SmarTracks Diagnostics v.3.10 Installation Guide & User Manual

Contents

1. Safety Instructions

ATTENTION!

Before using your SmarTracks Diagnostics, read all instructions on handling the device and timing gates, including the safety information.

1.1. Electronic Measuring Equipment

Non-compliance with this safety information may result in a fire, electric shocks or other injuries, or may lead to damage to the system components.

Do not drop the measuring equipment, and do not dismantle, open, break, bend, deform, drill through, crush, burn or paint it. Do not heat in a microwave and do not insert foreign objects into the device.

When attaching the sensor to your computer, we recommend using the provided USB extension cable to protect your computer from humidity and dirt. If you need to attach the sensor directly make sure there is no moisture or dirt on the sensor! Do not try to dry the measuring equipment with an external heat source such as a microwave or a hot air gun.

Never try to repair the measuring device yourself.

1.2. Timing Gates

Timing gates for the sprint module contain powerful magnets. The magnetic field can damage e.g. mobile phones, TVs, laptops, computer hard drives, credit cards, data media, mechanical clocks, hearing devices, speakers, and the measuring sensor.

Therefore, these devices should never be kept in close proximity to the timing gates. A minimum distance of 50 cm must be maintained. Do not try to open the timing gates.

Always keep the SmarTracks sensor-belt and the sensor inside it at a sufficient safety distance from the timing gates.

ATTENTION!

Magnets may affect the function of pacemakers and implanted defibrillators. If you have such devices fitted, keep them at a sufficient distance from the magnets.

1.3. Charging the Measuring Device

To charge the measuring device, always use the supplied USB cable with an adapter (power supply) or a high-power USB port on another device which is compatible with the USB 2.0 standard. If you use the adapter to charge the measuring device, ensure that the power supply is fully assembled before connecting it to a plug socket. Then securely plug the adapter into the plug socket. Do not touch the adapter with wet hands! Always use an approved power supply to charge your measuring device.

The adapter may become warm during normal use. Always ensure an adequate flow of air around the adapter and handle it with care.

1.4. Information on Disposal and Recycling

You must dispose of the measuring device properly according to the valid environmental directives and legislation. Since the measuring device contains electronic components and a battery, the measuring device may not be disposed of with normal domestic waste. If you want to dispose of your used measuring device, you can consult your local authority regarding disposal and recycling options. The battery is removed and taken for environmentally friendly recycling.

2. Glossary of Technical Terms

Measurement	A measurement starts from the moment the sensor is disconnected from the computer and ends when the sensor is reconnected with the computer.
Assessment	An assessment is an evaluation of specific capacities of the athlete/player, such as agility, sprinting capacity, etc. Several assessments can be carried out during one measurement.
Test	A test is one specific action of an assessment, such as one jump, one run, etc. Several tests can be carried out during one assessment.
Measurement data	Measurement data is the raw data measured by the sensor. This data can be uploaded to a computer and analyzed by the SmarTracks Diagnostics software.
Test results	Test results are the analyzed data as they are displayed in the SmarTracks Diagnostics software.
Measurement window	The measurement window is the window shown during a measurement. It displays the measure events.
Measure event	A measure event is either the marking of an invalid attempt or changing player. The chronology of these events during a measurement is displayed in the measurement window.

3. Hardware

3.1. Sensor-Belt

Depending on whether you have a DX3.1 sensor or a DX3.5 sensor, the sensor-belt consists of different components.

3.1.1. Sensor DX3.1

The DX3.1 sensor-belt consists of a rectangular DX3.1 sensor and a sensor-belt.

The sensor is connected to the belt with Velcro.

3.1.2. Sensor DX3.5

Figure 1: DX3.5 Sensor with and without USB cap

The DX3.5 sensor-belt consists of a DX3.5 sensor, a round clip, and a belt.

Figure 2: Clip (front) + DX3.5 sensor with USB cap

You can attach the sensor to the clip.
The clip can be attached to the belt with the black Velcro surface on the back (see figure 3 and 4).

Figure 3: Clip (back) + DX3.5 sensor with USB cap

Figure 4: DX3.5 Sensor + Clip attached to the belt

3.2. Timing Gates

3.2.1. Timing Gates Mobile

The Timing Gates Mobile can be placed everywhere to conduct performance tests. The gates do not contain sensitive electronics and are tolerant against humidity and dirt.

To maintain the integrity of the integrated magnets, the magnetic rods (MCD's) should be well protected from falling or other severe shocks at any time.

A mobile gate consists of two magnetic elements. A magnetic element consists of one cone and one magnetic rod (MCD), which is to be stuck into the hole of the cone (see figure 2).
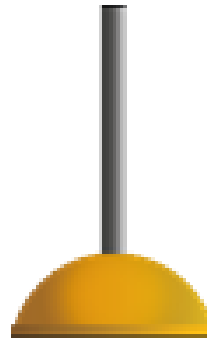
Figure 1: Magnetic rod (MCD)

Figure 2: Magnetic element (Cone + magnetic rod (MCD))

The rod (MCD) can be set up straight or angled. The angled setup is done with the help of an angled mount, which is stuck in the hole of the cone (see figure 3, 4 and 5).

Angled mounts are used for amplification or alignment of the magnetic field that is generated by our timing gates. In practice, the application is useful for smaller athletes (e.g. children) or for certain tests of agility.

Figure 3: Angled mount

Figure 4: Angled magnetic element (Cone + angled mount + magnetic rod (MCD))

Figure 5: Angled magnetic element (Cone + angled mount + magnetic rod (MCD))

IMPORTANT: The Humotion logo on the rods (MCD's) should always face upwards. This applies for both the straight and the angled setup.

## 3.2.2.   Placement of the Timing Gates Mobile

IMPORTANT: When installing the Timing Gates Mobile, do not hold the sensor-belt too close to the MCD's.

One timing gate consists of two magnetic elements (angled or straight).

You can either place both magnetic elements angled, both magnetic elements straight, or one angled and one straight.

The **two elements of a timing gate** should not be placed further away than 1.25 m from each other.

The distance between **two timing gates** should not be below 5 m to avoid the merging of the magnetic fields that are generated by the gates.
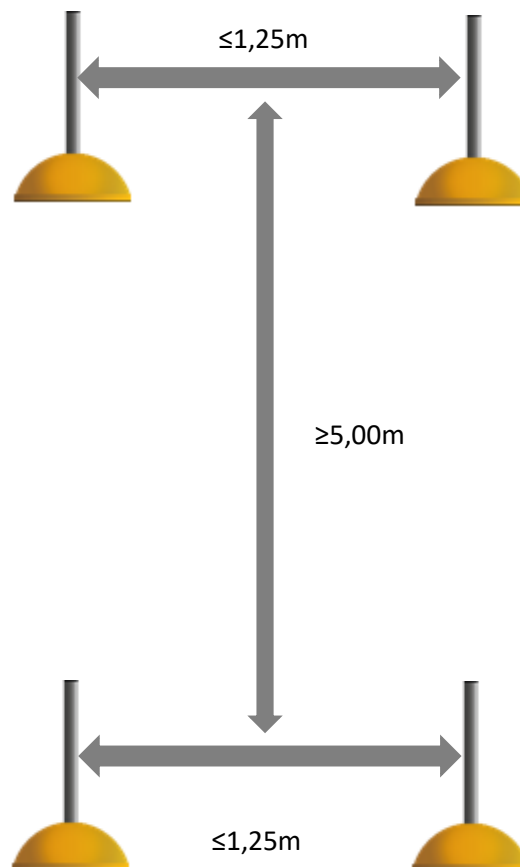

With adherence to these standards, any number of timing gates can be placed along a given distance to generate the desired split times.

3.2.3.   Timing Gates In-Ground

Timing Gates In-Ground are invisibly integrated into the running track. If you are not sure where the timing gates are integrated in your track, please contact your track operator.

Figures 1 and 2 below illustrate a track setup where timing gates are integrated into the 100m sprint lane (lane 9) and the 400m lane (lane 1).

Figure 1: SmarTracks with Timing Gates In-Ground – Exemplary Full Track Setup by Polytan
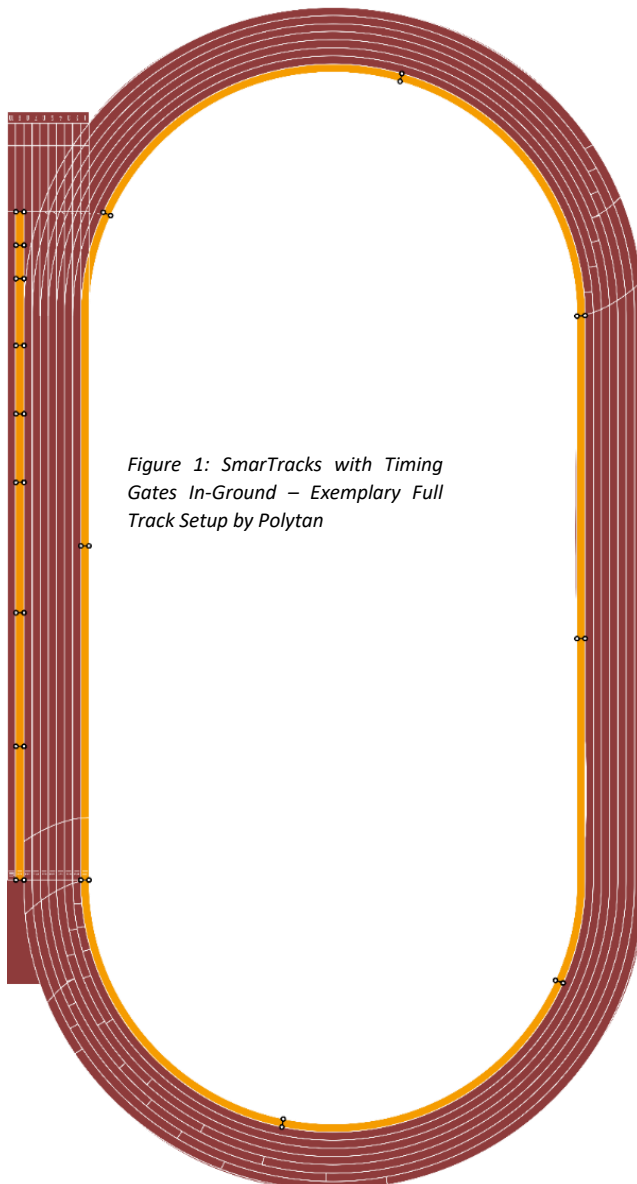
In this example track, the Timing Gates In-Ground are placed in the following intervals:

Lane 9: 0m-5m-10m-20m-30m-40m-60m-80m-100m

Lane 1: 0m-50m-100m-150m-200m-250m-300m-350m-400m

Figure 2: SmarTracks with Timing Gates In-Ground – Detail of Sprint Lane Setup by Polytan
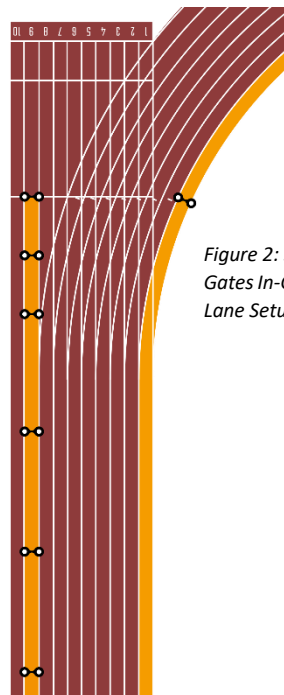
4. Software Installation
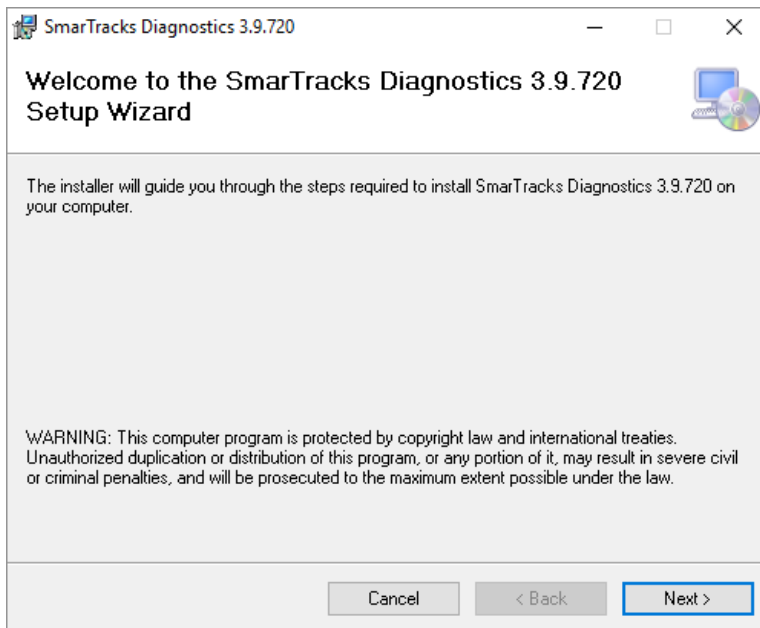
4.1. How do I install the SmarTracks Diagnostics software?

The SmarTracks Diagnostics software is either supplied on a USB stick, or you will be given access details for the Humotion download server.

Installation instructions when the software is supplied on a USB stick:

STEP 1: Connect the supplied USB stick.

STEP 2: Open the "SetupSmar-Tracks.msi" file.

STEP 3: Select "Next" and follow the rest of the instructions.

Installation instructions when the software is downloaded from the internet:
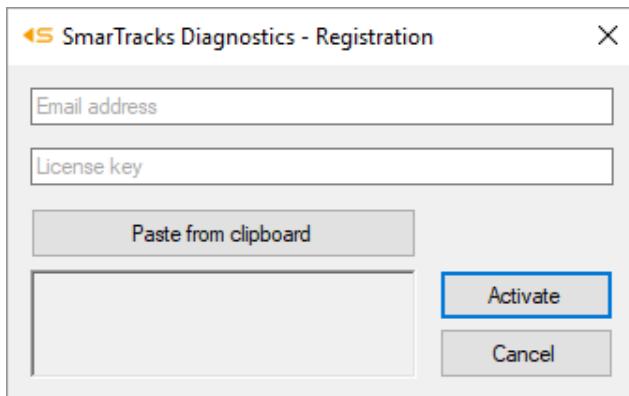
STEP 1: Download the setup file.

STEP 2: Depending on your operating system, you can get a notification screen about running an unrecognized app. (Example shown with Windows 10, this may differ per operating system.)
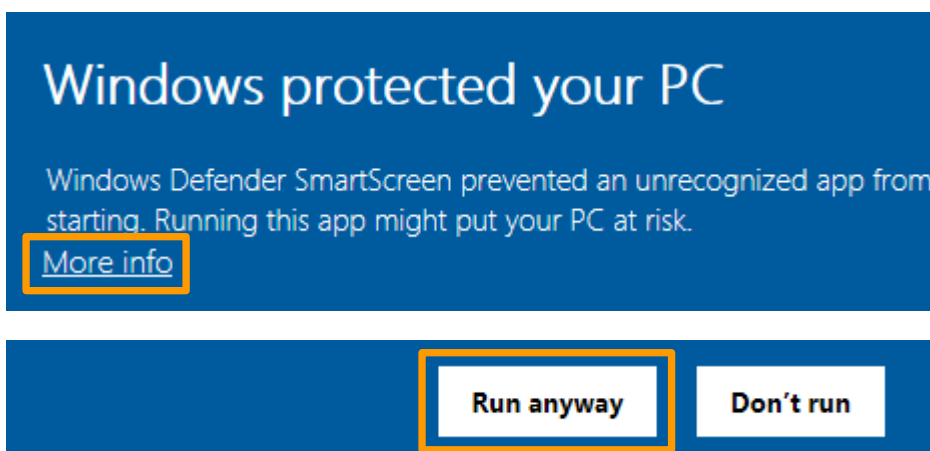
STEP 3: Click "More info".

STEP 4: Click "Run anyway" and follow the rest of the instructions.

4.2. How do I activate my SmarTracks Diagnostics license?

To activate your license:
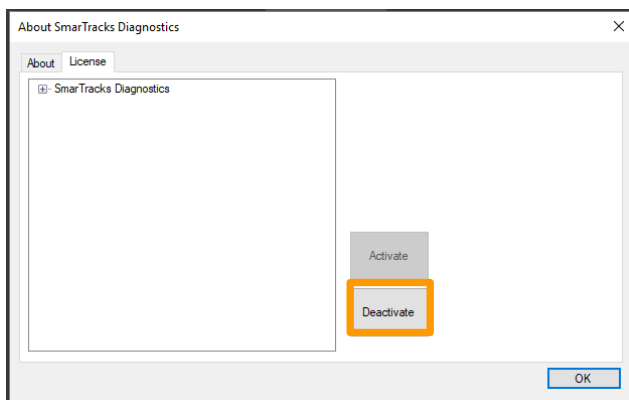
After installing SmarTracks Diagnostics, you need to register the product by activating your license.

STEP 1: Please enter your email address and the license key provided to you by Humotion.

STEP 2: Click "Activate".

To deactivate your license:
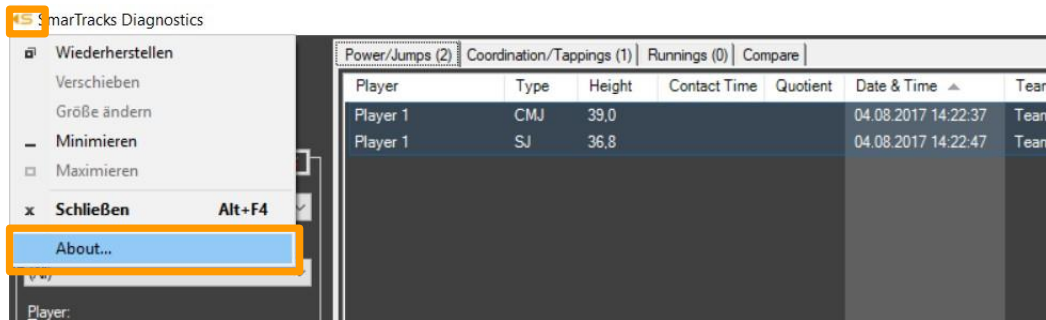
STEP 1: Click on the logo in the upper left corner and choose "About...".

STEP 2: Go to the License tab and click "Deactivate".

4.3. How do I change the language settings?

STEP 1: Click on the logo in the upper left corner and choose "About…".

STEP 2: Select the language in the drop-down menu and click "OK".

The changes will take effect after you restart SmarTracks Diagnostics.
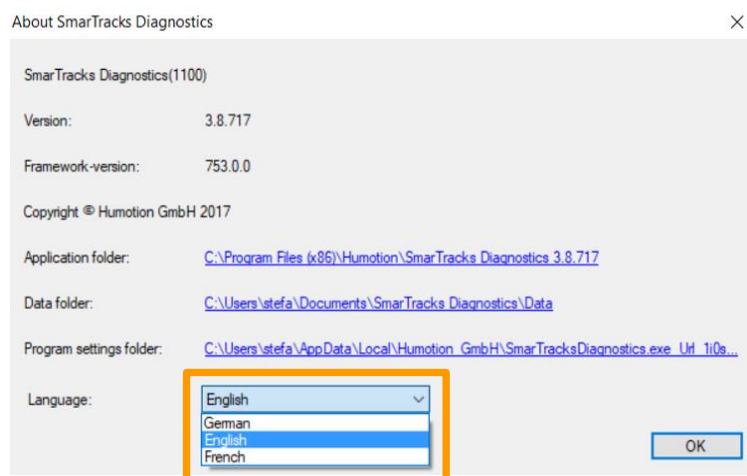
5.   Performing a Measurement

5.1.   How do I charge the sensor?

Figure 1: DX3.5 sensor + Clip + Attached USB cable

STEP 1: Start the SmarTracks Diagnostics soft-ware.

STEP 2: Connect the sensor to your PC using the USB cable.

Figure 2: DX3.1 sensor + Belt + Attached USB cable

STEP 3: The device, as well as the charge status of the battery, is dis-played bottom left.

When the charge status reaches 4,20V, it is fully charged.

5.2. How do I enter a player's name?
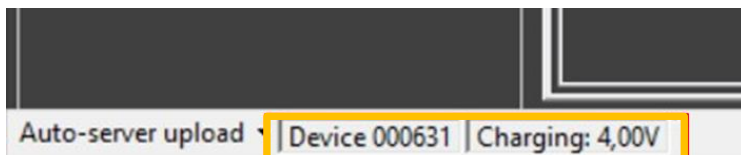
STEP 1: Start the SmarTracks Diagnostics software.

STEP 2: Connect the sensor to your PC using the USB cable.

NOTE: The data of the last measurement will be uploaded to our servers and analyzed by the SmarTracks Diagnostics software by default.

If you do not wish SmarTracks Diagnostics to analyze the data of the last measurement, see 6.2. How do I stop the automatic upload of measurement results?

NOTE: It does not matter which sensor you connect to the PC, the names are saved centrally on the software.

STEP 3: Click on "New Measurement".
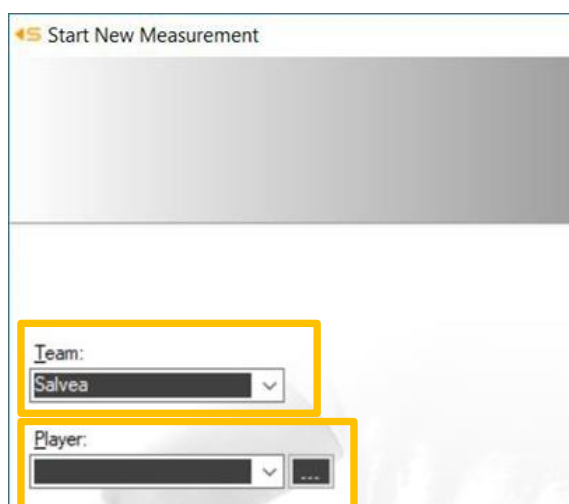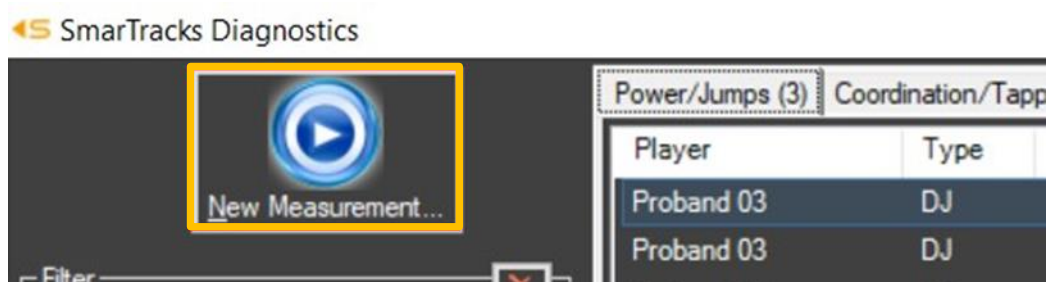
STEP 4: The window "Start New Measurement" opens. Here you can:

- Enter a team name (obligatory)

- Enter a player's/athlete's name (obligatory)

You can enter one or several teams under "Team". The entries will be saved for future measurements.

You can add one or several players to a team by clicking on the small square box on the right under "Player". The entries will be saved for future measurements.

STEP 5:

- If you do not wish to perform a measurement immediately, press "Cancel". The entered team and player names are saved for future measurements.
- If you wish to perform a measurement immediately, see 5.3. How do I start a new measurement?, STEP 4.

5.3.   How do I start a new measurement?

STEP 1: Start the SmarTracks Diagnostics software.

STEP 2: Connect the sensor-belt to your PC using the USB cable.

NOTE: The data of the last measurement will be uploaded to our servers and analyzed by the SmarTracks Diagnostics software by default.

If you do not wish SmarTracks Diagnostics to analyze the data of the last measurement, see 6.2. How do I stop/start the automatic upload of measurement results?

STEP 3: Click on the "New Measurement" button to start a measurement.
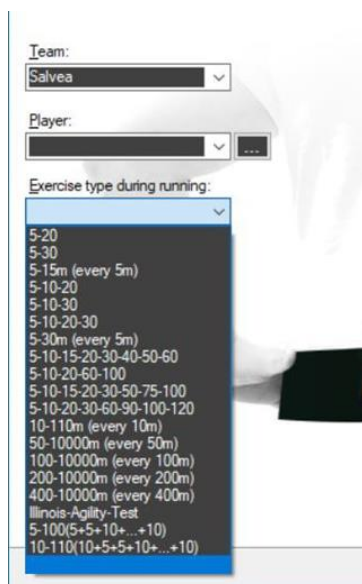
STEP 4: The window "Start New Measurement" opens. Here you can:

- Enter/select a team name (obligatory)

- Enter/select the first player's/athlete's name (obligatory)

- Select the exercise type during running (optional) (highly recommended if you only wish to perform runs of one type). For more information on the running type list, see 8.1. Sprinting Ability.

- Gate option (optional)

- Select the magnetic hemisphere (obligatory)

Gate option describes the options of timing gates: "Mobile", "Integrated – Vertical" or "Integrated – Horizontal".
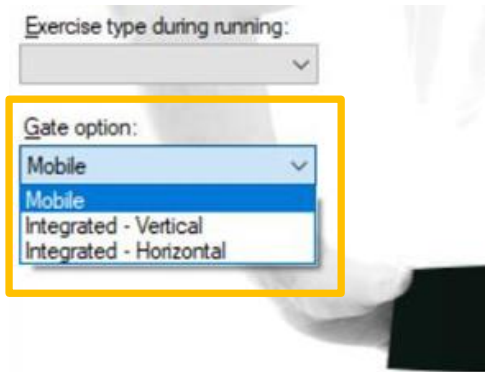
- If you are using SmarTracks Diagnostics with mobile timing gates, select "Mobile".

- If you are using SmarTracks with Timing Gates In-Ground, select "Integrated – Vertical" or "Integrated – Horizontal", according to the alignment of the integrated timing gates in your track. If you are not sure how the gates in your track are aligned, please contact your track operator.
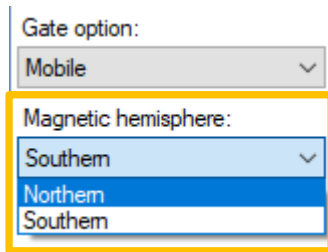
In the **magnetic hemisphere** menu you have to select either Northern or Southern, depending on your location.

STEP 5: When everything is set, click "Next".
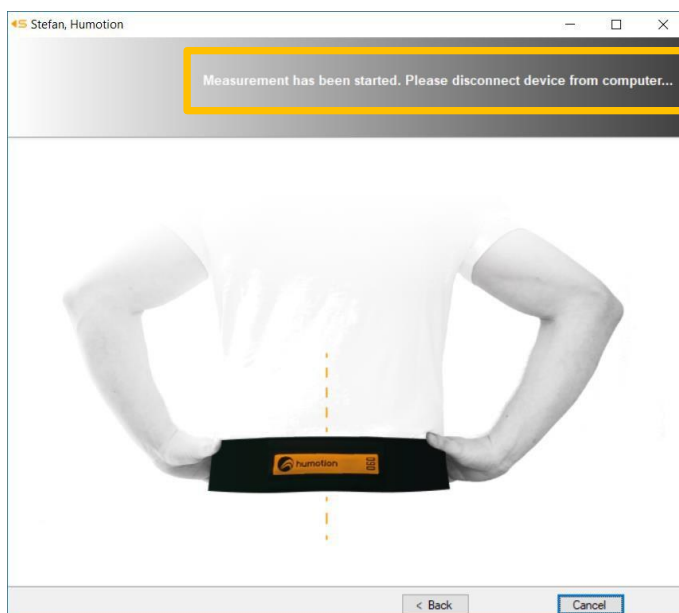
STEP 6: Remove the USB cable from the sensor-belt.

The sensor is now activated.

Do not press "Cancel".
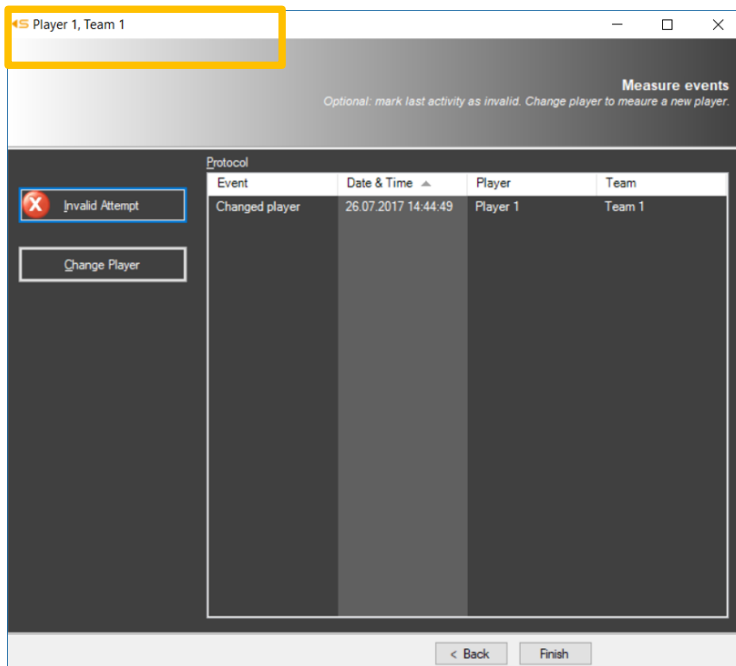
STEP 7: A measurement window is opened.

The window carries the name of the player and team that were first entered when starting the measurement.

Here you can enter measure events, such as a change of player or a deletion of an incorrectly performed test.

The first measure event is always "Changed player", which shows the time when the first player put on the sensor-belt.

Do not press "Finish".

STEP 8: The athlete can now put on the sensor-belt.

5.4.   How do I put on the sensor-belt?

DX3.1 sensor

When putting on the sensor-belt make sure that it fits tight and that the middle of the sensor (sometimes marked with a black arrow) is aligned with the spine.

The sensor-belt should cross the L4/L5 vertebrae.
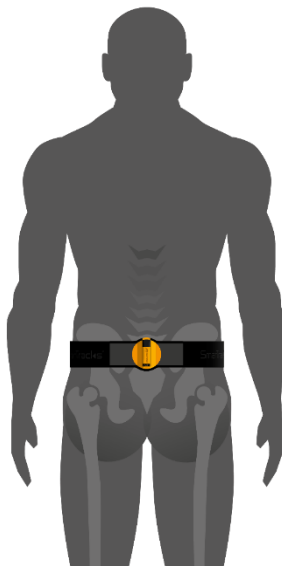
DX3.5 sensor

When putting on the DX3.5 sensor-belt, make sure the black USB cap points upwards, and the sensor is aligned with the spine.

The sensor-belt should cross the L4/L5 vertebrae.

The athlete can now start performing the assessments.

5.5.　　　How do I start multiple measurements simultaneously?

To perform two or more measurements simultaneously, carry out the instructions under 6.2. How do I start a new measurement? successively with each sensor-belt.

NOTE: Each sensor-belt has its own measurement window. The window carries the name of the player and team that were first entered when starting the measurement.

5.6.　　　How do I know the sensor is measuring?
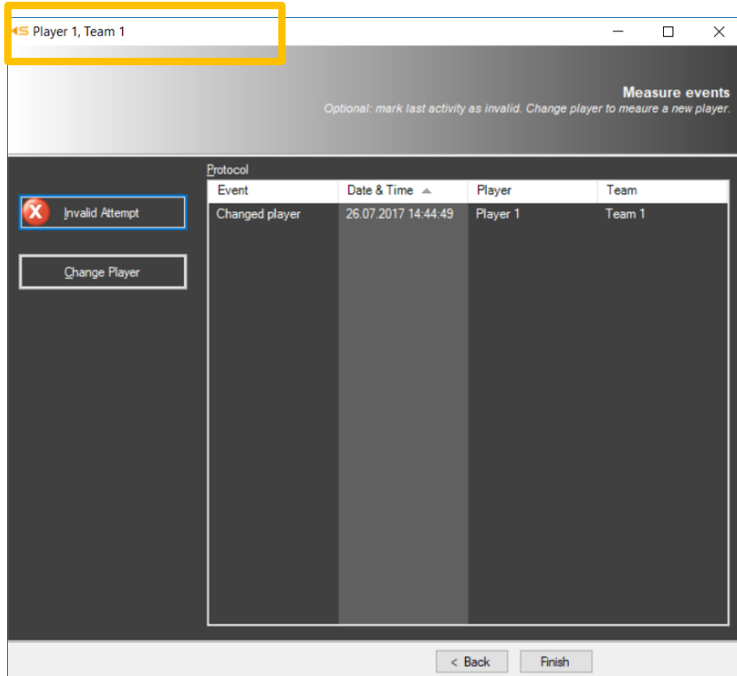
During a measurement, the sensor shows a **red blinking light**.

The measurement is started from the moment the sensor is disconnected from the computer.

To stop the measurement, connect the sensor to the computer using the USB cable.

5.7.　　　How do I start a new assessment?

If you want the same player to start a new assessment (e.g. first agility, then tapping), you do not need to enter anything into the computer. The software automatically recognizes the different assessments. The athlete can just start performing the new assessments.

5.8.　How do I remove an incorrectly performed test during measurement?
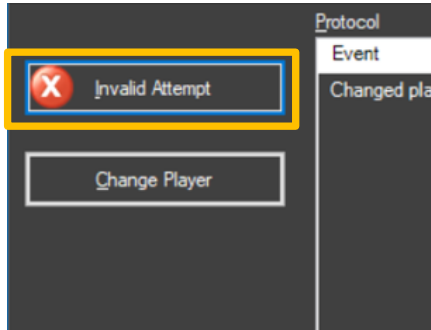
We recommend to always evaluate the correct execution of the test that has been performed.

If a test was performed incorrectly, click on "Invalid Attempt" and it will not show up in the test results. The athlete can immediately perform a new test.

5.9.　How do I change player during a measurement?
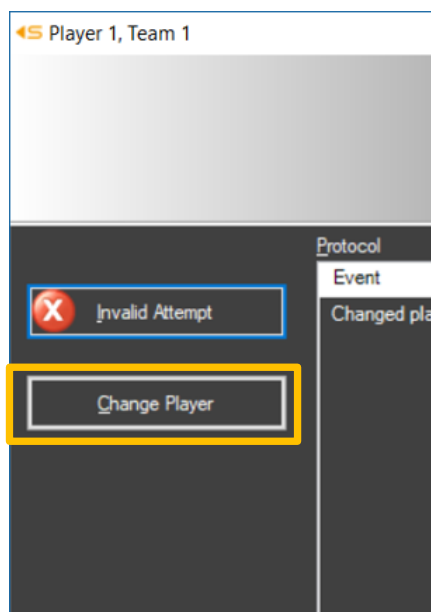
STEP 1: Click the "Change Player" button.

STEP 2: Select the next player.

- If you registered the player before/ during starting the measurement, select the player from the drop-down menu.

- If you did not register the player before/ during starting the measurement, enter the player's name in the box manually. The player's name will not be saved for later measurements.

STEP 3: Hand over the sensor-belt.

5.10.　How do I stop a measurement?

Reconnect the sensor-belt to the PC using the USB-cable. The measurement is now stopped.

6.   Data Analysis

6.1.   How do I upload the measurement data?

STEP 1: After completing the tests, reconnect the sensor-belt to your PC via the USB cable.

STEP 2: The data is analyzed automatically. The test results are displayed in the software.

6.2.   How do I stop/start the automatic upload of measurement data?

The data of the last measurement will be uploaded to the Humotion servers and analyzed by the Smar-Tracks Diagnostics software by default.

If you do not wish SmarTracks Diagnostics to analyze the data of the last measurement, you can disable this function by doing the following:
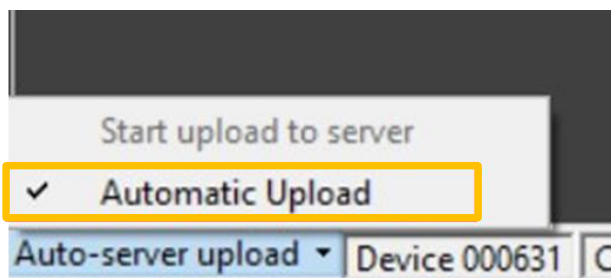
STEP 1: Click on the "Auto-Server Upload" button.

STEP 2: Click on the "Automatic Upload" menu item.

The server upload and data analysis now stops. The measured data will be saved on your computer, but will not be analyzed and displayed by the SmarTracks Diagnostics software.

To enable the automatic upload of measurement data again, click on the "Automatic upload" button.

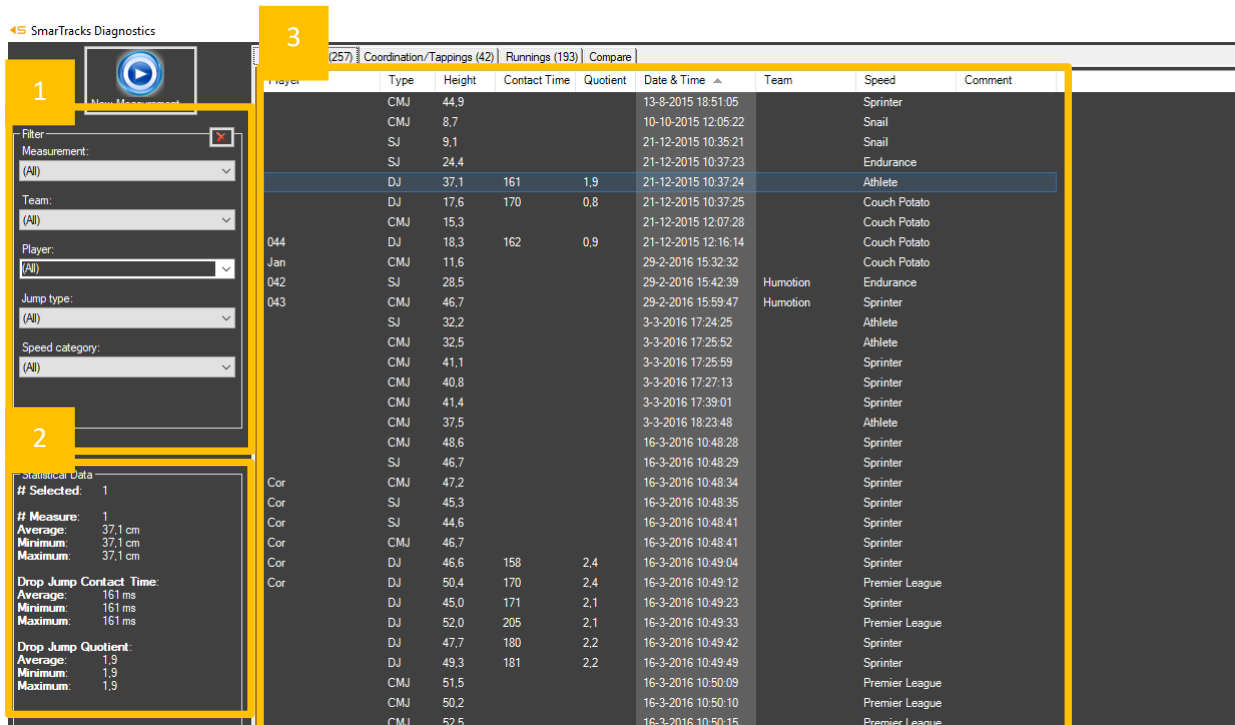## 6.3.   Where can I see the test results?

After the measurement data has been uploaded unto the SmarTracks Diagnostics software, the test results are automatically sorted over three tabs:

Power/Jumps	Coordination/Tappings	Runnings
Squat Jump (SJ)	Tappings	Speed
Drop Jump (DJ)		Endurance
Countermovement Jump (CMJ)		Agility

6.3.1. "Power/Jumps" tab

Under the "Power/Jumps" tab, you can find the test results for:

- Squat Jump
- Drop Jump
- Countermovement Jump

1   In the **Filter menu**, you can filter the test results you wish to view.

2   **Statistical data** of the selected player(s):

- For the Squat Jump (SJ) and Countermovement Jump (CMJ) you see the
  - average, minimum and maximum jump height.

- For the Drop Jump (DJ) you see the
  - average, minimum and maximum jump height
  - ground contact time ("Drop Jump Contact Time")
  - reactive speed ("Drop Jump Quotient").

3 In the **Results table**, the following results are shown:

Type	Squat Jump (SJ), Drop Jump (DJ), or Countermovement Jump (CMJ).
Height	Jump height [cm]
Contact time (only for DJ)	Ground contact time [ms] If the contact time exceeds 250ms, the contact time will be displayed in orange.
Quotient (only for DJ)	Reactive speed (jump time²/ground contact time) [s²/ms]
Speed	Categorizes the test result according to: Height>70: Ski jumper height>60: Champions league height>50: Premier league height>40: Sprinter height>30: Athlete height>20: Endurance height>10: Couch potato height>1: Snail Contact time > 250ms: No reactive force

6.3.2. "Coordination/Tappings" tab

In the "Coordination/Tappings" tab, you can find the test results for tappings.
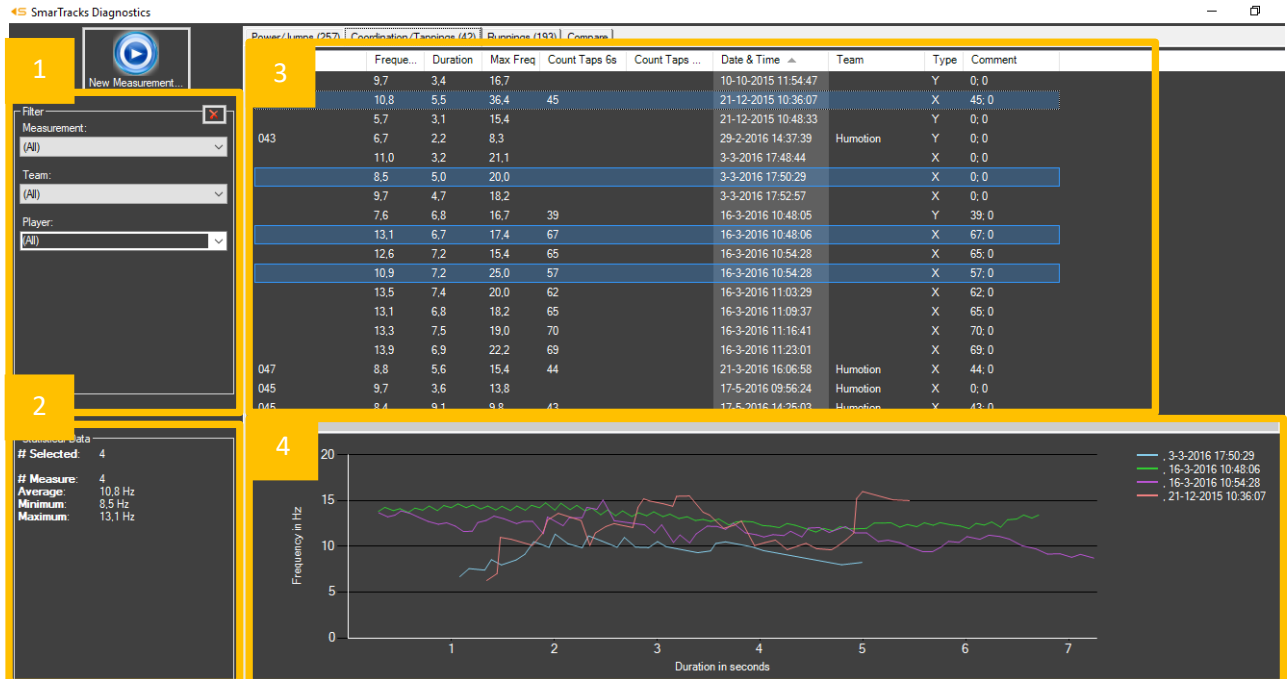
	In the **Filter menu**, you can filter the test results you wish to view.

	The **Statistical data** shows you the average, minimum and maximum tap frequency of the selected player(s).

3 In the **Results table**, the following results are shown:

Frequency	Average number of contacts with the ground per second [Hz]
Duration	Duration of tapping test
Max frequency	Maximum number of contacts with the ground per second [Hz]
Count taps 6s	Shows the number of taps in the first 6 seconds **if** duration was 6 seconds or more.
Count taps 15s	Shows the number of taps in the first 15 seconds if duration was 15 seconds or more.
Type	X or Y

4 The **Chart** shows the selected player's tap frequency (Hz) for the duration of the test.

When you click on the chart, the chart shows each individual ground contact for the duration of the test.

6.3.3. "Runnings" tab

In the "Runnings" tab, you can find the test results for speed, agility and endurance tests.

1   In the **Filter menu**, you can filter the test results you wish to view.

2   The **Export menu** allows you to export test results. For more information on exporting test results, see 6.7 How do I export tests results?

3   The **Statistical data** shows you the following data of selected player(s):

- the average, minimum and maximum running time at each point [s]
- the speed at each point [km/h].

4 In the **Results table**, the following results are shown:

Cooper 8 min	If the running time was 8 minutes or more, a Cooper value is shown here.
Cooper 12 min	If the running time was 12 minutes or more, a Cooper value is shown here.

1./2./3./… Point	Time when each respective point was reached [s]
	Each point represents:
	   ■ When no running type exercise has been selected: a timing gate
	   ■ When a running type exercise has been selected: a measurement point of the running type exercise

5 The **Chart** shows the selected player's steps for the duration of the test. It shows

- at what point in time a step was made (orange stripe)
- at what point in time a timing gate was passed (blue column).

NOTE: If multiple players are selected, it only shows the chart of the player that was selected first.

6.4. How do I filter or select test results?

6.4.1. How do I filter results with the Filter menu?

In the upper right corner, there is a **Filter menu**, which allows you to filter results according to:

- Measurement: You can select "All" to view the results of all measurements made, or you can select one specific measurement.
- Team: You can select one or all teams.
- Player: You can select all, one or more players.

In the "Power/Jumps" tab, you have additional filters in the Filter menu for:

- Jump type
- Speed category

In the "Runnings tab", you have additional filters in the Filter menu for:

- Exercise type
- Run type

To clear all filters, click the red cross button in the top right corner of the filter menu.

6.4.2. How do I select specific test results?

- To select **a specific test result**, click on the test result.

- To select **multiple test results** simultaneously, hold the CTRL key and click the test results you wish to select.

- To view **all test results**, right-click on any test results line, and click "Select all".

The Statistical Data menu in the lower left corner shows you how many test results you have selected.

6.4.3. How do I sort test results?

To sort the test results, click on the table tab according to which you wish to sort the test results.
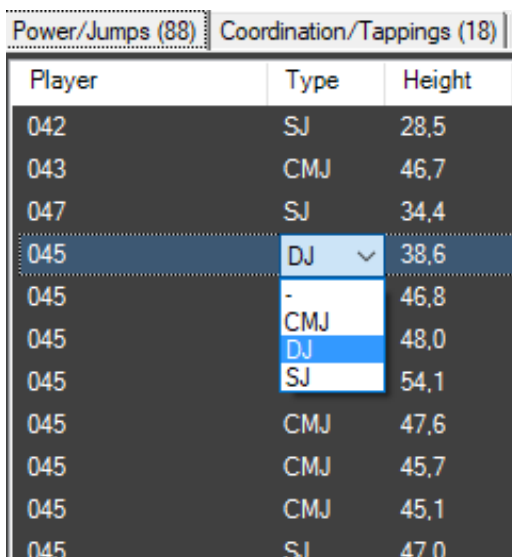
6.5. How do I edit test results?
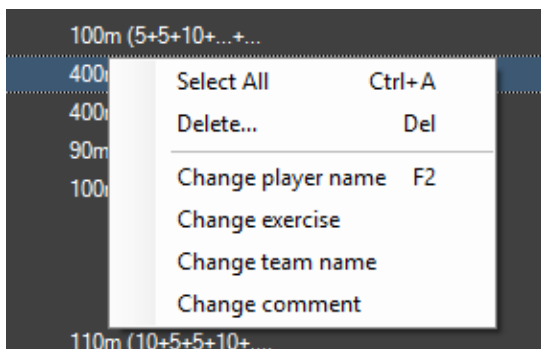
STEP 1: Right-click on the test result line you wish to edit.

STEP 2: Choose the item you wish to change from the drop-down menu.

6.5.1. How do I enter/change the jump type?

STEP 1: Go to the "Power/Jumps" tab.

STEP 2: Double-click on the field you wish to change under Type.

STEP 3: Choose the jump type from the drop-down menu.

6.5.2. How do I enter/change the running exercise type?
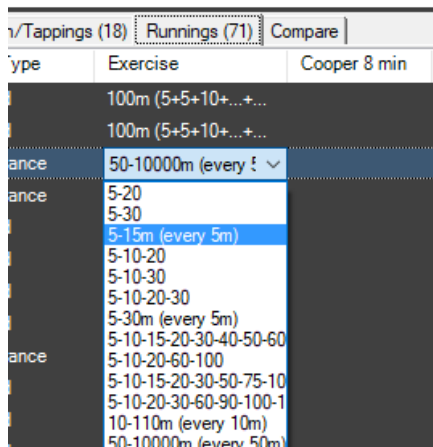
STEP 1: Go to the "Runnings" tab.

STEP 2: Double-click on the field you wish to change under Exercise.

STEP 3: Choose the exercise type from the drop-down menu.

NOTE: You cannot manually enter the Cooper Test. The software automatically recognizes each run that lasts for at least 8 or 12 minutes as a Cooper test and displays the Cooper value accordingly.

6.5.3. How do I enter/change a player's name or a team name after measurement?
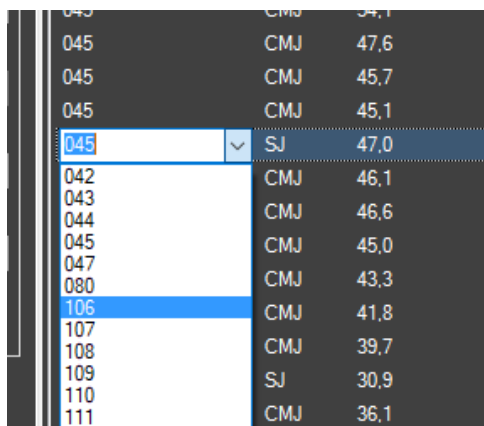
STEP 1: Double-click on the name you wish to change.

STEP 2:
- Option 1: Select a name from the drop-down menu. (recommended)

- Option 2: Type a name in the empty field and press ENTER.

  NOTE: With option 2, the name will not be saved for future measurements.

6.5.4.   How do I annotate a test result?

The comment section in each test result line allows you to make notes for specific test results.

STEP 1: Go to the test result for which you want to make notes.

STEP 2: Double-click on the field under Comment.

STEP 3: Enter any notes or comments you may have.

NOTE: You can sort test results according to comments.

6.5.5.   How do I delete test results?

To delete test results in the SmarTracks Diagnostics software:

STEP 1: Right-click on the test result line you wish to delete.

STEP 2: Click "Delete…".

6.6.   How do I compare test results?

6.6.1.   Comparing via the spider diagram

Under the "Compare" tab, you can see a spider diagram. This diagram allows you to compare the following results of different players:
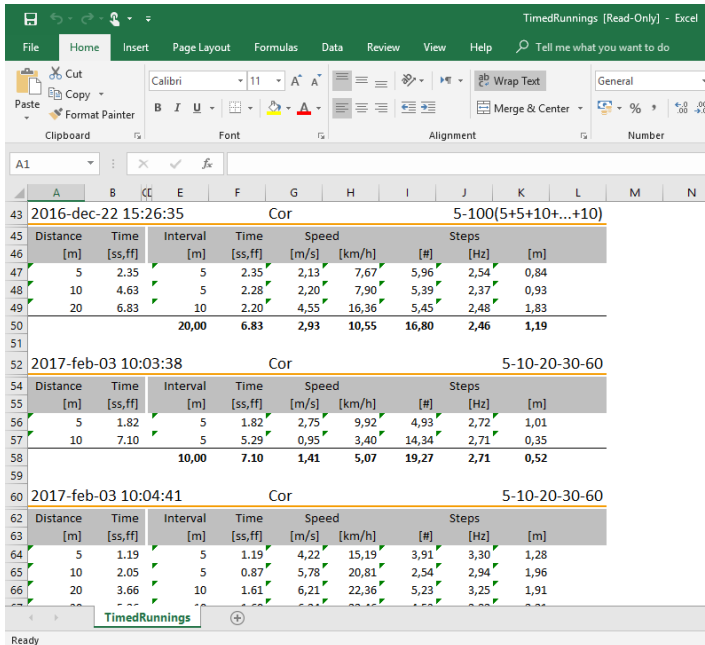
- Maximum force (SJ)

- 5m sprint time

- Springiness (CMJ)

- Cyclic speed (Tapping)

- Reactive speed (DJ)

- Final sprint speed
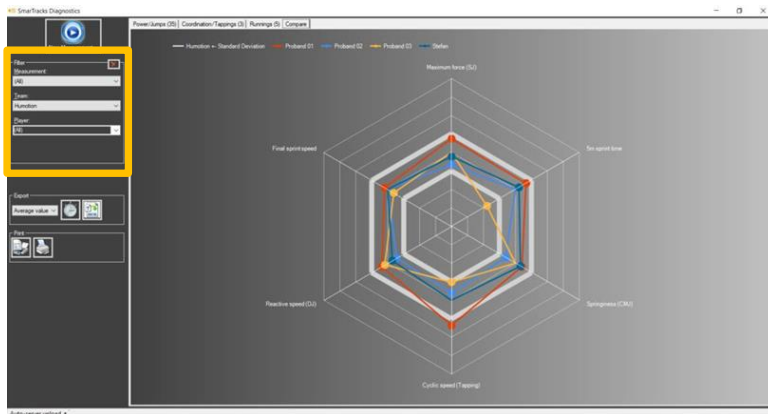
STEP 1: Select the players you wish to compare via the Filter menu.

STEP 2: The results for the selected players are shown in the spider diagram.

6.6.2. Comparing via Excel files

With the export function, you can create Excel files to compare:

- Speed, Agility, Endurance
- Jumps, Tappings, Sprints

For more information on creating Excel files, see 6.7. How do I export test results?

6.7. How do I export test results?

You can export test results for personal storage, presentation or distribution from the SmarTracks Diagnostics software.

You can only export test results via the "Runnings" tab or the "Compare" tab.

6.7.1. Exporting speed, endurance or agility test results
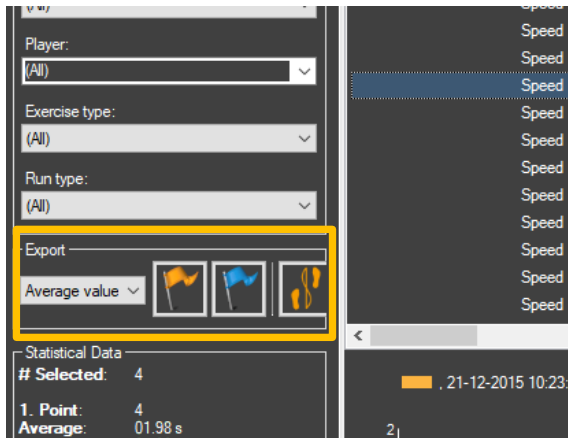
STEP 1: Go to the "Runnings" tab.

STEP 2: Filter the test results you wish to export using the Filter menu.

STEP 3: Go to the Export menu in the left column. Here you can select which data you wish to export.

The drop-down menu shows three options:
- All values: Export all values per player.

- Average values: Export only the average time per player.

- Best values: Export only the best time per player.

STEP 4: Click one of the export buttons. There are three export buttons:

  Export absolute time values of selected runs.

  Export relative time values of selected runs.

  Export absolute time values of selected runs.

The test results are exported to an Excel file.

STEP 5: Save the exported test results in the desired format, e.g. Excel, HTML, etc.

NOTE: If you want to do several exports, first save the exported file before starting a new export.

6.7.2.   Exporting jumps, tapping and sprints test results
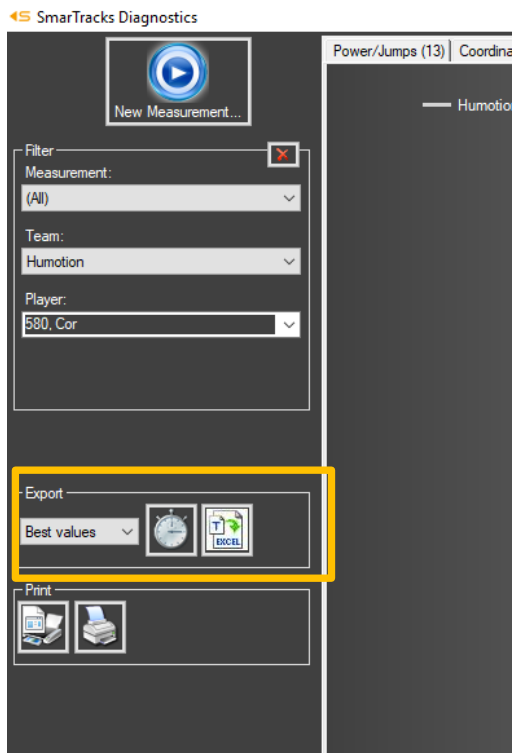
STEP 1: Go to the "Compare" tab.

STEP 2: Filter the test results you wish to export using the Filter menu.

STEP 3: Go to the Export menu. Here you can select which data you wish to export.

The drop-down menu shows three options:

- All values: Export all values per player.

- Average values: Export only the average time per player.

- Best values: Export only the best time per player.

STEP 4: Click one of the export buttons. There are two export buttons:

  Export key attributes of a measurement.

  Export all attributes of a measurement.

The test results are exported to an Excel file.

STEP 5: Save the exported test results in the desired format, e.g. Excel, HTML, etc.

NOTE: If you want to do several exports, first save the exported file before starting a new export.

6.7.3.   Printing the spider diagram
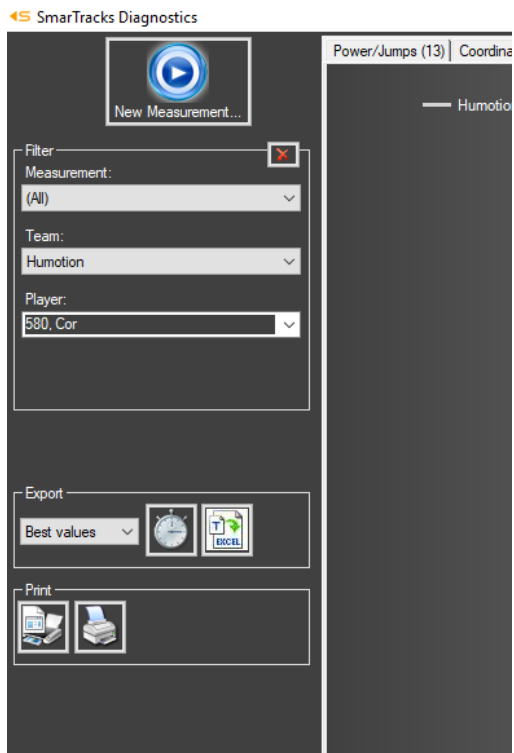
STEP 1: Go to the "Compare" tab

STEP 2: Filter the test results you wish to export using the Filter menu.

STEP 3: Go to the Print menu in the left column.

 You can preview the document by clicking on the "Print preview" button.

 You can directly print the document by clicking on the "Print chart" button.

7. Assessments

7.1. Sprinting Ability

An athlete's sprinting ability is absolutely crucial in many types of sports, especially when it comes to competition. With SmarTracks, you can record any distance depending on the number of timing gates.

Setting up the course field

- If you have SmarTracks Diagnostics with Timing Gates In-Ground, you can start at any gate.

- If you have SmarTracks Diagnostics with Timing Gates Mobile, we recommend starting at the 100m finish line or any other fixed point on your track. From there, place the mobile gates at the desired intervals.

- The software has an option to select a sprint interval at the start of the measurement under the drop-down menu "exercise type during running". This is highly recommended if you only wish to perform runs of one type.
  If you do not select a sprint interval, the software will assign appropriate intervals automatically. In both cases, the intervals can be changed manually after the data has been uploaded to the SmarTracks Diagnostics software.

Selecting the sprint interval

- If you are using Timing Gates In-Ground, the "Exercise type during running" depends on the integrated gate pattern of your track location. Since this setup can vary significantly, please contact your track operator for more detailed information about the track.

- If you are using Timing Gates Mobile, please strictly adhere to the given intervals, since differences can lead to false measurement data.

The intervals in our list are read as follows:

Interval list type 1: 5-20; 5-10-20; 5-10-20-60-100

This is a simple list of the respective intervals, which are always separated by a minus. It is important to know that the 0m gate is never mentioned.

For example:
- 5-20: There is a timing gate at 0m, 5m and 20m.
- 5-10-20: There is a timing gate at 0m, 5m, 10m and 20m.
- 5-10-20-60-100: There is a timing gate at 0m, 5m, 10m, 20m, 60m and 100m.

Interval list type 2: 5-30m (every 5m); 10-110m (every 10m); 50-10000m (every 100m)

To avoid long lists of intervals, we summarize the intervals if the distance between stays equal, e.g. every 10m. In this case, only the first and last measurement point are mentioned with the consistent distance between each point following in brackets. It is important to know that the 0m gate is never mentioned.

For example:
- 5-30m (every 5m): There is a timing gate 0m, 5m, 10m, 15m, 20m, 25m and 30m.
- 50-1000m (every 100m): There is a timing gate at 0m, 50m, 100m, 200m, 300m, etc.

Interval list type 3: 5-100m (5+5+10+...+10); 10-110m (10+5+5+10+...+10)

This kind of list is used if you have irregular gate patterns. You can see in the example that a few gates are just 5m apart instead of 10m. The irregular gates will be listed with individual distance of the interval and will be divided by '+'. The regular gates will be summarized by '...'. It is important to know that the 0m gate is never mentioned.

For example:
- 5-100m (5+5+10+…+10): There is a timing gate at 0m, 5m, 10m, 20m, 30m, 40m, 50m, 60m, 70m, 80m, 90m, and 100m.

Performing the test

- Mark the starting line 1 m in front of the first timing gate. The first timing gate corresponds to the zero-measuring point.

- Before and after each test the athlete should stand still for at least 1 second.

Test results

The test results are shown under the "Runnings" tab.

7.2.   Endurance

Cooper test

The Cooper Test is a test to determine aerobic endurance capacity. The aim of the test is to cover the maximum distance possible in 12 minutes. Conducting this test on a standardized running track, i.e. 400 m lap outdoors or 200 m lap indoors, ensures the most comparable results.

Setting up the course field

- You cannot enter the Cooper test as an exercise type in the software. The software automatically recognizes each run that lasts for at least 8 or 12 minutes as a Cooper test.

- If you have SmarTracks Diagnostics with Timing Gates In-Ground, you can start at any gate.

- If you have SmarTracks Diagnostics with Timing Gates Mobile, we recommend starting at the 100m finish line (see figure 7) or any other fixed point on your track. From there, place the Timing Gates Mobile at stated intervals, e.g. every 100 m.

Performing the test

- The test starts from the start position, 1 m before a gate.

- Before and after each test there should be standing time of at least 1 second.

Test results

The test results are shown under the "Runnings" tab.

7.3. Jumping Ability

Explosively fast reactions and speed strength are among the most important physical requirements for athletes. An athlete's jumping ability can tell us a lot about the speed strength of his leg muscles. Alongside other conditioning properties such as endurance and strength, speed strength is directly performance-related. In the standard jump ability test, three different jumps – the Drop Jump (DJ), Countermovement Jump (CMJ) and Squat Jump (SJ) – are performed several times in succession. The general aim of all three jump types is to achieve the maximum jump height during a basic vertical jump.
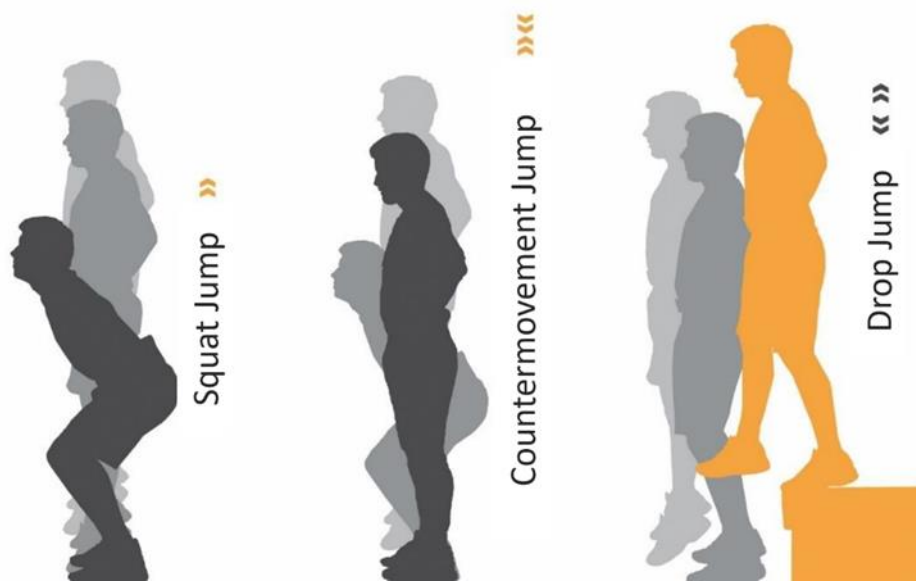
Performing the test

- We recommend to execute the jump tests in the following order:

  1. Squat Jump (SJ)

  2. Drop Jump (DJ)

  3. Countermovement Jump (CMJ)

  In this order the data of the jumps is more distinct and can be better evaluated afterwards.

- Before and after each test there should be standing time of at least 1 second.

- These tests are performed without timing gates.

7.3.1. Squat Jump (SJ)

The Squat Jump is a vertical jump used purely to test the concentric strength in muscles used for jumping. This jump is performed from the squat position without any countermovement. The upper body is bent slightly forward, with the knees bent to around 90°. The individual's hands are kept on their hips throughout the jump. This is to lessen the effect of the arms, which could be used to boost height while jumping.

The exercise consists of jumping up as high as possible from the rest position, without any countermovement when starting the jump. The jump height is normally lower than the jump height for the Countermovement Jump.

Measuring parameters:

- Jump height [cm]

7.3.2. Drop Jump (DJ)

The Drop Jump is a vertical jump for testing concentric strength in muscles used for jumping, including reactive strength. This jump is performed from a defined fall height. The individual's hands are kept on their hips throughout the jump. This is to lessen the effect of the arms, which could be used to boost height while jumping.

When executing the Drop Jump the athlete steps down and falls from a box or platform. Upon landing, he immediately jumps up as high as possible, keeping the ground time and horizontal movement to a minimum.

Alongside the jump height, a brief contact time with the ground is also measured. A reactive strength index (jump height divided by contact time) can then be calculated. The impact velocity and energy input into the muscles used for jumping are altered by varying the fall height. The output (jump height or the ratio of jump height and contact time on the ground) is maximized with optimal input (fall height).

The fall height is usually raised in 15 or 20 cm (6" or 8") steps and optimal height depends on the athlete's ability to absorb and transform the occurring forces. If the measured contact time exceeds 250 ms, the height should be decreased.

Measuring parameters:

- Jump height [cm]
- Ground contact time [ms]
- Efficiency ratio (jump time²/ground contact time) [s²/ms]

7.3.3.   Countermovement Jump (CMJ)

The Countermovement Jump is a vertical jump for testing concentric strength in muscles used for jumping. This jump is performed from a standing position with a downward countermovement. The countermovement is a rapid downward movement to the start position of the Squat Jump. The individual's hands are kept on their hips throughout the jump. This is to lessen the effect of the arms, which could be used to boost height while jumping.

The exercise consists of jumping up as high as possible from an upright position, after making a countermovement when starting the jump. The jump height is normally greater than the jump height of the Squat Jump.

Measuring parameters:

- Jump height [cm]

Test results

The test results are shown under the "Power/ Jumps" tab.

7.4.   Tapping

The tapping test is a test to determine cyclical speed. It is especially suitable for spotting "speed talent". SmarTracks records the tapping frequency, i.e. the number of contacts with the ground per second, measured in Hertz. Tapping performance depends on the ability to coordinate, as well as the individual's level of strength. Frequencies above 12 Hz (contacts per seconds) are considered good. The number of ground contacts is also determined over 6 or 15 seconds.

Performing the test

- This test is performed without timing gates.

- Before and after each test the athlete should stand still for at least 1 second.

Test results

The test results are shown under the "Coordination/Tappings" tab.

7.5.   Agility

7.5.1.   Illinois Agility Test

The Illinois Agility Test is used to test an athlete's agility, i.e., in a most simplistic way, his ability to change directions rapidly. The athlete should start in an upright position and maneuver through the represented course with maximum speed. The test should be conducted starting from both sides, to fully evaluate the athlete's ability.

Setting up the course field

- When starting a new measurement, you can choose the test in the drop-down menu under "Exercise type during running". This is highly recommended if you only wish to perform the Illinois Agility Test.

- 6 cones and 2 timing gates are to be set up according to the figures below.

- Place one timing gate at the start, and one timing gate at the finish.

- For better measurement results, we advise that the two magnetic elements on the inside position be angled.

Course field for Illinois Agility Test starting from the **right**.   Course field for Illinois Agility Test starting from the **left**.
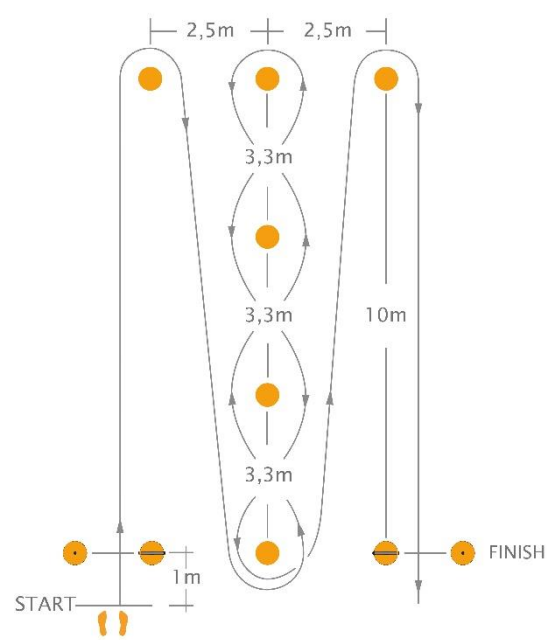
Performing the test

- The player starts from the start position, 1 m before a timing gate.

- Before and after each test there should be standing time of at least 1 second.

Test results

The test results are shown under the "Runnings" tab.

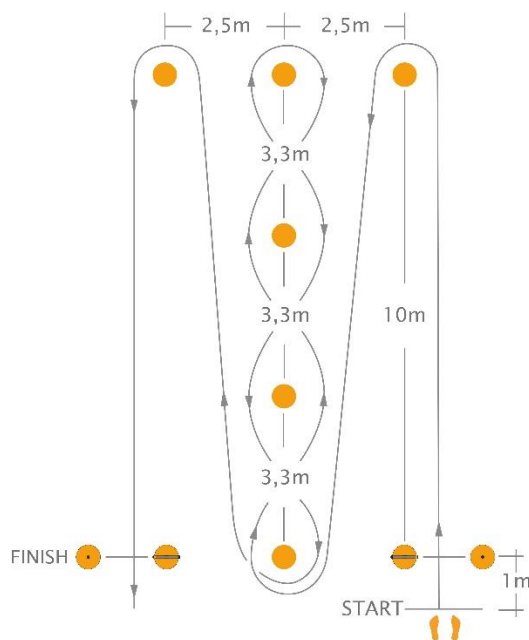## 7.5.2.　　　Three Cone Drill

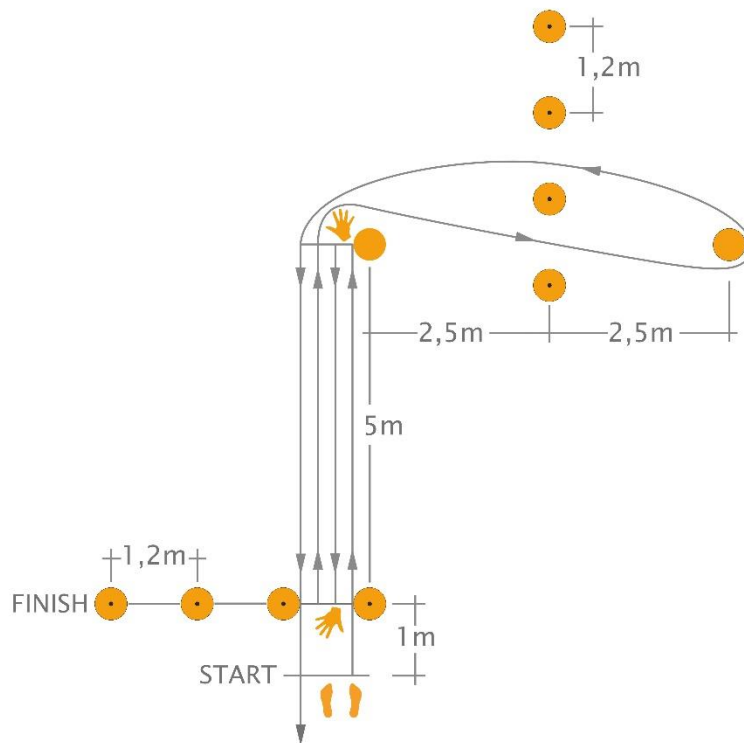The Three Cone Drill (3CD) is one of the most common tests of agility in American football. It is used as part of player assessment in the NFL combine. Nevertheless, the 3CD is a suitable test for all sports with high demands in agility, relatively short action periods and the necessity to maneuver in crowded spaces.

Setting up the course field

Four magnetic elements are set up at the start, each 1.2m apart. One cone (A) is placed 5m from the starting line. Another cone (B) is placed 5m from cone A at a 90 degree angle. In between cone A and cone B four magnetic elements are placed, each 1.2m apart.

Performing the test

The athlete starts in a three-point position or upright with his hand and/or feet behind or on the starting line. To ensure comparability, we recommend to define and use a standard position of your choice and make use of the "comment" field in the results if you differ from your standard.

The athlete can then either start on a given command or on his own accord (after at least 1 second of calm state).

The athlete runs to cone A, bends down and touches the ground with the **right** hand and turns over his **left shoulder**. Then he turns and runs back to the starting line, bends down and touches that line with his **right** hand and again turns over his **left shoulder**. Then he runs back to cone A and runs around the outside of it (right shoulder inside), weaves inside cone B and then around the outside of cone B (left shoulder inside). He runs back and around cone A (left shoulder inside) before finishing by maximally accelerating and running through the gate past the starting line.

- The player starts from the start position, 1 m before the timing gate.

- Before and after each test there should be standing time of at least 1 second.

Test results

The test results are shown under the "Runnings" tab.

7.5.3. Pro Agility Test

The Pro Agility Test (PAT) consists of rapid directional changes in a linear plane. It is commonly used as an assessment in American football, basketball, soccer, and most other field and court sports. This test has also been referred to as the 5-10-5 shuttle. It is used as part of player assessment in the NFL combine.

Setting up the course field

One magnetic gate consisting of two magnetic elements is set up at the starting line. The magnetic elements are 1.2m apart. Two cones are placed 5m on each side from the starting line to mark the turn-round-lines (1 and 2).
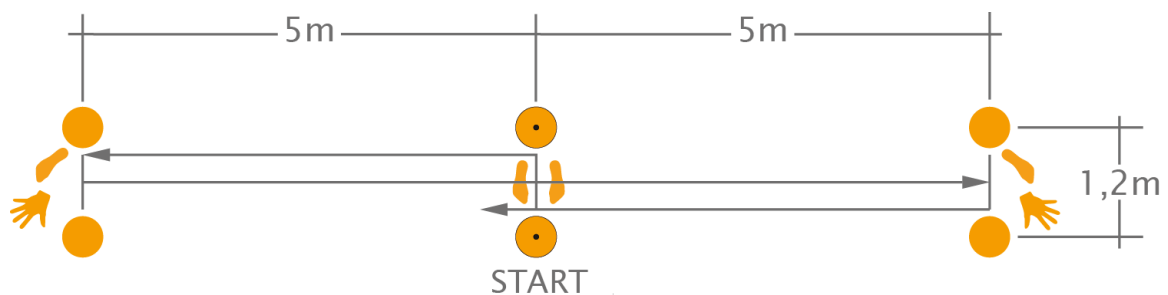
Performing the test

The athlete positions himself in a 3-point position on the starting line with feet shoulder width apart and placed equally either side of the starting line.

The hand in contact with the floor during the 3-point position determines which direction the athlete should travel. For example, if the athlete is going right, then he must start with his right hand on the starting line, and vice versa. We recommend to standardize the starting direction to ensure comparability.

The test can also be conducted from an upright starting position. To ensure comparability, we recommend to define and use a standard position of your choice and make use of the "comment" field in the results if you differ from your standard.

Example when starting with the **right** hand on the starting line:

The athlete starts the drill by accelerating maximally to the turn-around-line to his **right**. At the turn-around-line the athlete touches it with his **right foot and hand** and then turns over his **left shoulder**. Then he accelerates towards the opposite turn-around-line this time touching it with the **left foot and hand** and turning over his **right shoulder**. The athlete then accelerates towards the starting line to finish the test. On all turns the inside hand must never touch the ground.

- Before and after each test there should be standing time of at least 1 second.

Test results

The test results are shown under the "Runnings" tab.

7.5.4. Generic Agility Test

The Generic Agility Test allows trainers and athletes to create agility tests as specific to their sport as possible. The only general requirement is a start point and a finish point. There is no pre-specified distance or running course.

Setting up the course field

This test will not be recognized automatically by the software. It has to be either chosen from the drop-down menu "Exercise type during running" before the measurement is started or changed under "Exercise" after the data was analyzed (Generic Agility).

For the Generic Agility Test, **only two gates are set up**: One at the starting line and one at the finish line.
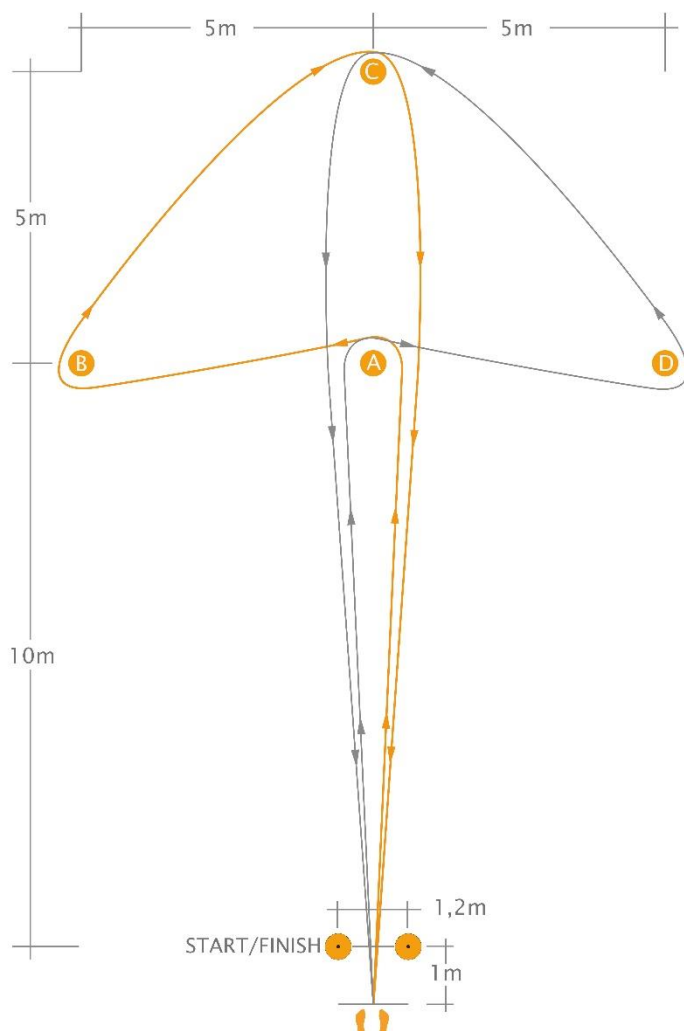
Performing the test

- The athlete starts the agility test 1m before the starting gate, and finishes the test by running through the finish gate.

- Before and after each test there should be standing time of at least 1 second.

7.5.5.   Arrowhead Agility Test

The Arrowhead Agility Test is a simple but effective tool to assess an athlete's change of direction speed. Although appropriate for all team sports, it is typically used in soccer.

Setting up the course field

One magnetic gate consisting of two magnetic elements is set up at the starting line. The magnetic elements are 1.2m apart. One cone (A) is placed 10m after the starting line, another one (C) 15m after the starting line. Two cones (B and D) are placed 5m on each side from the 10m cone (A), resulting in an arrow-shaped set up.

Performing the test – example direction left (orange line)

The athlete starts in an upright starting position, 1m in front of the starting line.

The athlete then maximally accelerates to cone A. He runs around the cone, turning to the left and accelerates to cone B, this turning to the right and starts accelerating to cone C. Another right turn and the athlete can accelerate back to the finish line.

Since the test can and should be conducted in two directions, it should be decided beforehand which direction the should turn first at cone A. Consequently, this needs to stay constant for all athletes to ensure comparability.

Test results

The test results are shown under the "Runnings" tab.