidentifies two consecutive letters, with a correction for earlier incorrect responses, determines the **log contrast sensitivity (CS)**. Contrast values associated with log CS scores of the Mars CS tests are given in the following table:

log CS	Contrast	log CS	Contrast	log CS	Contrast	log CS	Contrast	log CS	Contrast	log CS	Contrast
0.04	0.912	0.08	0.832	0.12	0.759	0.16	0.692	0.20	0.631	0.24	0.575
0.28	0.525	0.32	0.479	0.36	0.437	0.40	0.398	0.44	0.363	0.48	0.331
0.52	0.302	0.56	0.275	0.60	0.251	0.64	0.229	0.68	0.209	0.72	0.191
0.76	0.174	0.80	0.158	0.84	0.145	0.88	0.132	0.92	0.120	0.96	0.110
1.00	0.100	1.04	0.091	1.08	0.083	1.12	0.076	1.16	0.069	1.20	0.063
1.24	0.058	1.28	0.052	1.32	0.048	1.36	0.044	1.40	0.040	1.44	0.036
1.48	0.033	1.52	0.030	1.56	0.028	1.60	0.025	1.64	0.023	1.68	0.021
1.72	0.019	1.76	0.017	1.80	0.016	1.84	0.014	1.88	0.013	1.92	0.012

How to Administer the Mars Letter Contrast Sensitivity Test

Illumination: For best results, the chart should be illuminated uniformly, with an optimal luminance in the chart's white background of 85 cd/m^2. The chart's small size facilitates this, and the lamp on a standard ophthalmic equipment stand will generally provide sufficient and sufficiently uniform illumination. Luminance should be at least 60 and less than 120 cd/m^2 in all white areas of the chart. Luminance is best checked with a photometer. However, if one is not available, an inexpensive incident light meter can be used; illuminance should be in the range 189 to 377 lux, and optimally 267 lux. Testing should not be conducted through any coatings, laminations, or coverings on the chart, even if these are transparent or translucent.

Viewing distance and correction: The patient's viewing distance to the chart is by design 50 cm (20 inches), but may range from the standard near refraction distance of 40 cm (15.75 inches) to 59 cm (23 inches). Patients should wear their appropriate near correction, or their distance correction, with an add of +2.00 D, and an occluder or patch on the untested eye. The test is quite tolerant of small refractive errors since the letters are large (20/480 equivalent at 50 cm). Testing, however, should be performed with the eyes undilated. For patients with very low visual acuity who cannot easily read the highest contrast letters, test distance may be shortened to 25 cm (increasing the add, if necessary, to +4.00 D); in this case care must be taken not to allow the patient's head to occlude the light source illuminating the chart.

Instructions to the patient: Ask the patient to read the letters from left to right across each line of the chart. If the patient responds with a letter other than **C**, **D**, **H**, **K**, **N**, **O**, **R**, **S**, **V**, or **Z** , or with a numeral, do *not* score the response as incorrect. Instead, inform the patient of the restricted letter set, and ask for another response. This is in order to support the assumption that the probability of a guess is 1/10. ***Encourage the patient to guess even when they report that the letters appear too faint***.

Recording responses and scoring: On the score sheet, mark in the grid corresponding to the chart form used, an **X** for each letter incorrectly identified. Terminate testing *only* when the patient makes two consecutive errors *or* reaches the end of the chart. Do not terminate the test because the patient has given up and has stopped responding. If this happens, encourage the patient to

guess, and score the guesses as ordinary responses. This will help to ensure that the score is based on what the patient *can* see and not on what the patient *believes* he or she can see.

The log contrast sensitivity (**log CS**) score is given by the log contrast sensitivity value **at** the lowest contrast letter just prior to two incorrectly identified letters, minus a scoring correction. The letter just prior to the two consecutive misses is called the **final correct letter.** If the patient reaches the end of the chart without making two consecutive errors, then the final correct letter is simply the final letter correctly identified.

Example scoring: In the example below, the test terminates after the patient has read the first letter on the seventh row, because the consecutive letters **O** and **H** were missed. The log CS value at the final correct letter (**H**) is 1.40. A scoring correction of 0.04 is subtracted from this score because this patient also erred on the **K** a few letters earlier in the test.

Row	FORM 1 Left eye ☒ Right eye ☐ Binocular ☐					
1	C ☐ 0.04	H ☐ 0.08	V ☐ 0.12	O ☐ 0.16	S ☐ 0.20	N ☐ 0.24
2	D ☐ 0.28	S ☐ 0.32	Z ☐ 0.36	N ☐ 0.40	R ☐ 0.44	K ☐ 0.48
3	N ☐ 0.52	D ☐ 0.56	R ☐ 0.60	H ☐ 0.64	V ☐ 0.68	Z ☐ 0.72
4	C ☐ 0.76	S ☐ 0.80	O ☐ 0.84	N ☐ 0.88	K ☐ 0.92	H ☐ 0.96
5	K ☐ 1.00	N ☐ 1.04	V ☐ 1.08	D ☐ 1.12	S ☐ 1.16	R ☐ 1.20
6	Z ☐ 1.24	R ☐ 1.28	D ☐ 1.32	K ☒ 1.36	H ☐ 1.40	O ☒ 1.44
7	H ☒ 1.48	Z ☐ 1.52	C ☐ 1.56	V ☐ 1.60	R ☐ 1.64	K ☐ 1.68
8	S ☐ 1.72	C ☐ 1.76	Z ☐ 1.80	D ☐ 1.84	V ☐ 1.88	O ☐ 1.92

Log CS value at final correct letter: 1.40

Number of errors prior to final correct letter 1 **X 0.04** = 0.04

Subtract

log Contrast Sensitivity 1.36

Additional testing: To characterize contrast sensitivity more completely, test each eye alone and both eyes together, using different forms of the test for each to minimize letter sequence learning effects.

Normal values for log contrast sensitivity

Chart column

Chart row	1	2	3	4	5	6
1	0.04	0.08	0.12	0.16	0.20	0.24
2	0.28	0.32	0.36	0.40	0.44	0.48
3	0.52	0.56	0.60	0.64	0.68	0.72
4	0.76	0.80	0.84	0.88	0.92	0.96
5	1.00	1.04	1.08	1.12	1.16	1.20
6	1.24	1.28	1.32	1.36	1.40	1.44
7	1.48	1.52	1.56	1.60	1.64	1.68
8	1.72	1.76	1.80	1.84	1.88	1.92

Key

	Profound (< 0.48)
	Severe (0.52—1.00)
	Moderate (1.04—1.48)
and	Normal > age 60 (1.52—1.76)
and	Normal middle/young adult (1.72—1.92)

Note: Expect 0.15 ($\sqrt{2}$) higher values for binocular testing when two monocular values have similar contrast sensitivity.

Maintenance

Charts should be stored in their portfolio case, to protect them from light, dust and physical damage. Do not place other objects on the chart surface that can scratch or dent the charts, and try to avoid touching their front surface, especially in the area where the letters are printed.

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The Mars Letter Contrast Sensitivity Test

Score Sheet

Patient _____ **Administered by** _____

Date _____ **Correction** _____ **Test distance** _____

Comments _____

Quick Instructions: Instruct patient to read letters left to right for each line, from top to bottom of the chart. Mark misses with an "X." Terminate test on 2 consecutive misses.

Important: Allow *only* the letters C D H K N O R S V Z as responses.

Row	FORM 1 Left eye ☐ Right eye ☐ Binocular ☐					
1	C ☐ 0.04	H ☐ 0.08	V ☐ 0.12	O ☐ 0.16	S ☐ 0.20	N ☐ 0.24
2	D ☐ 0.28	S ☐ 0.32	Z ☐ 0.36	N ☐ 0.40	R ☐ 0.44	K ☐ 0.48
3	N ☐ 0.52	D ☐ 0.56	R ☐ 0.60	H ☐ 0.64	V ☐ 0.68	Z ☐ 0.72
4	C ☐ 0.76	S ☐ 0.80	O ☐ 0.84	N ☐ 0.88	K ☐ 0.92	H ☐ 0.96
5	K ☐ 1.00	N ☐ 1.04	V ☐ 1.08	D ☐ 1.12	S ☐ 1.16	R ☐ 1.20
6	Z ☐ 1.24	R ☐ 1.28	D ☐ 1.32	K ☐ 1.36	H ☐ 1.40	O ☐ 1.44
7	H ☐ 1.48	Z ☐ 1.52	C ☐ 1.56	V ☐ 1.60	R ☐ 1.64	K ☐ 1.68
8	S ☐ 1.72	C ☐ 1.76	Z ☐ 1.80	D ☐ 1.84	V ☐ 1.88	O ☐ 1.92

log CS value at final correct letter: _____

Number of errors prior to final correct letter _____ **X 0.04 =** _____

Subtract

log Contrast Sensitivity _____

Row	FORM 2 Left eye ☐ Right eye ☐ Binocular ☐					
1	K ☐ 0.04	S ☐ 0.08	H ☐ 0.12	O ☐ 0.16	N ☐ 0.20	C ☐ 0.24
2	Z ☐ 0.28	D ☐ 0.32	C ☐ 0.36	R ☐ 0.40	V ☐ 0.44	O ☐ 0.48
3	C ☐ 0.52	K ☐ 0.56	O ☐ 0.60	N ☐ 0.64	R ☐ 0.68	S ☐ 0.72
4	N ☐ 0.76	S ☐ 0.80	Z ☐ 0.84	K ☐ 0.88	H ☐ 0.92	D ☐ 0.96
5	H ☐ 1.00	N ☐ 1.04	C ☐ 1.08	O ☐ 1.12	R ☐ 1.16	Z ☐ 1.20
6	V ☐ 1.24	K ☐ 1.28	S ☐ 1.32	N ☐ 1.36	D ☐ 1.40	R ☐ 1.44
7	K ☐ 1.48	R ☐ 1.52	V ☐ 1.56	Z ☐ 1.60	O ☐ 1.64	S ☐ 1.68
8	V ☐ 1.72	Z ☐ 1.76	C ☐ 1.80	D ☐ 1.84	V ☐ 1.88	H ☐ 1.92

log CS value at final correct letter: _____

Number of errors prior to final correct letter _____ **X 0.04 =** _____

Subtract

log Contrast Sensitivity _____

Row	FORM 3 Left eye ☐ Right eye ☐ Binocular ☐					
1	H ☐ 0.04	R ☐ 0.08	Z ☐ 0.12	V ☐ 0.16	C ☐ 0.20	N ☐ 0.24
2	S ☐ 0.28	O ☐ 0.32	K ☐ 0.36	D ☐ 0.40	R ☐ 0.44	S ☐ 0.48
3	K ☐ 0.52	D ☐ 0.56	C ☐ 0.60	V ☐ 0.64	O ☐ 0.68	H ☐ 0.72
4	N ☐ 0.76	S ☐ 0.80	O ☐ 0.84	Z ☐ 0.88	C ☐ 0.92	D ☐ 0.96
5	R ☐ 1.00	H ☐ 1.04	N ☐ 1.08	K ☐ 1.12	Z ☐ 1.16	O ☐ 1.20
6	C ☐ 1.24	R ☐ 1.28	S ☐ 1.32	V ☐ 1.36	K ☐ 1.40	N ☐ 1.44
7	S ☐ 1.48	K ☐ 1.52	R ☐ 1.56	N ☐ 1.60	H ☐ 1.64	D ☐ 1.68
8	C ☐ 1.72	V ☐ 1.76	H ☐ 1.80	D ☐ 1.84	O ☐ 1.88	Z ☐ 1.92

log CS value at final correct letter: _____

Number of errors prior to final correct letter _____ **X 0.04 =** _____

Subtract

log Contrast Sensitivity _____

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