



ESET: Easy Strength and Endurance Test

Author(s): Dr. Jerry Medernach
Issue: 2015/1

Introduction

ESET (Easy Strength and Endurance Test) was developed by Dr. Jerry Medernach at the German Sport University Cologne and is a simple method to investigate grip strength and endurance in intermediate to advanced climbers. Data from ESET are used to establish an individual four-week fingerboard regimen. ESET is easily accessible, has low space requirements and purchase prices, and enables fingerboarding at individual training intensities.

In the study of the German Sport University Cologne [4], the results of 24 intermediate male sport climbers after a four-week fingerboard regimen (one session / week) display an increase of the hanging times to exhaustion of up to ~38% and a maximum finger strength increase of about 80% after a 12-week training regimen.

Details:

- Test duration: ~60 min (without warm-up)
- Duration of the training regimen: four-week periodization
- Training frequency: 2-3 sessions per week
- Duration of the training session: ~2 hours

Step 1: The fingerboard

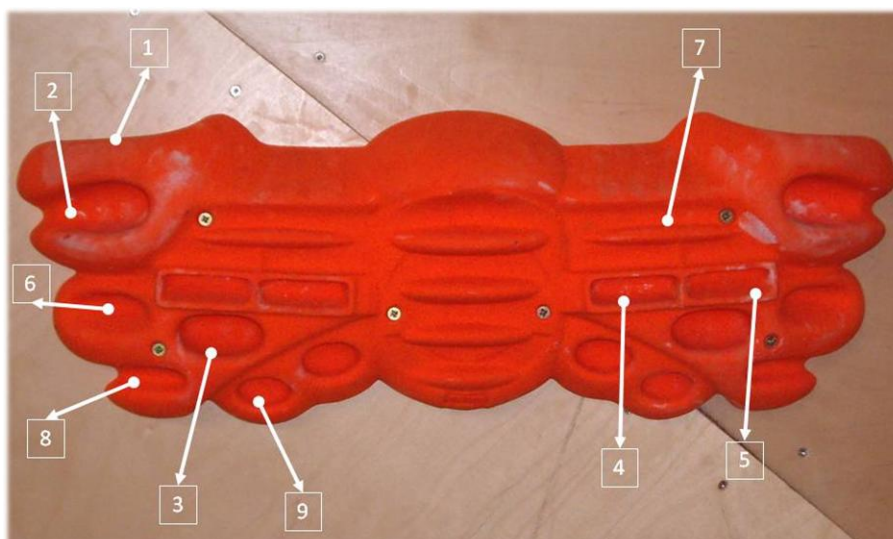
ESET and the subsequent training sessions are performed on a fingerboard. Although ESET can be applied to almost all types of fingerboards, it is recommended to use a high-quality tool with various grip sizes and grip shapes [4]. In addition to the fingerboard, ESET requires:

- a stopwatch,
- a brush to clean the grips,
- chalk to dry your hands,
- a weight vest or additional weights,
- a thermometer to determine changes in the temperature,
- and a diagnostic sheet with a form to determine the perceived physical state (annexed).

Step 2: Give numbers to the grips

In this second step, numbers are given in descending order to the different grips of the fingerboard that is used. To give an example, the fingerboard of the manufacturer CORE CLIMBING (Sheffield, UK) is used in this guide (see figure below). GRIP 1 is the easiest hold on the fingerboard, GRIP 2 is a bit harder to hang on to, and so on, until every grip has a number. The total number of grips depends on the fingerboard that is used. In addition, some grips are more or less similar (or even hurt), so that it's not worth giving a number to each of them. Moreover, always consider the principle of individuality:

The numbers one person may give to the grips can slightly differ from the numbers given by another person. If the fingerboard does not have enough grips, additional weight can be used to intensify the effort and to “create” additional grips that are harder to hang on to. It is recommended to start with additional 2 kg and to continue by adding systematically 2 kg.



Step 3: Warm-up

Although the warm-up should be individual (according to the principle of individualization), the program should be broadly equal for all tests in order to minimize the risk of collecting erroneous data due to different warm-up regimens [5]. After the warm-up, a standardized rest of 5 min is required.

Step 4: The tests

- **Test 1:** The first test investigates the hanging times in seconds until exhaustion with a 90° flexion at the elbow joint. The start is on GRIP 1, on which the athlete should hang to exhaustion. The hanging performance should be noted in the diagnostic sheet (annexed) and a standardized rest of 7 min should be implemented. This process is repeated for GRIP 2, GRIP 3, and so on, until a grip is reached, on which the maximum hanging time to exhaustion is about 5-10 s. This grip is defined in the diagnostic sheet as **MAX_{hold}**. To give an example, let's say that the **MAX_{hold}** is GRIP 7.
- **Test 2:** This intermittent endurance test (**IET_{Bouldering}**) is used to investigate the bouldering-specific grip endurance (sport climbers are referred to Test 3). The hanging time is 6 s with extended arms and a rest time between the repetitions of 3 s (work-to-rest ratio of 2:1). The test is repeated until exhaustion and the total number of repetitions is noted in the diagnostic sheet. **IET_{Bouldering}** is performed on the **MAX_{Hold}-2**. This corresponds in the given example to GRIP 5 (GRIP 7 - 2), which is two numbers lower (means better) than **MAX_{hold}**. If the fingerboard does not enable to jump down two grips (e.g. not enough grips on your fingerboard), **IET_{Bouldering}** should be performed on GRIP 1 (the easiest GRIP).

- **Test 3:** This intermittent endurance test (**IET_{Climbing}**) is used to investigate the climbing-specific grip endurance. The hanging time is 10 s with extended arms and a rest time between the repetitions of 5 s (work-to-rest ratio of 2:1). Again, the test is repeated to exhaustion and the total number of repetitions noted in the diagnostic sheet. **IET_{Climbing}** is performed on **MAX_{Hold-3}**. In the given example, this would be GRIP 4. In the case the fingerboard does not enable to jump down three grips, **IET_{Bouldering}** should be performed on GRIP 1.

Note:

- To guarantee reliable data collections, the tests should always be performed at the same time of day [5].
- In addition, standardized rest times of 48 hrs before testing, as well as the rest time of 7 min between the attempts and the different tests, have to be guaranteed [4-5].
- The perceived physical state should always be controlled [4-5]. When data shows weak results, an additional rest day should be considered.
- To ensure standardized conditions, the same chalk and brush to clean the holds should be used for all tests [5].
- Changes of the temperature and the body weight can noticeably influence the hanging time to exhaustion [4].
- The standardized data collection does not implement the use of the thumb as the thumb can exert a supplementary force [8].
- The fingerboard should be fixed at head-height to guarantee sufficient leg space [4].
- Always verify an exact 90° flexion at the elbow joint to enable a standardized test implementation [4].
- Some fingerboards do not permit a continuous gradation from GRIP 1 to GRIP X. Therefore, it may be that the intensity increase between the grips is not continuous. Before doing the tests, it is recommended to extensively test the numbers of the different grips.

Step 5: Training Design

The tests in step 4 should be considered as a first training session of the four-week regimen. A rest time of 48 hrs is recommended before the following sessions are performed. These are based, according to the principle of individualization, on the findings of step 4.

- **Grip Strength Training - Fingerboard Repeaters:** The Fingerboard Repeaters are performed on **MAX_{hold}** (in the given example GRIP 7). The hanging time is 5 s with extended arms and a rest time of 5 s (work-to-rest ratio of 1:1). The exercise is repeated about seven times with a total of five sets. The rest time between the sets is 5 min.
- **Grip Endurance Training – Bouldering Cascade:** The hanging time is 6 s with a 90° flexion at the elbow joint and a rest time of 3 s (work-to-rest ratio of 2:1). The exercise is repeated eight times with a total of three sets. The rest time between the sets is 7 min. The first two repetitions are performed on **MAX_{hold -1}** (in the given example GRIP 6), the third and fourth repetition on **MAX_{hold -2}** (GRIP 5), the fifth and sixth repetition on **MAX_{hold -3}** (GRIP 4), and the seventh and eighth repetition on **MAX_{hold -4}** (GRIP 3). If the fingerboard is not equipped with enough grips to enable a total of eight repetitions on different grips, the remaining repetitions should be performed on GRIP 1 (see Table on page 6).
- **Grip Endurance Training – Climbing Cascade:** The hanging time is 10 s with a 90° flexion at the elbow joint and a rest of 5 s (work-to-rest ratio 2:1). The exercise is repeated eight times with a total of three sets. The first repetition is performed on **MAX_{hold -1}** (in the given example



GRIP 6), the second repetition on $MAX_{hold} -2$ (GRIP 5), the third repetition on $MAX_{hold} -3$ (GRIP 4), and so on, until a total number of eight repetitions is obtained. The rest time between the different sets is 7 min. Again, if the fingerboard is not equipped with enough grips to enable a total of eight repetitions on different grips, the remaining repetitions should be performed on GRIP 1.

Note:

- The four-week regimen is based on the findings of the study of the German Sport University Cologne, in which the highest gains could be displayed during the first four weeks [4]. Moreover, according to the principle of variation, uniform training regimens over a longer period of time lead to performance stagnation [3].
- In climbing, multiple variables, such as climbing skills, flexibility, and individual tactics are required. Therefore, fingerboarding to increase grip strength and endurance is only one part of the multi-factor strategy in training [3,6].
- The increases of grip strength and endurance depend on the climbing ability level. Improvements will take more time in advanced climbers compared with intermediate climbers [3].
- Since grip strength and endurance are gained in isolation, enhanced climbing or bouldering performances will take some additional time [6].
- Slight adjustment with regard to the different grips may be possible due to internal (e.g. recovery state) and external factors (e.g. room temperature).
- To reduce the risk of injuries, maximum hanging time should be higher than 5 s [4].
- Physical exhaustion is a prerequisite to maintain reliable data [4]. Therefore, psychological factors may potentially cause variability in the results [6].

Step 6: Retest

A retest should be performed after the 4-week training regimen with a rest time of 48 hrs before testing.

Training	Description	Grip		Picture
Grip Strength Training	Fingerboard Repeaters: extended Hang 5 s Rest 5 s 7 reps 5 sets	MAX _{hold}	GRIP 7	
Grip Endurance Training	Bouldering Cascade: 90° at elbow joint Hang for 6 s Rest for 3 s 8 reps 3 sets	Rep 1+2: MAX _{hold -1}	GRIP 6 (7-1)	
		Rep 3+4: MAX _{hold -2}	GRIP 5 (7-2)	
		Rep 5+6: MAX _{hold -3}	GRIP 4 (7-3)	
		Rep 7+8: MAX _{hold -4}	GRIP 3 (7-4)	
Grip Endurance Training	Climbing Cascade: 90° at elbow joint Hang for 10 s Rest for 5 s 8 reps 5 sets	Rep 1: MAX _{hold -1}	GRIP 6 (7-1)	
		Rep 2: MAX _{hold -2}	GRIP 5 (7-2)	
		Rep 3: MAX _{hold -3}	GRIP 4 (7-3)	
		Rep 4: MAX _{hold -4}	GRIP 3 (7-4)	
		Rep 5: MAX _{hold -5}	GRIP 2 (7-5)	
		Rep 6: MAX _{hold -6}	GRIP 1 (7-6)	
		Rep 7: MAX _{hold -7}	GRIP 1 (7-7)	
		Rep 8: MAX _{hold -7}	GRIP 1 (7-7)	

Overview of the grips

Training								
Grip Strength Training	Grip Endurance Training Bouldering Cascade							
	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 6	Rep 7	Rep 8
MAX _{hold}	MAX _{hold} -1	MAX _{hold} -1	-2	-2	-3	-3	-4	-4
15	14		13		12		11	
14	13		12		11		10	
13	12		11		10		9	
12	11		10		9		8	
11	10		9		8		7	
10	9		8		7		6	
9	8		7		6		5	
8	7		6		5		4	
7	6		5		4		3	
6	5		4		3		2	
5	4		3		2		1	
4	3		2		1		1	
3	2		1		1		1	
2	1		1		1		1	

Training								
Grip Strength Training	Grip Endurance Training Climbing Cascade							
	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 6	Rep 7	Rep 8
MAX _{hold}	MAX _{hold} -1	-2	-3	-4	-5	-6	-7	-8
15	14	13	12	11	10	9	8	7
14	13	12	11	10	9	8	7	6
13	12	11	10	9	8	7	6	5
12	11	10	9	8	7	6	5	4
11	10	9	8	7	6	5	4	3
10	9	8	7	6	5	4	3	2
9	8	7	6	5	4	3	2	1
8	7	6	5	4	3	2	1	1
7	6	5	4	3	2	1	1	1
6	5	4	3	2	1	1	1	1
5	4	3	2	1	1	1	1	1
4	3	2	1	1	1	1	1	1
3	2	1	1	1	1	1	1	1
2	1	1	1	1	1	1	1	1



Diagnostic sheet [EXAMPLE]

Date: 22.08.2015

Day: Saturday

First name: Test **Surname:** Person **Age:** 26 **Gender:** W / M

Boulderer / **Sport Climber**

Temperature: 21 °C **Weight:** 72 kg **Height:** 176 cm

Climbing since: 10 years

Ability level: 7c ~~Sport Climbing~~ / Bouldering / ~~Onsight~~ / Redpoint / ~~Indoor~~ / Outdoor

Hours of sleep: 7 hrs

Sleep quality:

[1] very bad

[2] bad

[3] medium

[4] good

[5] very good

[6] excellent

Perceived physical state:

[1] very week

[2] week

[3] medium

[4] good

[5] very good

[6] excellent

Hanging times: 90° flexion at the elbow joint, standardized rest time of 7 min

GRIP 1: 75 s	GRIP 2: 63 s	GRIP 3: 45 s	GRIP 4: 34 s	GRIP 5: 28 s
GRIP 6: 17 s	GRIP 7: 9 s	GRIP 8: /	GRIP 9: /	GRIP 10: /
GRIP 11: /	GRIP 12: /	GRIP 13: /	GRIP 14: /	GRIP 15: /

MAX_{hold}: GRIP 7 (should be hold maximum 5-10 s)

IET_{Bouldering} (jump down two GRIPS): GRIP 5 **Number of repetitions [n]:** 8

IET_{Climbing}: (jump down three GRIPS): GRIP 4 **Number of repetitions [n]:** 11

Complaints:

Notes:



Diagnostic sheet

Date: __.__.20__

Day: _____

First name: Surname: Age: Gender: W / M

Boulderer / Sport Climber

Temperature: °C Weight: kg Height: cm

Climbing since: years

Ability level: Sport Climbing / Bouldering / Onsight / Redpoint / Indoor / Outdoor

Hours of sleep: hrs

Sleep quality:

- [1] very bad
- [2] bad
- [3] medium
- [4] good
- [5] very good
- [6] excellent

Perceived physical state:

- [1] very week
- [2] week
- [3] medium
- [4] good
- [5] very good
- [6] excellent

Hanging times: 90° flexion at the elbow joint, standardized rest time of 7 min

GRIP 1:	GRIP 2:	GRIP 3:	GRIP 4:	GRIP 5:
GRIP 6:	GRIP 7:	GRIP 8:	GRIP 9:	GRIP 10:
GRIP 11:	GRIP 12:	GRIP 13:	GRIP 14:	GRIP 15:

MAX_{hold}: GRIP (should be hold maximum 5-10 s)

IET_{Bouldering} (jump down two GRIPS): GRIP Number of repetitions [n]:

IET_{Climbing}: (jump down three GRIPS): GRIP Number of repetitions [n]:

Complaints:

Notes:



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