# THE PSE SYNDROME TEST: A MANUAL FOR PHYSICIANS

Rapid, reliable diagnostic procedure for the quantitative evaluation of (minimal) hepatic encephalopathy

Developed with the support of Merz Pharmaceuticals GmbH and
the International Society on Hepatic Encephalopathy and Nitrogen Metabolism

# INTRODUCTION

The portosystemic encephalopathy **(PSE) Syndrome Test** is a simple, reliable, quantitative evaluation of the neuropsychological symptoms of liver insufficiency. It can be used to diagnose minimal **hepatic encephalopathy (HE)** and to evaluate progress of therapy.

This guide presents background information about the causes and consequences of HE and explains how to administer and score the PSE Syndrome Test.

# TABLE OF CONTENTS

# WHAT IS HE?

## HE is a potentially reversible disorder of the brain, thought to be caused by toxic accumulation of ammonia[1]

### Symptoms (amongst others)

- Include alterations of cognitive, emotional, behavioral, and motor functions[2]
  - Asterixis (as well as alterations of consciousness up to stupor and coma) can develop as the disease progresses, eventually leading to stupor and coma[2,3]
- Are often ignored early in the disease, or their association with liver disease is not recognized[2,3]
- Often overt HE can be detected by bedside clinical testing. However, patients with minimal HE can present with normal mental and neurological status during clinical examination, but show abnormal results during specific psychometric tests[2]
- Can negatively impact quality of life (QoL), including ability to drive an automobile or operate machinery[4,5]

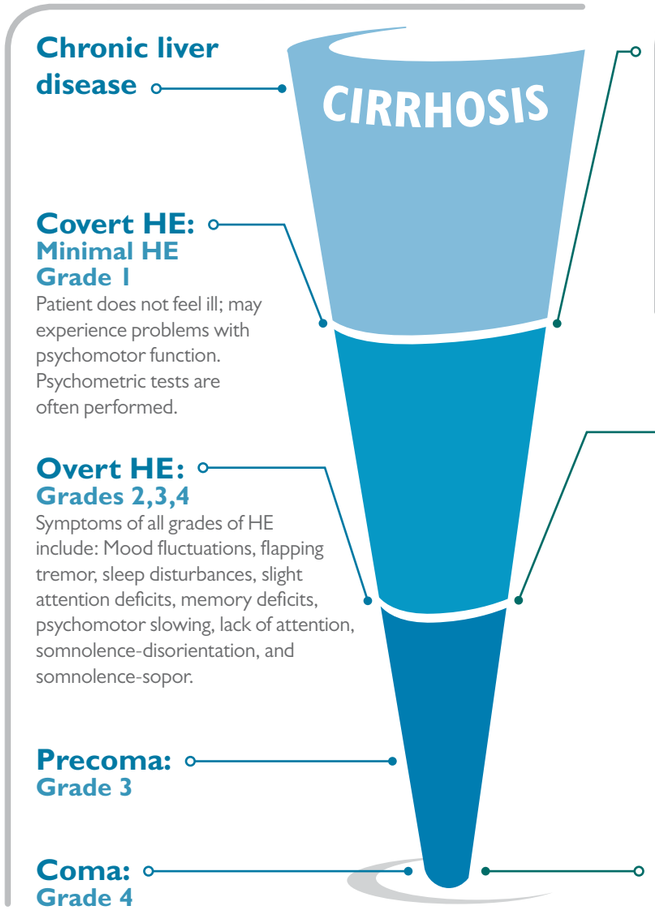
### HE

- There is an increasing need to recognize the complications of cirrhosis and improve the diagnosis and management of these complications, including HE[4]
- Must be diagnosed and treated early to prevent impairment and life-threatening sequelae[6]
- Can result in devastating neurological psychiatric symptoms if left untreated[7]

## The importance of diagnosing and treating HE

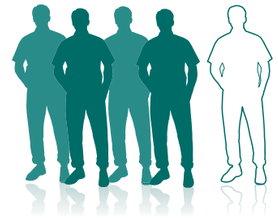
- Decompensated cirrhosis with HE portends a poor prognosis and lessened prospect of overall survival[5,7]
- Timely and effective treatment of HE reduces both hospitalization costs and per-patient treatment costs, as well as improves QoL[5,8,9]
- Early diagnosis (0-Grade 1) of HE is crucial since HE can be treated successfully, quickly, safely, and at low cost[2,3,8]

### CLINICAL SPECTRUM OF HE[3,10]



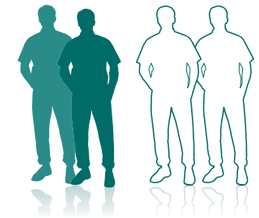

### INCIDENCE

A large percentage of cirrhosis patients may suffer from HE without the correct diagnosis[2]



### PROGNOSIS

**50%** of patients with minimal HE progress toward overt HE disease within 6 months[6]



HE survival probability is estimated to be **42%** at 1 year, **27%** at 2 years, and **23%** at 3 years[11]

## The PSE Syndrome Test is a recommended test for diagnosing HE[12]

# THE PSE SYNDROME TEST

## The recommended test for the diagnosis of minimal HE and the evaluation of the progress of therapy

*Recommended for use by both the International Society for Hepatic Encephalopathy and Nitrogen Metabolism (ISHEN) and the Working Group at the 11th World Congress of Gastroenterology*[10,12]

The PSE Syndrome Test is a battery consisting of 5 paper-and-pencil tests. It can be taken by patients from ages 15 to 80, including bedridden patients. The full battery of 5 tests requires 10-20 minutes to complete, and 3 minutes to score. Patients need to take all 5 tests to get an accurate score.

The test was developed in Germany in the early 1980s and has become standardized for other countries, including Spain, Italy, India, and the United Kingdom. There are several differences in the tests used internationally, but all versions share the same basic structure.
All tests include[13]:

- A digit symbol test
- A serial dotting test
- A line tracing test
- A number or figure connection test

The PSE Syndrome Test is portable, does not require a computer, and can be given with just a pencil and paper. It does not rely on a particular level of education or occupation, and can be used by patients who are illiterate (figure connection tests).[12] It is practical, easy to apply, sensitive, specific, and inexpensive.[13]

## Test measurements

The PSE Syndrome Test measures cognitive functions that are directly relevant to activities of daily living.[12] These include[13]:

1. psychomotor speed
2. visual scanning efficiency
3. sequencing
4. concentration
5. attention
6. attention set shifting ability
7. visual perception
8. visual search
9. working memory
10. associative learning
11. graphomotor speed
12. cognitive processing speed
13. motor speed
14. motor accuracy

# THE PSE SYNDROME TEST STRUCTURE

## Scoring

Each of the 5 paper-and-pencil tests is scored separately. The subtests are scored either on accuracy or time to completion. The Line Drawing Test generates 2 scores, one for total time to completion and one for accuracy.

Once raw value scores for each subtest are generated, they must be converted into score points using the accompanying lists of scoring norms. Use the age of the patient and the score on the subtest to generate the total Psychometric Hepatic Encephalopathy Score (PHES).[12,13]

Converted scores on each subtest are assigned a value ranging from +1 to -3, based on age-related norms (+1 for scores better than one standard deviation [SD] above the normal mean, to -3 for scores more than 3 SDs below the normal mean). A baseline performance is assigned a score of 0. Test values below 1, 2, or 3 times the SD are assigned a score of -1, -2, or -3 score points. Test values above one SD are assigned a score of +1 score points.[12,13]

Because the Line Drawing Test generates 2 scores, there are a total of 6 measures that contribute to the total PHES. Therefore, the total PHES scores range from +6 to -18. A total value of <-4 is considered pathological.[12,13]

See pages 24 to 35 of this brochure for evaluation sheets of statistical norms.

The PSE Syndrome Test consists of forms I through IV. Each form consists of the 5 subtests, collected in a test booklet. The tasks themselves differ from one another, so that during subsequent measurements over the course of therapy evaluation, a patient will not exhibit performance improvement due to having done the test previously.

Each test requires:


**Test manual**

**Pen or pencil**

**Clipboard**
for use as a base for performing the test if bedridden

**Template set**
for evaluation of subtests 1 and 5


**Test booklet**
with forms I through IV, each with 5 subtests, instructions, and practice tasks, along with an entry sheet for personal data and an evaluation sheet

**A stopwatch**
is absolutely required

# THE PSE SYNDROME TEST STRUCTURE (continued)

## General instructions for the clinician/evaluator

- Before testing a patient, check that all required documentation is available and usable. Before starting the test, check that the pen is working and keep a replacement ready for emergencies. If using a pencil, make sure it is sharpened at the start of the test

- If you repeat a test or retest, you should also check which form the patient used for the last test and provide him or her with a different one for the repeat test. This ensures that the result will not be influenced by memory of the previous test

- Use only the original documents, since any deviation could change the conditions of performance and influence the result. This applies to the evaluation as well, since the templates are precisely matched to the printed documents

- To measure the time of performance of the individual subtests, use a stopwatch. Do not rely on a wristwatch. The accuracy of measurement can be significantly reduced by reading errors even with a watch with a second hand, aside from the considerable discomfort for the examiner

- The following rules apply to the start and end of the test intervals: At the specified limit times (subtest 1), give the start instruction (the beginning of measurement) and the stop instruction yourself (the end of measurement). For the subtests without time requirements, measure the time from the second the pen is picked up by the patient at the start of the subtest until the specific target point is reached. In this context, follow the specific instructions and remarks for each subtest in the testing instructions section of this brochure (pages 13 to 23)

- During the test, always adhere to the specified test times, and always read the test instructions to the patient precisely as they are given. This is the only way to ensure that the test values are reliable and comparable with the values in the normal tables

- Use and completely read aloud the instructions in this test manual each time the test is carried out, even if you think you already know the text perfectly. Ask whether the patient has understood the instructions and knows what to do. If there is any doubt, please repeat the entire instructions once, then allow the patient to work on the associated practice line(s). If the patient makes errors, point them out immediately until you are sure that the patient can carry out the assigned task according to the instructions. See the remarks for each subtest for more detailed test instructions

- Always read the entire instructions, even when retesting the same patient. Always have the patient fill in the practice lines completely for each test—even when you are retesting the same patient

- Be sure before the beginning of the test that patients who need reading glasses are wearing them. Be sure the testing locations are sufficiently well lit. If possible, the patient should sit at a normal table for writing while performing the test

## General instructions before starting the test

The patient should be informed why this examination is being performed. He or she should be informed that the tasks are short and simple and will require only about 15 minutes to complete. Interruptions should be avoided as much as possible during this time.

The subtests are carried out according to the following principles:

- Instructing the patient
  (checking for understanding)
- Carrying out the practice tasks
- Checking of the practice tasks
  (together with the patient, and making any correction necessary)
- Performance of the test itself

# INDIVIDUAL SUBTEST TESTING AND SCORING INSTRUCTIONS

# SUBTEST 1:
# DIGIT SYMBOL TEST

*This test evaluates associative learning, graphomotor speed, cognitive processing speed, visual perception, and working memory*[13]

## Instructions for testing, to be read aloud to the patient by the evaluator

Please look at the top line on this sheet. You see 9 boxes there. Each box has a number in the top part and a symbol in the bottom part. Each number has its own symbol.

In the practice line below it, you can see that the symbols are already written into the first 5 boxes. Please complete this line by writing the missing symbols into the empty boxes.

**Note to evaluator:**

– Check whether the patient has written the correct symbols into the practice line. Draw his or her attention to any errors. Be sure that the patient has not skipped any boxes and that the patient is not filling in all the "1" boxes, then all the "2" boxes, etc, which can sometimes happen

Now you know how to do this task.

In the lower part of the page, there are more empty boxes. I will tell you when to start. Please write the correct symbols for each number, as you just did. Do them in order and as quickly as possible without making any mistakes. Don't leave any boxes out. Once you finish the first row, please start the second row immediately. Please continue until I tell you to stop. You will have exactly 90 seconds. Did you understand all that?—Good, then start now.

**Note to evaluator:**

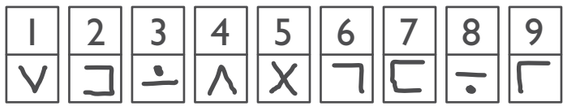
– Start recording the time immediately after telling the patient to start. Be sure that the patient does not continue to work after the time has elapsed

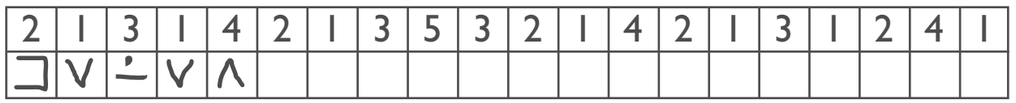
**Time:** 90 seconds

Now we'll go on to the next test.



### EXAMPLE TEST




*This is only to be used as an example for the evaluator, and is not to be used as a practice test.*

## Evaluation and scoring

The test value here is the total number of boxes filled in correctly.

Using the evaluation template, first check how many boxes the patient filled in. The template has sequential numbering for this purpose. Any incorrect answers—that is, any that are greatly displaced, spatially inverted or rotated, or incorrectly assigned—are subtracted from this total number. The template shows the correct symbols in the right places. The examples shown represent the tolerable deviations and incorrect solutions.

**CORRECT AND INCORRECT SOLUTIONS FOR SUBTEST 1**

| Example shown | Correct | | | Incorrect | | |
|---|---|---|---|---|---|---|
|  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |

The test score is written into the evaluation sheet and converted into a score using the normal values.

# SUBTEST 2:
# NUMBER CONNECTION TEST A (NCT-A)

*This test evaluates psychomotor speed, visual scanning efficiency, sequencing, attention, and concentration*[13]

## Instructions for testing, to be read aloud to the patient by the evaluator

On this page, you see the numbers 1 to 25 spread around the page. Your task is to connect the numbers as quickly as possible, in the same order that you count. Always take the shortest path. Try it out on this page.

**Note to evaluator:**

– If the patient leaves a number out, stop him or her immediately. The patient should correct the error and only then continue

Now comes the actual test. This page also has the numbers from 1 to 25, but this time in a different order than on the practice page. You should connect the numbers in the correct order again, and I will measure the time you need to do that. Start immediately when I tell you to start, and don't leave any numbers out.

Did you understand all that? – Good, then start now.

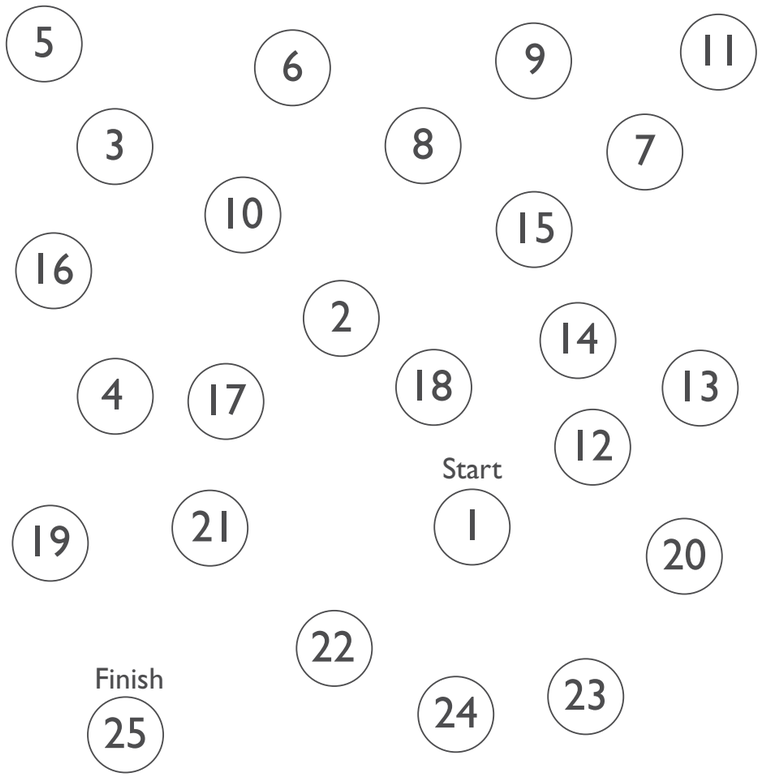
**Note to evaluator:**

– If the patient leaves a number out, stop him or her immediately. The patient should correct the error and only then continue. The time to correct the error is included in the total time

– Don't forget to stop the clock when 25 is reached and to record the total time on the test sheet. There is a blank (T=_) provided for this purpose

Immediately after subtest 2, proceed to subtest 3. There is no need to practice the task again.

**EXAMPLE TEST**




*This is only to be used as an example for the evaluator, and is not to be used as a practice test.*

## Evaluation and scoring

The test score is the number of seconds needed to complete the task.

The time measured for completion is rounded to whole seconds and written on the evaluation sheet. This raw value is converted into a score using the normal value table.

# SUBTEST 3:
# NUMBER CONNECTION TEST B (NCT-B)

*This test evaluates attention set shifting ability, psychomotor speed, visual scanning efficiency, sequencing, attention, and concentration*[13]

## Instructions for testing, to be read aloud to the patient by the evaluator

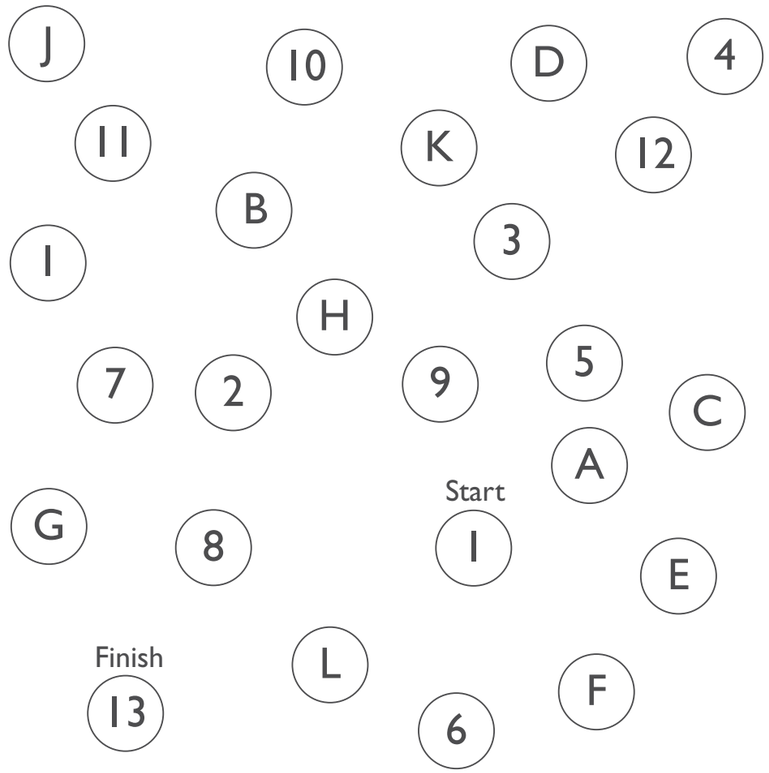
On this page, you see the numbers from 1 to 13 and letters from A to L. Your task is to connect the numbers and letters in alternating order, first a number and then a letter, so you'll go from 1 to A, from A to 2, from 2 to B, and so on until the end. The point of this test is also to complete the task as quickly as possible. The amount of time you need will be measured again.

Did you understand all that? – Good, then start now.

**Note to evaluator:**

– If the patient leaves a number out, stop him or her immediately. The patient should correct the error and only then continue. The time to correct the error is included in the total time. Don't forget to stop the clock when 13 is reached and to record the total time on the test sheet. There is a blank (T=_) provided for this purpose.

**EXAMPLE TEST**




*This is only to be used as an example for the evaluator, and is not to be used as a practice test.*

## Evaluation and scoring

The test score is the number of seconds needed to complete the task.

The time measured for completion (rounded to whole seconds) is written on the evaluation sheet and converted into a score using the normal value table.

# SUBTEST 4:
# SERIAL DOTTING TEST

*This test evaluates motor speed*[13]

## Instructions for testing, to be read aloud to the patient by the evaluator

On this page, you see 10 lines of large circles. Your task is to make a dot as close to the center of each circle as possible, in order starting on the left. First, fill in the 2 practice rows.

**Note to evaluator:**

– Be sure that the patient works quickly and doesn't forget any circles

When I tell you to start, please work as quickly as possible in the same way you just did, using the empty circles in the other rows. Don't leave any out, and start each row all the way at the left.

I will again measure the time you need for this task.

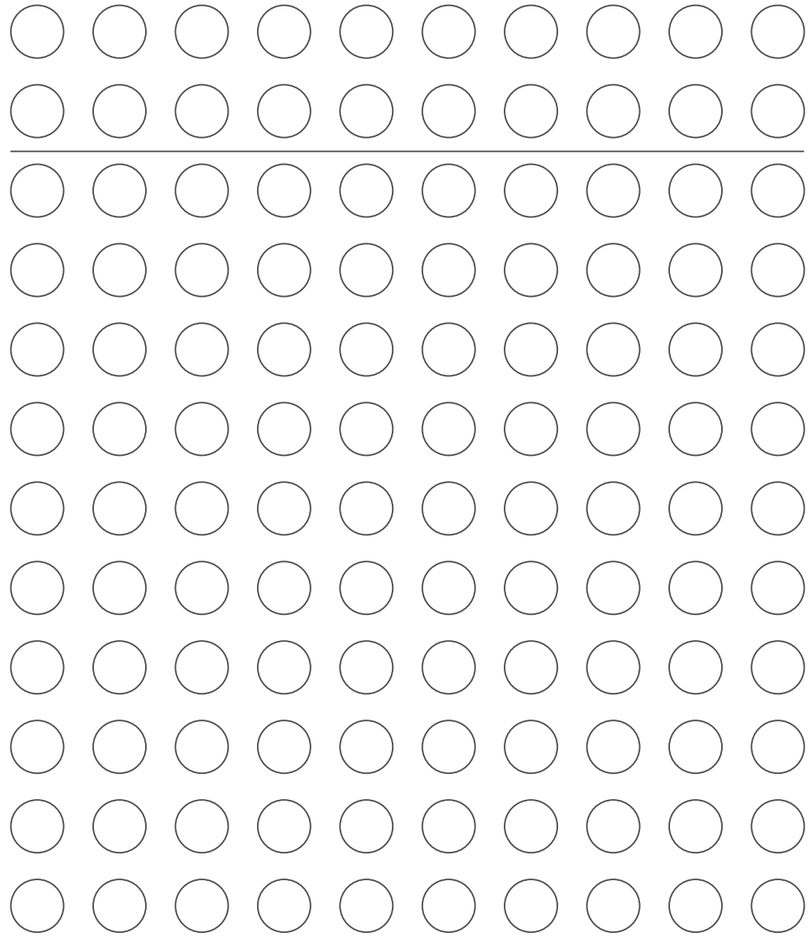
Did you understand all that? – Good, then start now.

**Note to evaluator:**

– Be sure that the patient fills in each row starting all the way to the left. For the time measurement, the following rules apply: Start when the patient marks the first circle in the first row, and stop when the last circle on the right of the last row is reached. Enter the time on the test sheet (T=_)

Now comes the last task.

**EXAMPLE TEST**



*This is only to be used as an example for the evaluator, and is not to be used as a practice test.*

## Evaluation and scoring

The test score is the number of seconds needed to complete the task.

For this test as well, the time measured for completion (rounded to whole seconds) is written on the evaluation sheet and converted into a score using the normal value table.

# SUBTEST 5: LINE TRACING

*This test evaluates motor speed and accuracy*[13]

## Instructions for testing, to be read aloud to the patient by the evaluator

In this test, you draw a line with your pen between the 2 lines on the page. Don't touch or write over the preprinted lines. Please don't turn the page or lift the pen while drawing. Try it out first on the figure on the practice page. Work quickly, but carefully.

**Note to evaluator:**

– Be sure that the patient doesn't lift the pen or turn the page and clipboard very far

On the next page, you will find the actual task. I will measure the time you need. But the important thing is that you don't make mistakes and that you stay between the printed lines.

Did you understand all that? – Good, then start now.

**Note to evaluator:**

– Be sure that the patient doesn't lift the pen or turn the page and clipboard very far. Time measurement: Start when the patient places the pen on the starting point, and stop when the end point is reached. Don't forget to enter the time on the test sheet (T=_)

## Evaluation and scoring

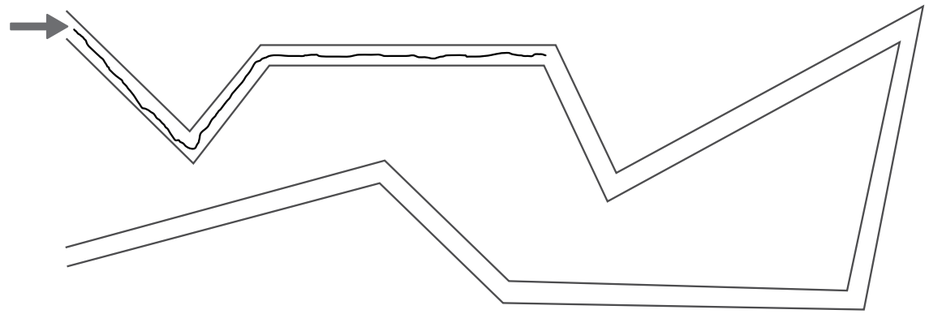
In this test, there are 2 test values: the completion time in seconds and the error score.

The first test value is the time measured for completion (again rounded to whole seconds) and written on the evaluation sheet.

To calculate the second test value, the evaluation template is placed on the test sheet in such a way that the marks on the template and the test sheet match up precisely. The grid now visible on the test sheet is used to determine the number of errors and the weighting of the errors. Each contact and/or crossing of the boundary lines is considered an error. Each crossing of the grid is counted as a separate error.

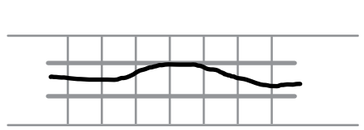


### EXAMPLE TEST

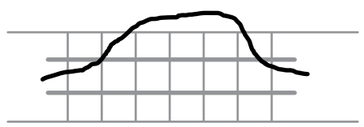


*This is only to be used as an example for the evaluator, and is not to be used as a practice test.*

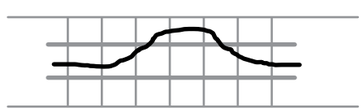
| THE FOLLOWING RULES ARE USED TO EVALUATE THE PATIENT'S ERRORS | |
|---|---|
| **No error** | The line drawn by the patient is between the boundary lines and doesn't touch either of them. |
| **Level 1 error** | Contact with the boundaries without crossing them entirely. (1 error point) |
| **Level 2 error** | Crossing of the boundary line without reaching the grid boundary. (2 error points) |
| **Level 3 error** | The line drawn by the patient crosses the grid boundary. (3 error points) |



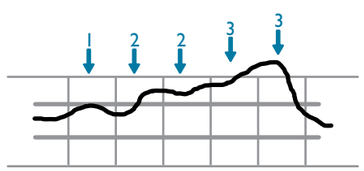
**2 x 1 error points**



**5 x 3 error points**



**3 x 2 error points**




**11 error points**

The total number of error points is written into the evaluation sheet and converted into a score using the normal values.

# EVALUATION SHEETS OF STATISTICAL NORMS– DIGIT SYMBOL TEST

| | +1 score | 0 score | -1 score | -2 score | -3 score |
|---|---|---|---|---|---|
| Age (years) | +1 SD | Norm | -1 SD | -2 SD | -3 SD |
| 15 | 80 | 66 | 55 | 45 | 37 |
| 16 | 79 | 65 | 54 | 45 | 37 |
| 17 | 78 | 65 | 54 | 44 | 37 |
| 18 | 77 | 64 | 53 | 44 | 36 |
| 19 | 77 | 63 | 52 | 43 | 36 |
| 20 | 76 | 63 | 52 | 43 | 36 |
| 21 | 75 | 62 | 51 | 43 | 35 |
| 22 | 74 | 62 | 51 | 42 | 35 |
| 23 | 74 | 61 | 50 | 42 | 34 |
| 24 | 73 | 60 | 50 | 41 | 34 |
| 25 | 72 | 60 | 49 | 41 | 34 |
| 26 | 72 | 59 | 49 | 40 | 33 |
| 27 | 71 | 59 | 48 | 40 | 33 |
| 28 | 70 | 58 | 48 | 40 | 33 |
| 29 | 69 | 57 | 47 | 39 | 32 |
| 30 | 69 | 57 | 47 | 39 | 32 |
| 31 | 68 | 56 | 47 | 38 | 32 |
| 32 | 67 | 56 | 46 | 38 | 32 |
| 33 | 67 | 55 | 46 | 38 | 31 |
| 34 | 66 | 55 | 45 | 37 | 31 |
| 35 | 65 | 54 | 45 | 37 | 31 |
| 36 | 65 | 54 | 44 | 37 | 30 |
| 37 | 64 | 53 | 44 | 36 | 30 |
| 38 | 63 | 52 | 43 | 36 | 30 |
| 39 | 63 | 52 | 43 | 36 | 29 |
| 40 | 62 | 51 | 43 | 35 | 29 |
| 41 | 62 | 51 | 42 | 35 | 29 |
| 42 | 61 | 50 | 42 | 34 | 29 |
| 43 | 60 | 50 | 41 | 34 | 28 |
| 44 | 60 | 49 | 41 | 34 | 28 |
| 45 | 59 | 49 | 40 | 33 | 28 |

| | +1 score | 0 score | -1 score | -2 score | -3 score |
|---|---|---|---|---|---|
| Age (years) | +1 SD | Norm | -1 SD | -2 SD | -3 SD |
| 46 | 59 | 48 | 40 | 33 | 27 |
| 47 | 58 | 48 | 40 | 33 | 27 |
| 48 | 57 | 47 | 39 | 32 | 27 |
| 49 | 57 | 47 | 39 | 32 | 27 |
| 50 | 56 | 47 | 38 | 32 | 26 |
| 51 | 56 | 46 | 38 | 32 | 26 |
| 52 | 55 | 46 | 38 | 31 | 26 |
| 53 | 55 | 45 | 37 | 31 | 26 |
| 54 | 54 | 45 | 37 | 31 | 25 |
| 55 | 54 | 44 | 37 | 30 | 25 |
| 56 | 53 | 44 | 36 | 30 | 25 |
| 57 | 52 | 43 | 36 | 30 | 25 |
| 58 | 52 | 43 | 36 | 29 | 24 |
| 59 | 51 | 43 | 35 | 29 | 24 |
| 60 | 51 | 42 | 35 | 29 | 24 |
| 61 | 59 | 42 | 34 | 29 | 24 |
| 62 | 50 | 41 | 34 | 28 | 23 |
| 63 | 49 | 41 | 34 | 28 | 23 |
| 64 | 49 | 40 | 33 | 28 | 23 |
| 65 | 48 | 40 | 33 | 27 | 23 |
| 66 | 48 | 40 | 33 | 27 | 22 |
| 67 | 47 | 39 | 32 | 27 | 22 |
| 68 | 47 | 39 | 32 | 27 | 22 |
| 69 | 47 | 38 | 32 | 26 | 22 |
| 70 | 46 | 38 | 32 | 26 | 22 |
| 71 | 46 | 38 | 31 | 26 | 21 |
| 72 | 45 | 37 | 31 | 26 | 21 |
| 73 | 45 | 37 | 31 | 25 | 21 |
| 74 | 44 | 37 | 30 | 25 | 21 |
| 75 | 44 | 36 | 30 | 25 | 21 |
| 76 | 43 | 36 | 30 | 25 | 20 |
| 77 | 43 | 36 | 29 | 25 | 20 |
| 78 | 43 | 35 | 29 | 24 | 20 |
| 79 | 42 | 35 | 29 | 24 | 20 |
| 80 | 42 | 34 | 29 | 24 | 20 |

# EVALUATION SHEETS OF STATISTICAL NORMS– NUMBER CONNECTION TEST A (NCT-A)

| | +1 score | 0 score | -1 score | -2 score | -3 score |
|---|---|---|---|---|---|
| Age (years) | +1 SD | Norm | -1 SD | -2 SD | -3 SD |
| up to 19 | 18.2 | 25.1 | 34.8 | 48.1 | 66.5 |
| 20 | 18.5 | 25.5 | 35.3 | 48.9 | 67.6 |
| 21 | 18.7 | 25.9 | 35.9 | 49.6 | 68.6 |
| 22 | 19.0 | 26.3 | 36.4 | 50.4 | 69.7 |
| 23 | 19.3 | 26.8 | 37.0 | 51.2 | 70.8 |
| 24 | 19.6 | 27.2 | 37.6 | 52.0 | 71.9 |
| 25 | 20.0 | 27.6 | 38.2 | 52.8 | 73.1 |
| 26 | 20.3 | 28.0 | 38.8 | 53.7 | 74.2 |
| 27 | 20.6 | 28.5 | 39.4 | 54.5 | 75.4 |
| 28 | 20.9 | 28.9 | 40.0 | 55.4 | 76.6 |
| 29 | 21.2 | 29.4 | 40.7 | 56.2 | 77.8 |
| 30 | 21.6 | 29.9 | 41.3 | 57.1 | 79.0 |
| 31 | 21.9 | 30.3 | 41.9 | 58.0 | 80.2 |
| 32 | 22.3 | 30.8 | 42.6 | 58.9 | 81.5 |
| 33 | 22.6 | 31.3 | 43.3 | 59.9 | 82.8 |
| 34 | 23.0 | 31.8 | 44.0 | 60.8 | 84.1 |
| 35 | 23.3 | 32.3 | 44.7 | 61.8 | 85.4 |
| 36 | 23.7 | 32.8 | 45.4 | 62.7 | 86.8 |
| 37 | 24.1 | 33.3 | 46.1 | 63.7 | 88.1 |
| 38 | 24.5 | 33.8 | 46.8 | 64.7 | 89.5 |
| 39 | 24.8 | 34.4 | 47.5 | 65.7 | 90.9 |
| 40 | 25.2 | 34.9 | 48.3 | 66.8 | 92.3 |
| 41 | 25.6 | 35.5 | 49.0 | 67.8 | 93.8 |
| 42 | 26.0 | 36.0 | 49.8 | 68.9 | 95.3 |
| 43 | 26.4 | 36.6 | 50.6 | 70.0 | 96.8 |
| 44 | 26.9 | 37.2 | 51.4 | 71.1 | 98.3 |
| 45 | 27.3 | 37.7 | 52.2 | 72.2 | 99.8 |
| 46 | 27.7 | 38.3 | 53.0 | 73.3 | 101.4 |
| 47 | 28.1 | 38.9 | 53.9 | 74.5 | 103.0 |
| 48 | 28.6 | 39.5 | 54.7 | 75.7 | 104.6 |
| 49 | 29.0 | 40.2 | 55.6 | 76.8 | 106.3 |

| | +1 score | 0 score | -1 score | -2 score | -3 score |
|---|---|---|---|---|---|
| Age (years) | +1 SD | Norm | -1 SD | -2 SD | -3 SD |
| 50 | 29.5 | 40.8 | 56.4 | 78.1 | 107.9 |
| 51 | 30.0 | 41.4 | 57.3 | 79.3 | 109.6 |
| 52 | 30.4 | 42.1 | 58.2 | 80.5 | 111.4 |
| 53 | 30.9 | 42.8 | 59.1 | 81.8 | 113.1 |
| 54 | 31.4 | 43.4 | 60.1 | 83.1 | 114.9 |
| 55 | 31.9 | 44.1 | 61.0 | 84.4 | 116.7 |
| 56 | 32.4 | 44.8 | 62.0 | 85.7 | 118.5 |
| 57 | 32.9 | 45.5 | 63.0 | 87.1 | 120.4 |
| 58 | 33.4 | 46.2 | 63.9 | 88.4 | 122.3 |
| 59 | 34.0 | 47.0 | 65.0 | 89.8 | 124.2 |
| 60 | 34.5 | 47.7 | 66.0 | 91.2 | 126.2 |
| 61 | 35.0 | 48.5 | 67.0 | 92.7 | 128.2 |
| 62 | 35.6 | 49.2 | 68.1 | 94.1 | 130.2 |
| 63 | 36.1 | 50.0 | 69.1 | 95.6 | 132.2 |
| 64 | 36.7 | 50.8 | 70.2 | 97.1 | 134.3 |
| 65 | 37.7 | 51.6 | 71.3 | 98.6 | 136.4 |
| 66 | 37.9 | 52.4 | 72.5 | 100.2 | 138.6 |
| 67 | 38.5 | 53.2 | 73.6 | 101.8 | 140.7 |
| 68 | 39.1 | 54.0 | 74.8 | 103.4 | 143.0 |
| 69 | 39.7 | 54.9 | 75.9 | 105.0 | 145.2 |

# EVALUATION SHEETS OF STATISTICAL NORMS– NUMBER CONNECTION TEST B (NCT-B)

| | +1 score | 0 score | -1 score | -2 score | -3 score |
|---|---|---|---|---|---|
| Age (years) | +1 SD | Norm | -1 SD | -2 SD | -3 SD |
| up to 19 | 38.0 | 51.1 | 68.7 | 92.2 | 123.9 |
| 20 | 38.6 | 51.9 | 69.7 | 93.6 | 125.8 |
| 21 | 39.2 | 52.7 | 70.8 | 95.0 | 127.7 |
| 22 | 39.8 | 53.5 | 71.8 | 96.5 | 129.6 |
| 23 | 40.4 | 54.3 | 72.9 | 97.9 | 131.6 |
| 24 | 41.0 | 55.1 | 74.0 | 99.4 | 133.6 |
| 25 | 41.6 | 55.9 | 75.1 | 100.9 | 135.6 |
| 26 | 42.3 | 56.8 | 76.3 | 102.5 | 137.6 |
| 27 | 42.9 | 57.6 | 77.4 | 104.0 | 139.7 |
| 28 | 43.5 | 58.3 | 78.6 | 105.6 | 141.8 |
| 29 | 44.2 | 59.4 | 79.8 | 107.2 | 144.0 |
| 30 | 44.9 | 60.3 | 81.0 | 108.8 | 146.1 |
| 31 | 45.6 | 61.2 | 82.2 | 110.4 | 148.3 |
| 32 | 46.2 | 62.1 | 83.5 | 112.1 | 150.6 |
| 33 | 46.9 | 63.1 | 84.7 | 113.8 | 152.9 |
| 34 | 47.7 | 64.0 | 86.0 | 115.5 | 155.2 |
| 35 | 48.4 | 65.0 | 87.3 | 117.3 | 157.5 |
| 36 | 49.1 | 66.0 | 88.6 | 119.0 | 159.9 |
| 37 | 49.9 | 67.0 | 90.0 | 120.8 | 162.3 |
| 38 | 50.6 | 68.0 | 91.3 | 122.7 | 164.8 |
| 39 | 51.4 | 69.0 | 92.7 | 124.5 | 167.3 |
| 40 | 52.1 | 70.1 | 94.1 | 126.4 | 169.8 |
| 41 | 52.9 | 71.1 | 95.5 | 128.3 | 172.4 |
| 42 | 53.7 | 72.2 | 97.0 | 130.3 | 175.0 |
| 43 | 54.6 | 73.3 | 98.4 | 132.2 | 177.6 |
| 44 | 55.4 | 74.4 | 99.9 | 134.2 | 180.3 |
| 45 | 56.2 | 75.5 | 101.4 | 136.3 | 183.0 |
| 46 | 57.1 | 76.7 | 103.0 | 138.3 | 185.8 |
| 47 | 57.9 | 77.8 | 104.5 | 140.4 | 188.6 |
| 48 | 58.8 | 79.0 | 106.1 | 142.5 | 191.4 |
| 49 | 59.7 | 80.2 | 107.7 | 144.7 | 194.3 |

| | +1 score | 0 score | -1 score | -2 score | -3 score |
|---|---|---|---|---|---|
| Age (years) | +1 SD | Norm | -1 SD | -2 SD | -3 SD |
| 50 | 60.6 | 81.4 | 109.3 | 146.9 | 197.3 |
| 51 | 61.5 | 82.6 | 111.0 | 149.1 | 200.3 |
| 52 | 62.4 | 83.9 | 112.7 | 151.3 | 203.3 |
| 53 | 63.4 | 85.1 | 114.4 | 153.6 | 206.4 |
| 54 | 64.3 | 86.4 | 116.1 | 156.0 | 209.5 |
| 55 | 65.3 | 87.7 | 117.9 | 158.3 | 212.6 |
| 56 | 66.3 | 89.1 | 119.6 | 160.7 | 215.9 |
| 57 | 67.3 | 90.4 | 121.5 | 163.1 | 219.1 |
| 58 | 68.3 | 91.8 | 123.3 | 165.6 | 222.4 |
| 59 | 69.4 | 93.2 | 125.2 | 168.1 | 225.8 |
| 60 | 70.4 | 94.6 | 127.0 | 170.7 | 229.2 |
| 61 | 71.5 | 96.0 | 129.0 | 173.2 | 232.7 |
| 62 | 72.6 | 97.5 | 130.9 | 175.8 | 236.2 |
| 63 | 73.7 | 98.9 | 132.9 | 178.5 | 239.8 |
| 64 | 74.8 | 100.4 | 134.9 | 181.2 | 243.4 |
| 65 | 75.9 | 102.0 | 136.9 | 183.9 | 247.1 |
| 66 | 77.0 | 103.5 | 139.0 | 186.7 | 250.8 |
| 67 | 78.2 | 105.1 | 141.1 | 189.5 | 254.6 |
| 68 | 79.4 | 106.6 | 143.3 | 192.4 | 258.4 |
| 69 | 80.6 | 108.3 | 145.4 | 195.3 | 262.4 |

# EVALUATION SHEETS OF STATISTICAL NORMS– SERIAL DOTTING TEST

| | +1 score | 0 score | -1 score | -2 score | -3 score |
|---|---|---|---|---|---|
| Age (years) | +1 SD | Norm | -1 SD | -2 SD | -3 SD |
| 15 | 31 | 36 | 43 | 50 | 59 |
| 16 | 31 | 36 | 43 | 50 | 59 |
| 17 | 31 | 37 | 43 | 51 | 59 |
| 18 | 31 | 37 | 43 | 51 | 60 |
| 19 | 32 | 37 | 43 | 51 | 60 |
| 20 | 32 | 37 | 44 | 51 | 60 |
| 21 | 32 | 37 | 44 | 52 | 61 |
| 22 | 32 | 38 | 44 | 52 | 61 |
| 23 | 32 | 38 | 44 | 52 | 61 |
| 24 | 32 | 38 | 45 | 52 | 61 |
| 25 | 32 | 38 | 45 | 53 | 62 |
| 26 | 33 | 38 | 45 | 53 | 62 |
| 27 | 33 | 38 | 45 | 53 | 62 |
| 28 | 33 | 39 | 45 | 53 | 63 |
| 29 | 33 | 39 | 46 | 54 | 63 |
| 30 | 33 | 39 | 46 | 54 | 63 |
| 31 | 33 | 39 | 46 | 54 | 64 |
| 32 | 33 | 39 | 46 | 54 | 64 |
| 33 | 34 | 40 | 46 | 55 | 64 |
| 34 | 34 | 40 | 47 | 55 | 64 |
| 35 | 34 | 40 | 47 | 55 | 65 |
| 36 | 34 | 40 | 47 | 55 | 65 |
| 37 | 34 | 40 | 47 | 56 | 65 |
| 38 | 34 | 40 | 48 | 56 | 66 |
| 39 | 35 | 41 | 48 | 56 | 66 |
| 40 | 35 | 41 | 48 | 56 | 66 |
| 41 | 35 | 41 | 48 | 57 | 67 |
| 42 | 35 | 41 | 48 | 57 | 67 |
| 43 | 35 | 41 | 49 | 57 | 67 |
| 44 | 35 | 42 | 49 | 57 | 68 |
| 45 | 36 | 42 | 49 | 58 | 68 |

| | +1 score | 0 score | -1 score | -2 score | -3 score |
|---|---|---|---|---|---|
| Age (years) | +1 SD | Norm | -1 SD | -2 SD | -3 SD |
| 46 | 36 | 42 | 49 | 58 | 68 |
| 47 | 36 | 42 | 50 | 58 | 68 |
| 48 | 36 | 42 | 50 | 59 | 69 |
| 49 | 36 | 43 | 50 | 59 | 69 |
| 50 | 36 | 43 | 50 | 59 | 69 |
| 51 | 37 | 43 | 51 | 59 | 70 |
| 52 | 37 | 43 | 51 | 60 | 70 |
| 53 | 37 | 43 | 51 | 60 | 70 |
| 54 | 37 | 44 | 51 | 60 | 71 |
| 55 | 37 | 44 | 52 | 61 | 71 |
| 56 | 37 | 44 | 52 | 61 | 71 |
| 57 | 38 | 44 | 52 | 61 | 72 |
| 58 | 38 | 44 | 52 | 61 | 72 |
| 59 | 38 | 45 | 52 | 62 | 72 |
| 60 | 38 | 45 | 53 | 62 | 73 |
| 61 | 38 | 45 | 53 | 62 | 73 |
| 62 | 39 | 45 | 53 | 63 | 73 |
| 63 | 39 | 46 | 53 | 63 | 74 |
| 64 | 39 | 46 | 54 | 63 | 74 |
| 65 | 39 | 46 | 54 | 63 | 75 |
| 66 | 39 | 46 | 54 | 64 | 75 |
| 67 | 39 | 46 | 54 | 64 | 75 |
| 68 | 40 | 47 | 55 | 64 | 76 |
| 69 | 40 | 47 | 55 | 65 | 76 |
| 70 | 40 | 47 | 55 | 65 | 76 |
| 71 | 40 | 47 | 56 | 65 | 77 |
| 72 | 40 | 47 | 56 | 66 | 77 |
| 73 | 41 | 48 | 56 | 66 | 77 |
| 74 | 41 | 48 | 56 | 66 | 78 |
| 75 | 41 | 48 | 57 | 66 | 78 |
| 76 | 41 | 48 | 57 | 67 | 78 |
| 77 | 41 | 49 | 57 | 67 | 79 |
| 78 | 42 | 49 | 57 | 67 | 79 |
| 79 | 42 | 49 | 58 | 68 | 80 |
| 80 | 42 | 49 | 58 | 68 | 80 |

# EVALUATION SHEETS OF STATISTICAL NORMS– LINE TRACING (TIME)

| | +1 score | 0 score | -1 score | -2 score | -3 score |
|---|---|---|---|---|---|
| Age (years) | +1 SD | Norm | -1 SD | -2 SD | -3 SD |
| 15 | 37 | 49 | 66 | 89 | 119 |
| 16 | 37 | 50 | 67 | 89 | 120 |
| 17 | 37 | 50 | 67 | 90 | 121 |
| 18 | 38 | 50 | 67 | 90 | 121 |
| 19 | 38 | 51 | 68 | 91 | 122 |
| 20 | 38 | 51 | 68 | 92 | 123 |
| 21 | 38 | 51 | 69 | 92 | 124 |
| 22 | 39 | 52 | 69 | 93 | 125 |
| 23 | 39 | 52 | 70 | 94 | 125 |
| 24 | 39 | 52 | 70 | 94 | 126 |
| 25 | 39 | 53 | 71 | 95 | 127 |
| 26 | 40 | 53 | 71 | 95 | 128 |
| 27 | 40 | 53 | 72 | 96 | 129 |
| 28 | 40 | 54 | 72 | 97 | 130 |
| 29 | 40 | 54 | 73 | 97 | 131 |
| 30 | 41 | 55 | 73 | 98 | 131 |
| 31 | 41 | 55 | 74 | 99 | 132 |
| 32 | 41 | 55 | 74 | 99 | 133 |
| 33 | 42 | 56 | 75 | 100 | 134 |
| 34 | 42 | 56 | 75 | 101 | 135 |
| 35 | 42 | 56 | 76 | 101 | 136 |
| 36 | 42 | 57 | 76 | 102 | 137 |
| 37 | 43 | 57 | 77 | 103 | 138 |
| 38 | 43 | 58 | 77 | 103 | 139 |
| 39 | 43 | 58 | 78 | 104 | 140 |
| 40 | 43 | 58 | 78 | 105 | 141 |
| 41 | 44 | 59 | 79 | 106 | 142 |
| 42 | 44 | 59 | 79 | 106 | 142 |
| 43 | 44 | 60 | 80 | 107 | 143 |
| 44 | 45 | 60 | 80 | 108 | 144 |
| 45 | 45 | 60 | 81 | 108 | 145 |

| | +1 score | 0 score | -1 score | -2 score | -3 score |
|---|---|---|---|---|---|
| Age (years) | +1 SD | Norm | -1 SD | -2 SD | -3 SD |
| 46 | 45 | 61 | 81 | 109 | 146 |
| 47 | 46 | 61 | 82 | 110 | 147 |
| 48 | 46 | 62 | 83 | 111 | 148 |
| 49 | 46 | 62 | 83 | 111 | 149 |
| 50 | 47 | 62 | 84 | 112 | 150 |
| 51 | 47 | 63 | 84 | 113 | 151 |
| 52 | 47 | 63 | 85 | 114 | 152 |
| 53 | 47 | 64 | 85 | 114 | 153 |
| 54 | 48 | 64 | 86 | 115 | 154 |
| 55 | 48 | 64 | 86 | 116 | 155 |
| 56 | 48 | 65 | 87 | 117 | 156 |
| 57 | 49 | 65 | 88 | 117 | 158 |
| 58 | 49 | 66 | 88 | 118 | 159 |
| 59 | 49 | 66 | 89 | 119 | 160 |
| 60 | 50 | 67 | 89 | 120 | 161 |
| 61 | 50 | 67 | 90 | 121 | 162 |
| 62 | 50 | 68 | 91 | 122 | 163 |
| 63 | 51 | 68 | 91 | 122 | 164 |
| 64 | 51 | 68 | 92 | 123 | 165 |
| 65 | 51 | 69 | 92 | 124 | 166 |
| 66 | 52 | 69 | 93 | 125 | 167 |
| 67 | 52 | 70 | 94 | 126 | 168 |
| 68 | 52 | 70 | 94 | 126 | 170 |
| 69 | 53 | 71 | 95 | 127 | 171 |
| 70 | 53 | 71 | 96 | 128 | 172 |
| 71 | 54 | 72 | 96 | 129 | 173 |
| 72 | 54 | 72 | 97 | 130 | 174 |
| 73 | 54 | 73 | 98 | 131 | 175 |
| 74 | 55 | 73 | 98 | 132 | 177 |
| 75 | 55 | 74 | 99 | 133 | 178 |
| 76 | 55 | 74 | 100 | 133 | 179 |
| 77 | 56 | 75 | 100 | 134 | 180 |
| 78 | 56 | 75 | 101 | 135 | 181 |
| 79 | 56 | 76 | 102 | 136 | 183 |
| 80 | 57 | 76 | 102 | 137 | 184 |

# EVALUATION SHEETS OF STATISTICAL NORMS– LINE TRACING (ERRORS)

| | +1 score | 0 score | -1 score | -2 score | -3 score |
|---|---|---|---|---|---|
| Age (years) | +1 SD | Norm | -1 SD | -2 SD | -3 SD |
| 15 | 12 | 29 | 54 | 87 | 128 |
| 16 | 12 | 29 | 54 | 87 | 128 |
| 17 | 12 | 30 | 55 | 88 | 129 |
| 18 | 12 | 30 | 55 | 88 | 129 |
| 19 | 12 | 30 | 56 | 89 | 130 |
| 20 | 13 | 30 | 56 | 90 | 131 |
| 21 | 13 | 31 | 57 | 90 | 131 |
| 22 | 13 | 31 | 57 | 91 | 132 |
| 23 | 13 | 31 | 57 | 91 | 133 |
| 24 | 13 | 32 | 58 | 92 | 133 |
| 25 | 14 | 32 | 58 | 92 | 134 |
| 26 | 14 | 32 | 59 | 93 | 135 |
| 27 | 14 | 33 | 59 | 93 | 135 |
| 28 | 14 | 33 | 60 | 94 | 136 |
| 29 | 14 | 33 | 60 | 94 | 137 |
| 30 | 15 | 34 | 60 | 95 | 137 |
| 31 | 15 | 34 | 61 | 95 | 138 |
| 32 | 15 | 34 | 61 | 96 | 138 |
| 33 | 15 | 35 | 62 | 97 | 139 |
| 34 | 16 | 35 | 62 | 97 | 140 |
| 35 | 16 | 35 | 63 | 98 | 140 |
| 36 | 16 | 36 | 63 | 98 | 141 |
| 37 | 16 | 36 | 63 | 99 | 142 |
| 38 | 16 | 36 | 64 | 99 | 142 |
| 39 | 17 | 37 | 64 | 100 | 143 |
| 40 | 17 | 37 | 65 | 100 | 144 |
| 41 | 17 | 37 | 65 | 101 | 144 |
| 42 | 17 | 38 | 66 | 102 | 145 |
| 43 | 18 | 38 | 66 | 102 | 146 |
| 44 | 18 | 38 | 67 | 103 | 147 |
| 45 | 18 | 39 | 67 | 103 | 147 |

| | +1 score | 0 score | -1 score | -2 score | -3 score |
|---|---|---|---|---|---|
| Age (years) | +1 SD | Norm | -1 SD | -2 SD | -3 SD |
| 46 | 18 | 39 | 68 | 104 | 148 |
| 47 | 19 | 39 | 68 | 104 | 149 |
| 48 | 19 | 40 | 68 | 105 | 149 |
| 49 | 19 | 40 | 69 | 106 | 150 |
| 50 | 19 | 40 | 69 | 106 | 151 |
| 51 | 20 | 41 | 70 | 107 | 151 |
| 52 | 20 | 41 | 70 | 107 | 152 |
| 53 | 20 | 42 | 71 | 108 | 153 |
| 54 | 20 | 42 | 71 | 108 | 153 |
| 55 | 21 | 42 | 72 | 109 | 154 |
| 56 | 21 | 43 | 72 | 110 | 155 |
| 57 | 21 | 43 | 73 | 110 | 155 |
| 58 | 21 | 43 | 73 | 111 | 156 |
| 59 | 22 | 44 | 74 | 111 | 157 |
| 60 | 22 | 44 | 74 | 112 | 158 |
| 61 | 22 | 44 | 75 | 113 | 158 |
| 62 | 22 | 45 | 75 | 113 | 159 |
| 63 | 23 | 45 | 76 | 114 | 160 |
| 64 | 23 | 46 | 76 | 114 | 160 |
| 65 | 23 | 46 | 77 | 115 | 161 |
| 66 | 23 | 46 | 77 | 116 | 162 |
| 67 | 24 | 47 | 78 | 116 | 163 |
| 68 | 24 | 47 | 78 | 117 | 163 |
| 69 | 24 | 48 | 79 | 117 | 164 |
| 70 | 25 | 48 | 79 | 118 | 165 |
| 71 | 25 | 48 | 80 | 119 | 165 |
| 72 | 25 | 49 | 80 | 119 | 166 |
| 73 | 25 | 49 | 81 | 120 | 167 |
| 74 | 26 | 49 | 81 | 120 | 168 |
| 75 | 26 | 50 | 82 | 121 | 168 |
| 76 | 26 | 50 | 82 | 122 | 169 |
| 77 | 27 | 51 | 83 | 122 | 170 |
| 78 | 27 | 51 | 83 | 123 | 170 |
| 79 | 27 | 51 | 84 | 124 | 171 |
| 80 | 27 | 52 | 84 | 124 | 172 |

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