

MODULE: DROP JUMP

BRIEF DESCRIPTION:

Drop jump is a vertical jump and among the most often used tests for maximal anaerobic power output of the lower extremities. It is an aggressive eccentric-concentric muscle action which involves utilization of stored elastic energy, called stretch-shortening cycle. If only the plantar flexors of the foot and knee extensors play a role of prime movers in this task, the entire body and lower extremities need to be strongly activated to assure general stiffness and optimal technique. Based on the parameters derived from the ground reaction force (GRF) and flight time dynamics of this elementary movement pattern can be thoroughly studied.

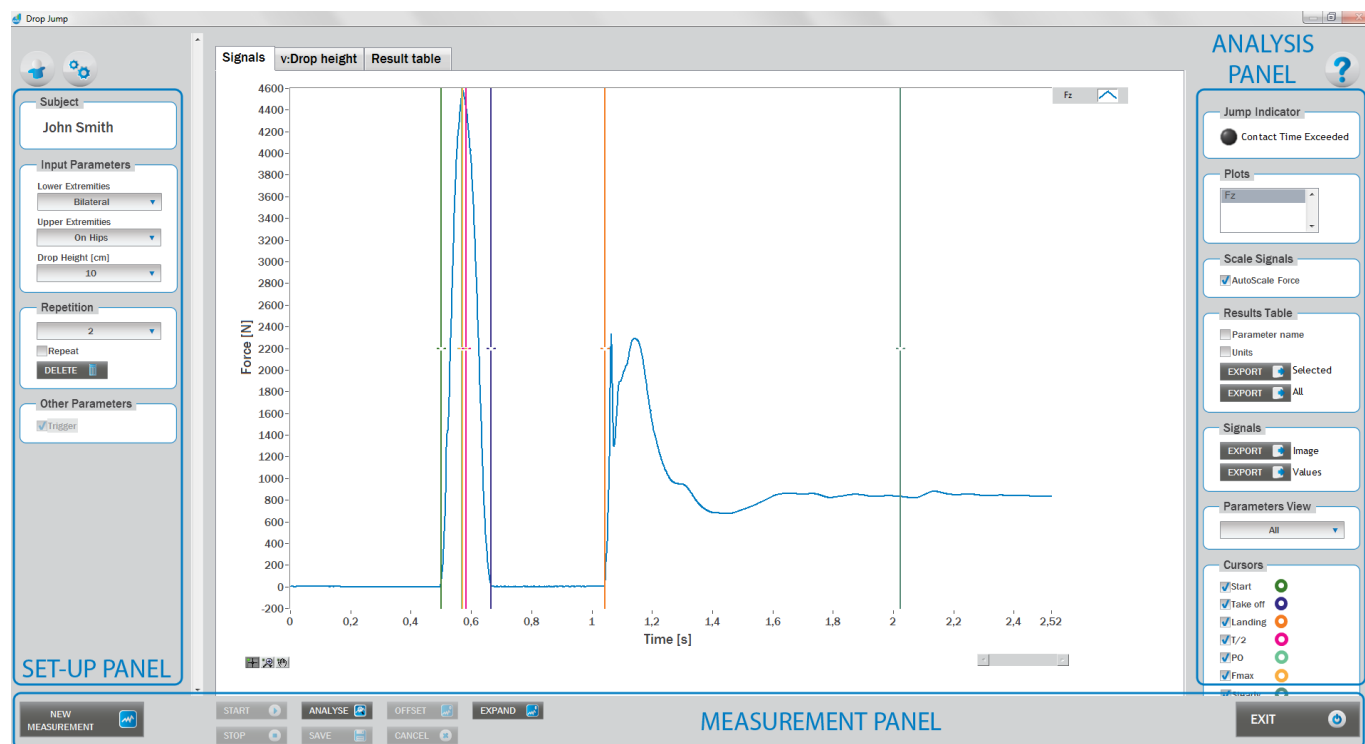
The initial position of the subject is usually in a standing position on the bench (or other surface lifted from the ground) of different heights. The height of the starting point can be adjusted to the specific goals of the measurement. From the starting position the subject performs a drop on a force plate and then a vertical push-off action as quickly and as explosively as possible in order to perform the highest possible jump in the shortest possible time; thereby using an eccentric-concentric muscle action. It is important that the subject does not strike with heels against the ground.



When the Drop Jump module opens, the existing measurements of the selected subject inside the current Visit are displayed and the user can review them (see section Analysis for details). If no measurements have yet been done for this subject, than only the option to start a new measurement is enabled. In order to begin a new measurement, click New Measurement button and select the Input Parameters to exactly define the measurement task.

When the New Measurement button is selected for the first time after entering the Drop Jump module, the force plate is initialized. After the automatic initialization process is finished, the zero offset must be done (follow the instructions on the pop-up message). The plate must be unloaded during the entire initialization and zero offset procedure. This procedure is performed every time you enter the Drop Jump measurement module. Zero offset can be repeated any time manually by pressing the Offset button, otherwise the automatic zero offset is done every 30 minutes.

BASIC FUNCTIONS:



SET-UP PANEL:

SUBJECT

Name

The selected subject.

INPUT PARAMETERS

See Selecting Input Parameters section for details.

REPETITION

Repetition

Number of repetitions for the selected Input parameters.

Repeat

If checked, the selected repetition is replaced when the new measurement is performed.

Delete

Delete the selected repetition.



OTHER PARAMETERS:

Trigger

When trigger option is selected, software will automatically cut the signal before the »first cursor« (duration is defined with Start buffer parameter) and after the »last cursor« (duration is defined with Stop buffer parameter). Start buffer and Stop buffer can be set in settings window. For details about setting the parameters refer to Settings Section.

ANALYSIS PANEL:

PLOTS

Plots

The list of all channels. The selected channels are shown on the graph.

SCALE

AutoScale Force

If checked, the vertical scale of the graph is adapted to the maximum and minimum value of all force signals.

RESULTS TABLE

In the Result Table panel, result parameters from Result table tab can be exported into clipboard, CSV or TXT format. Format of the file can be set in settings window under export section. For details about setting the parameters refer to Settings Section.

Parameter Name

Parameter name will be included.

Units

Units of the parameters will be included.

Export Selected

By clicking on Export Selected button only the parameters that are selected in the table will be included.

Export All

By clicking on Export All button all parameters from the table will be included.

SIGNALS

In the Signals panel, image or values (row data) of acquired signal can be exported. Image and values can be exported with different parameters, which can be set in Settings window under export section.

For details about setting the parameters refer to Settings Section.

Export Image

Export the image of signals (as visible on the graph on the Signals tab) into the clipboard. Image can be paste in any image editor.

Export Values

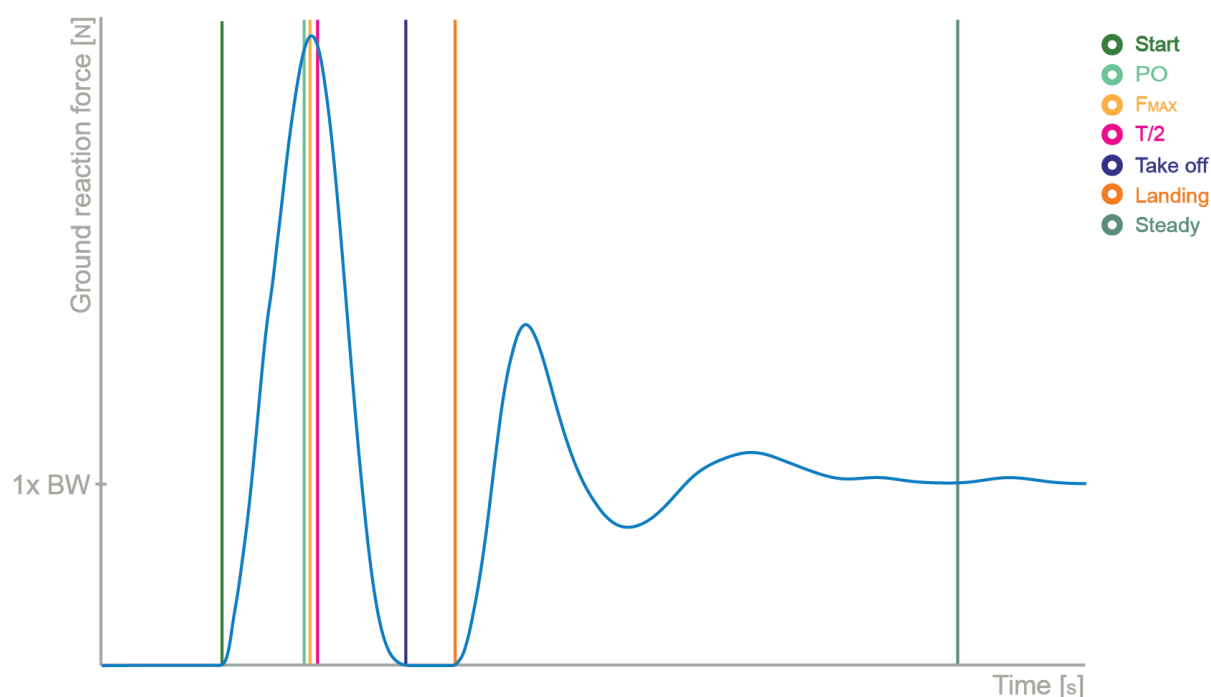
Export values (raw data) of signals (as visible on the graph on the Signals tab) into CSV or TXT format. Format of the file can be set in settings window under export section. For details about setting the parameters refer to Settings Section.

PARAMETERS VIEW

In the Parameters View panel, calculated parameters which are displayed in the result table can be set. By default, all and basic view are available. Basic view contains preset parameters and cannot be changed. Custom view can be defined, by clicking »Manage...« button.

To create a new view click on add button and enter the name of the view. Parameters included in the view are selected by checking the checkboxes next to them. To confirm the changes click save.

CURSORS:



Start

Indicates the start of the jump (start of the movement).

Take Off

Indicates the start of the flight phase.

Landing

Indicates the start of the landing.



T/2

Indicates the half of the time between the Start and Take Off event.

PO

Indicates the start of the push off.

Fmax

Indicates the maximum force between the Start and Take Off event.

Steady

Indicates the event when force becomes steady after the landing.

JUMP INDICATORS:

Indicates if contact time(time between take off and start) exceeded the Contact Time Criteria parameter which can be set under Result parameters in Settings window.

MEASUREMENT PANEL

New Measurement

Starts with a new measurement.

Start

Starts the measurement.

Stop

Stops the measurement.

Save

Saves the measurement.

Cancel

Cancel the last measurement.

Offset

Makes zero offset. Note that the force platform must be unloaded during the process.

Analyse

Performs the analysis.

Collapse

Collapses the graph and the side panels are shown.

Expand

Expands the graph and the side panels are hidden.

Exit

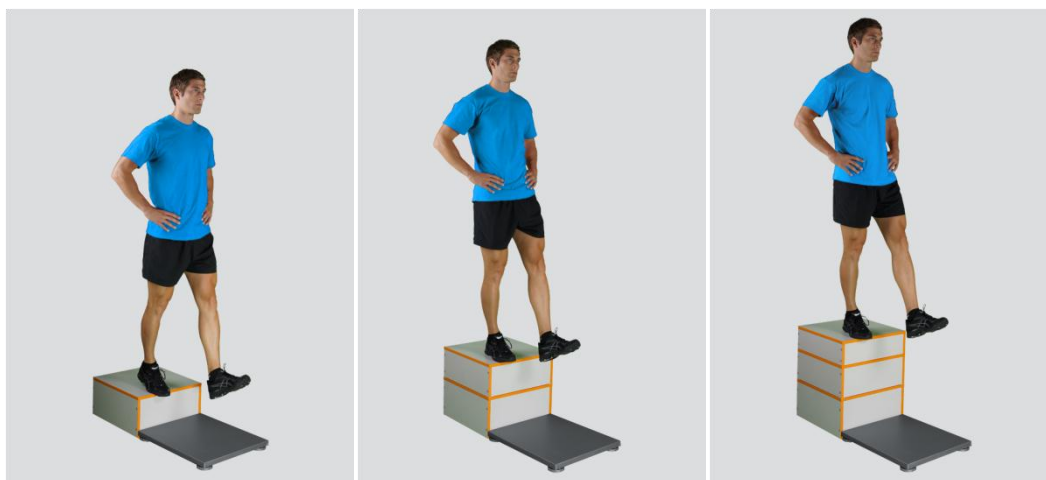
Closes the measurement module.

SELECTING INPUT PARAMETERS:

Before the measurement can start, the user has to choose some input parameters with which the measured motor task (drop jump, i.e. hop) is specifically defined. These parameters are important for further analysis, comparisons and reporting. The jump's characteristics are defined by the following parameters:

DROP HEIGHT:

- 10 cm:** select this if the starting point is 10 cm higher than the force plate
- 20 cm:** select this if the starting point is 20 cm higher than the force plate
- 30 cm:** select this if the starting point is 30 cm higher than the force plate
- 40 cm:** select this if the starting point is 40 cm higher than the force plate
- 50 cm:** select this if the starting point is 50 cm higher than the force plate
- 60 cm:** select this if the starting point is 60 cm higher than the force plate
- 70 cm:** select this if the starting point is 70 cm higher than the force plate
- 80 cm:** select this if the starting point is 80 cm higher than the force plate
- 90 cm:** select this if the starting point is 90 cm higher than the force plate
- 100 cm:** select this if the starting point is 100 cm higher than the force plate



Other user defined

In case of any other starting point height, the user can select this option and can define another height (see Settings Section for details). After doing so, the newly defined input parameter will from then on appear as an optional choice under the Starting point height in the Drop Jump measurement module.

LOWER EXTREMITIES

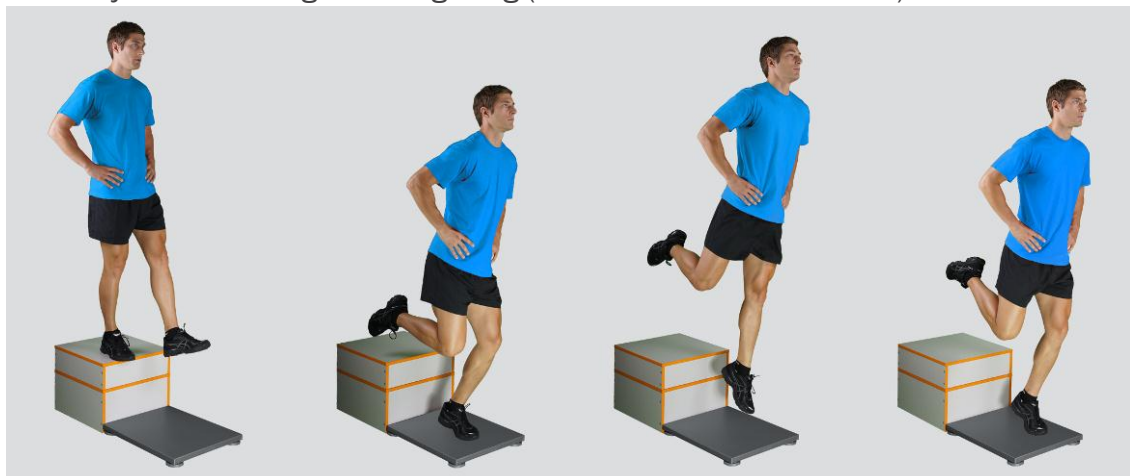
Bilateral

The subject is standing on the bench with the feet placed parallel or with toes pointing slightly outward. Feet should be shoulder-width apart. The subject needs to land and perform a push off with the same feet position.



Unilateral-Left / Unilateral-Right

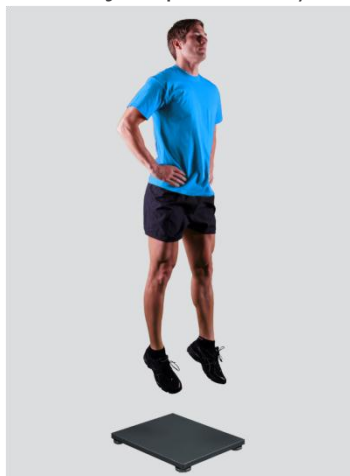
The subject is standing on a single leg (dominant or non-dominant) in the centre of the plate.



UPPER EXTREMITIES

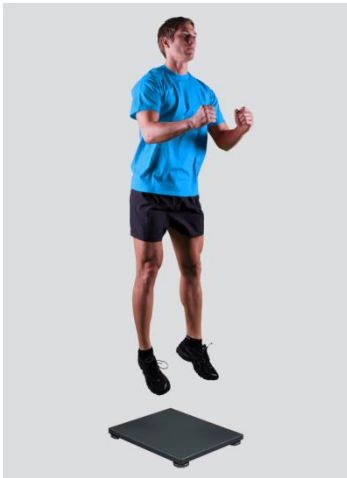
On Hips

The subject places his/her hands on his/her hips.



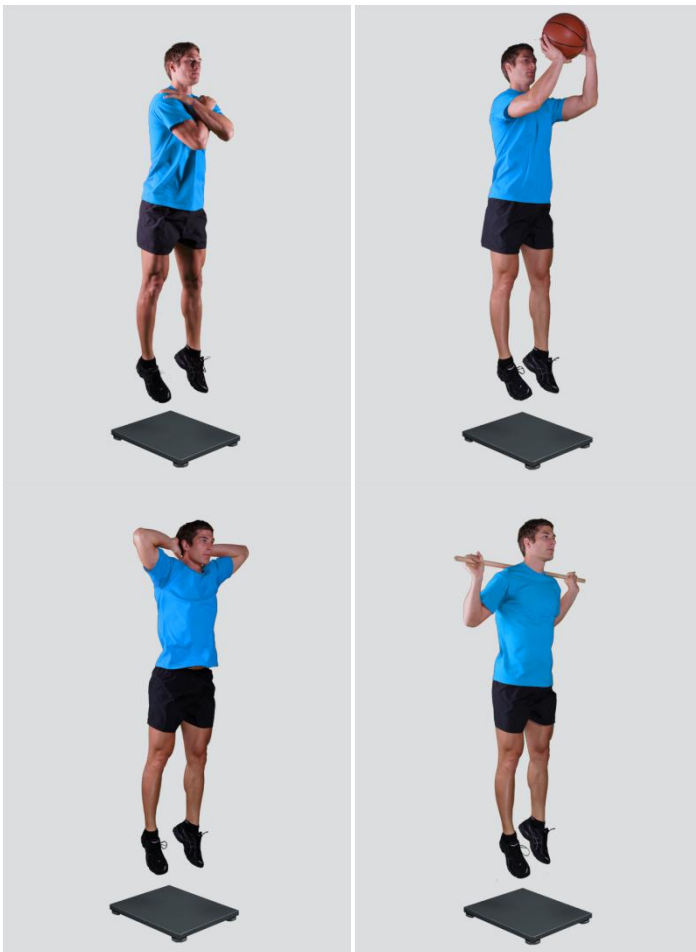
Free

Subjects are free to use their arms as they want. Specifically useful when observing how subjects differ in using arms as a biomechanical advantage.



Other user defined

In case of any other position of the upper extremities, the user can select this option and can define another function/placement of the upper extremities (see Settings Section for details). After doing so, the newly defined input parameter will from then on appear as an optional choice under the Upper extremities in the Drop Jump measurement module.





MEASUREMENT:

After selecting input parameters, the subject steps on a bench next to the force plate and acquires in a required position (i.e. upright stance). When the subject acquires the required position and is ready to start the movement, click Start. At that time, the subject is free to drop on a force plate (after landing the second time the subject must stand still until the software stops the acquisition) and the software will automatically recognize the beginning and the end of the jump. For details about this automatic acquisition please see Settings Section.

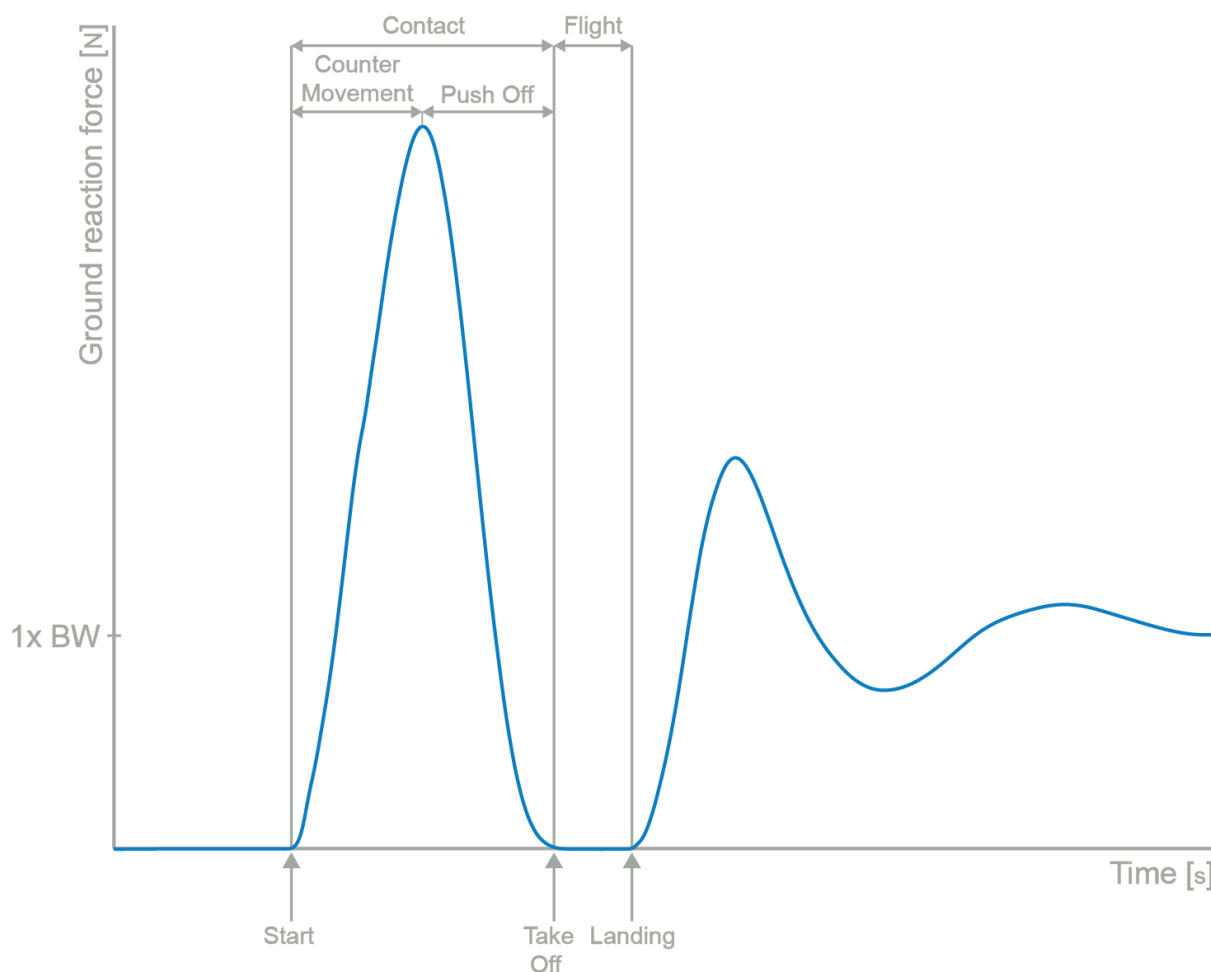
If you want to start a new measurement, click the New Measurement button and repeat the procedure. Before doing so, you can change the Input Parameters; if not, the Input Parameters of the previous measurements will be used. If you want to repeat a certain measurement, click on the drop down menu, select the repetition you want to replace and check the box Repeat. Then click Start and a pop-up window will ask you if you really want to repeat the measurement. Click OK if you want to repeat.

ANALYSIS:

Analysis enables you to check the signal(s) of the ground reaction force and the calculated parameters. Under the Signal tab you can see the signal and markers which are placed automatically. You can move all markers if they have been placed incorrectly. Under the Results Table tab you can see all the calculated parameters numerically, while the visualisation of the results comparisons can be done under the Results Graphs tab. These two tabs enable you to make quick comparisons of the values of the parameters among different repetitions and/or among different sub-versions of the test. If you want to confirm the measurement, click Save. If you would like to export the calculated parameters use Export function in Result Table panel.

All the parameters calculated for analysis are commonly used in biomechanics, kinesiology and rehabilitation¹⁻⁵. Parameters are calculated from the ground reaction force and flight time. For more information regarding the parameters see the references below.

For some modules additional analysis routines are available as a separate product. See section About the Product for more information.



CALCULATED PARAMETERS:

GENERAL

Jump height from Take Off V [m]

The height of the jump calculated from the Take Off velocity as calculated from the force impulse.

Jump height from Flight T [m]

The height of the jump calculated from the Flight Time.

Ratio between jump height and Contact T [m/s]

Ratio between the height of the jump and the time interval between the Start and the Take Off.

Start interval relative F [%BW]

Average force in the 1st 50 ms of the Push Off (50 ms is a default value and can be changed under the Settings section).

**Start interval relative P [W/kg]**

Average power in the 1st 50 ms of the Push Off divided by the body weight (50 ms is a default value and can be changed under the Settings section).

Start interval A [m/s²]

Average acceleration in the 1st 50ms of the Push Off (50 ms is a default value and can be changed under the Settings section).

Start interval V [m/s]

Average velocity in the 1st 50ms of the Push Off (50 ms is a default value and can be changed under the Settings section).

Relative maximal F [%BW]

Maximal force during the Contact divided by the body weight.

Relative maximal F during Counter Movement [%BW]

Maximal force during the Counter Movement divided by the body weight.

Relative maximal F during Push Off [%BW]

Maximal force during the Push Off divided by the body weight.

Relative maximal F in the 1st half of Push Off [%BW]

Maximal force between the Lowest Position and the half of the Push Off divided by the body weight.

Relative maximal F in the 2nd half of Push Off [%BW]

Maximal force between the half of the Push Off and the Take Off divided by the body weight.

Relative maximal P [W/kg]

Maximal power during the Contact divided by the body weight.

Relative E [J/kg]

Energy during the Contact divided by the body weight.

Counter Movement A [m/s²]

Average acceleration during the Counter Movement phase.

Push Off A [m/s²]

Average acceleration during the Push Off phase.

Vertical Take Off V [m/s]

Velocity of the vertical movement at the Take Off.

Drop Jump / Squat Jump height ratio [%]

Ratio between the Drop Jump height and the Squat Jump height. This parameter is calculated only if the data from the Squat Jump module exists for the same person.

TIME PARAMETERS

Contact T [s]

Time interval between the Start and the Take Off.



Flight T [s]

Time interval between the Take Off and the Landing.

Counter Movement T [s]

Duration of the Counter Movement phase from the Start to the Push Off.

Push Off T [s]

Duration of the Push Off phase.

Ratio between Counter Movement and Push Off T [%]

Ratio between the duration of the Counter Movement and the duration of the Push Off.

T to maximal F [s]

Time interval between the Start and the maximal force).

T between maximal F and Take Off [s]

Time interval between the maximal force and the Take Off.

FORCE IMPULSE PARAMETERS

Total FI [Ns]

Force impulse (i.e. integral of a force with respect to time) between the Start and the Take Off.

Push Off FI from Flight T [Ns]

Force impulse calculated from the Flight Time.

Counter Movement FI [Ns]

Force impulse (i.e. integral of a force with respect to time) between the Start and the beginning of the Push Off.

Push Off FI [Ns]

Force impulse (i.e. integral of a force with respect to time) between the beginning of the Push Off and the Take Off.

Ratio between Counter Movement and Push Off FI [%]

Ratio between the Counter Movement force impulse (i.e. integral of a force with respect to time) and Take Off force impulse.

FI between Start and maximal F [Ns]

Force impulse (i.e. integral of a force with respect to time) between the Start and the maximal force.

FI between maximal F and Take Off [Ns]

Force impulse (i.e. integral of a force with respect to time) between the maximal force and the Take Off.

Ratio between FI before and after maximal F [%]

Ratio between the force impulse (i.e. integral of a force with respect to time) between the Start and the maximal force and the force impulse between the maximal force and the Take Off.



REFERENCES:

1. Baca, A. A comparison of methods for analyzing drop jump performance. *Med Sci Sports Exerc* 31, 437-442 (1999).
2. Pietraszewski, B. & Rutkowska-Kucharska, A. Relative power of the lower limbs in drop jump. *Acta Bioeng Biomech* 13, 13-18 (2011).
3. McLellan, C.P., Lovell, D.I. & Gass, G.C. The role of rate of force development on vertical jump performance. *J Strength Cond Res* 25, 379-385 (2011).
4. Vanezis, A. & Lees, A. A biomechanical analysis of good and poor performers of the vertical jump. *Ergonomics* 48, 1594-1603 (2005).
5. Walsh, M.S., Ford, K.R., Bangen, K.J., Myer, G.D. & Hewett, T.E. The validation of a portable force plate for measuring force-time data during jumping and landing tasks. *J Strength Cond Res* 20, 730-734 (2006).