15.6 Field tests

15.6.1 Test conditions

Tests must be conducted under the meteorological conditions found at the time of the test, subject to the limits of section 5: Field (site) tests. The conditions must be reported.

15.6.2 Procedure

Energy return is calculated for the position tested for shock absorption (see section 14.6.2: Procedure).

15.6.3 Calculation of results

Report the values of energy return for each test position.

16. DETERMINATION OF PEAK TORQUE (FIFA TEST METHOD 2024-06)

16.1 Scope

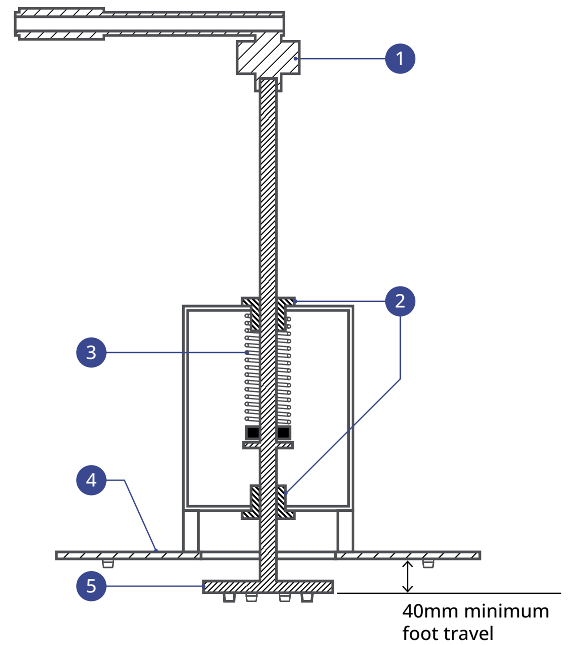
The peak torque test method for a football turf surface measures the maximum torque needed to rotate a loaded foot placed flat on the test surface, with a central axis of rotation perpendicular to the surface. This measurement determines the rotational resistance of the surface.

16.2 Test apparatus

A schematic presenting the mechanical configuration of the apparatus is provided below in Figure 14: rotational traction athlete (RTA) apparatus. It comprises the following components:

- A circular test foot of diameter 150±2mm, with six football studs (as described above in section 9: Football studs used for test) equally spaced on the underside of the test foot on a pitch radius of 46±1mm from the centre of the disc.
- A shaft is rigidly attached to the test foot and supported by a minimum of two low-friction bushings or bearings positioned at least 200mm from one another. The shaft-foot assembly must freely rotate around the vertical (Z) axis only. When in operation, the shaft-foot assembly slides linearly in the vertical axis, facilitating compression of the internal spring.
- The body of the device is rigidly attached to a baseplate upon which the operator stands or kneels. A minimum of six football studs (as described in section 9: Football studs used for test) are arranged on the underside of the baseplate to minimise any counterrotation during operation.
- A single-handled torque wrench of length 500±10mm that attaches to the top of the shaft. The mass of the torque wrench should not exceed 2.5kg.
- A torque sensor (minimum range 0-60Nm, to an accuracy of ±1Nm including calibration uncertainty) and an angle sensor both attached to the shaft and capable of recording the torque and angle data throughout the full rotation of the test foot. There should be a means to calibrate the angle sensor to an accuracy of 0.5° between 0° and 90°. The total mass of the sensors and attachments should not exceed 1.0kg.
- A means of recording and filtering the signals from the torque and angle sensors and a means of displaying the resulting signals (see Figure 15: example plots of torque v. angle (top) and angle v. time (bottom) from an RTA trial). The minimum sampling rate should be 250Hz and the A/D (analogue-to-digital) converter should have a minimum resolution of 16 bits. Angle and torque signals data with time base must be recorded and stored.
- The device houses a spring of 4±1N/mm stiffness. The spring stiffness must remain within this tolerance over a compressed distance of at least 50mm following any precompression, or 150mm when no precompression is used.

Figure 14: RTA apparatus



Key:
1 Digital torque transducer
2. Low-friction bush or bearing to enable free linear and rotational movement
3. Compression spring of 4±1N/mm stiffness
4. Studded baseplate
5. Studded test foot

The device applies a force of 450N±20N through the test foot onto the surface when compressed by the operator standing mounting the baseplate. The spring must compress by a minimum of 40mm when the device is mounted, at which point the underside of the test foot must align horizontally with the underside of the baseplate.

The applied force must include the force generated by the compression spring in addition to any downward force resulting from the mass of the shaft-foot assembly and any rigidly affixed components thereof.

When standing on the baseplate, the technician must take extra care to ensure that the underside of the studded disc is parallel to the underside of the baseplate and no counterrotation of the baseplate occurs whilst applying torque to the shaft-foot assembly.

In the equipment design, thought must be afforded to reducing to a minimum any source of rotational friction not resulting from the interaction between the test foot and surface, including but not limited to the shaft support mechanism, spring support mechanism and any other mating surface that may affect the peak torque value measured.

16.3 Test procedure
Before conducting each test, ensure that the disc and studs are cleared of any infill/detritus.

Assemble the apparatus and ensure the free movement of the shaft and test foot. Place the test foot onto a representative area of the surface and avoid any large particles that may be present, which could affect the stability of the baseplate or the values recorded by the test foot.

The technician puts their first foot or knee on the baseplate and then puts their second foot or knee on the baseplate.

The technician then lifts their first foot/knee from the baseplate and puts it back on the baseplate. They also lift their second foot/knee from the baseplate and put it back on the baseplate. This balancing operation serves to force the baseplate studs into the surface, ensuring that it is both flat and stable upon the surface. Without placing any vertical pressure on the torque wrench and applying minimum rotational torque to the torque wrench, the technician turns the wrench and test foot smoothly, without jerking, a minimum of 90° for a duration of approximately four seconds.

Record the maximum value displayed on the torque meter to the nearest 0.1Nm.

16.4 Laboratory tests
Determine the peak torque in five positions, ensuring each test position is at least 100mm (outside edge of the test foot to the outside edge) apart and at least 100mm (outside edge of the test foot) from the sides of the test specimen. If the mean rotational velocity for any trial is below 20°/s or above 50°/s, repeat the trial in a new position. Calculate the mean from the five test positions.

Undertake tests under dry and wet conditions, as appropriate.

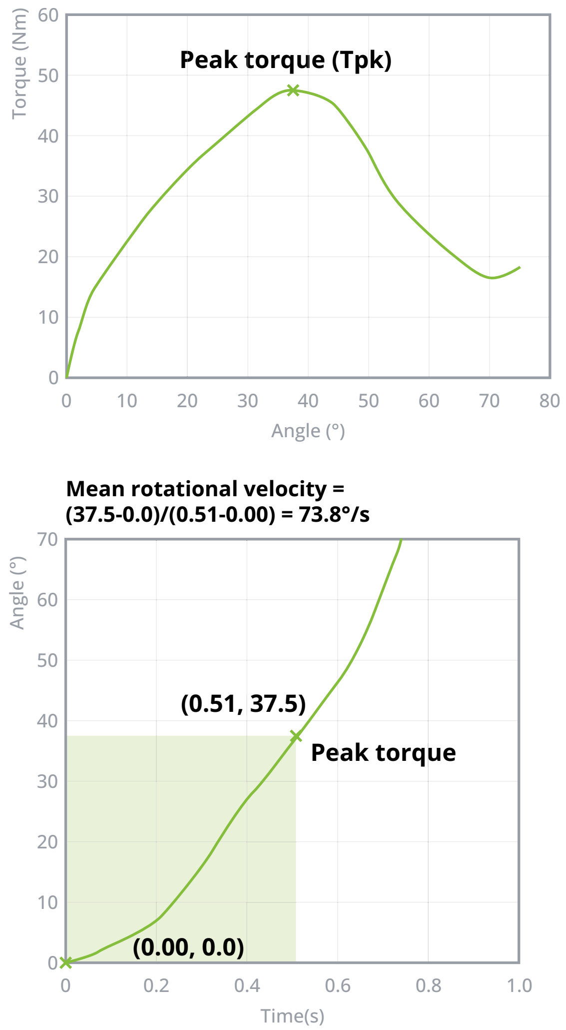
16.5 Laboratory test after simulated use
Whenever possible, perform the tests with the test specimen inside the Lisport XL machine or carefully remove the test specimen from the Lisport Wear machine and place it on the test floor. Determine the peak torque, the rotational shear stiffness and the torque at 10° of the test specimen in five positions. Each measurement must be conducted on the fully conditioned area of the test specimen, at least 250mm from any edge and at least 100mm from any other test position. If the mean rotational velocity for any trial is below 20°/s or above 50°/s, repeat the trial in a new position. Calculate the mean from the five test positions.

16.6 Field tests
16.6.1 Test conditions
Tests must be conducted under the meteorological conditions found at the time of the test, subject to the limits of section 5: Field (site) tests. The conditions must be reported.

16.6.2 Procedure
At each test location, conduct five individual measurements, each at least 100mm (outside edge of the baseplate to outside edge of the baseplate) apart. If the mean rotational velocity for any test is below 20°/s or above 50°/s, repeat the test in a new position.

16.7 Calculation and expression of results
Low pass filter both the torque and angle data at 10Hz using a second-order Butterworth filter. Correct any baseline drift in the torque and angle data sets by subtracting the minimum value from the whole signal, so that the minimum torque becomes 0.0Nm and the minimum angle becomes 0.0°.

Figure 15: example plots of torque v. angle (top) and angle v. time (bottom) from an RTA trial



Find the peak torque and the time at which it occurs. The peak torque represents the rotational resistance.

Find the angle and the time corresponding to peak torque.

Working backwards from the peak torque, find the time when the torque first drops below 1Nm, which is assumed to represent the start of rotation.

Find the angle at the start of rotation.

Calculate the mean rotational velocity from the start of rotation to peak torque as the change in angle divided by the change in time:

$$RV_{MN} = \frac{(A_{PK} - A_S)}{(t_{PK} - t_S)}$$

Where:
- RV_{MN} = the mean rotational velocity from the start of rotation to peak torque, expressed in degrees per second
- A_{PK} = the angle of peak torque, expressed in degrees
- A_S = the angle at the start of rotation, expressed in degrees
- t_{PK} = the time of peak torque, expressed in seconds
- t_S = the time at the start of rotation, expressed in seconds

Calculate the mean value of peak torque.

Report the mean result to the nearest 0.1Nm, e.g. 40.3Nm.

17. DETERMINATION OF ROTATIONAL SHEAR STIFFNESS (FIFA TEST METHOD 2024-07)

17.1 Scope

The test method for rotational shear stiffness on a football turf surface assesses the rate of torque increase with the rotation angle necessary to rotate a loaded test foot positioned flat on the surface. The test foot has a central axis of rotation perpendicular to the surface. Rotational shear stiffness quantifies the gradient from the surface's resistance to rotational forces and determines the torque required along the rotation.

17.2 Test apparatus

Rotational shear stiffness can be determined using the RTA (see section 16.2: Test apparatus).

17.3 Test procedure

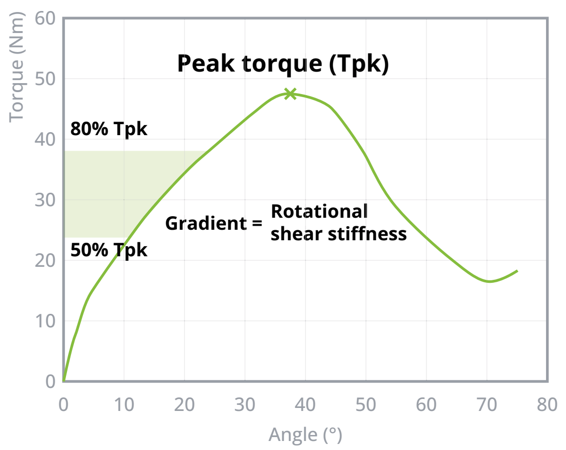
See the description in section 16.3: Test procedure.

17.4 Calculation and expression of results

Fit a straight line to all the torque (y-axis) and angle (x-axis) data between 50% and 80% of peak torque during the build-up to the peak (see Figure 16: example plot of torque v. angle, illustrating the region used to calculate the rotational shear stiffness below). The gradient of this line represents the rotational shear stiffness.

Figure 16: example plot of torque v. angle, illustrating the region used to calculate the rotational shear stiffness

Calculate the mean value of rotational shear stiffness.



Report the mean rotational shear stiffness to the nearest 0.01Nm/°, e.g. 0.92Nm/°. The uncertainty of measurement in rotational shear stiffness is ±0.05 Nm/°.

17.5 Laboratory tests

The rotational shear stiffness is calculated for the five positions tested for (lightweight) rotational resistance. Calculate the mean rotational shear stiffness from the five test positions.

17.6 Laboratory test after simulated use (Lisport XL)

Undertake tests under dry and wet conditions, as appropriate.

The rotational shear stiffness is calculated for the five positions tested for (lightweight) rotational resistance. Calculate the mean rotational shear stiffness from the five test positions.

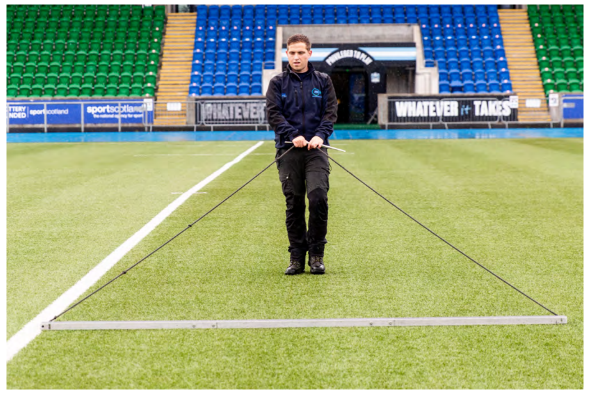
17.7 Field tests

17.7.1 Test conditions

Tests must be conducted under the meteorological conditions found at the time of the test, subject to the limits of section 5: Field (site) tests. The conditions must be reported.

17.7.2 Procedure

The rotational shear stiffness is calculated for the positions tested for (lightweight) rotational resistance.



18. PROCEDURE FOR ASSESSMENT OF SURFACE PLANARITY (FIFA TEST METHOD 2024-08)

18.1 Scope

The assessment of surface planarity on a football turf surface involves evaluating the evenness of the playing surface using a straight edge that is pulled longitudinally and transversely between the playing lines. A calibrated graduated wedge called a slip gauge is used to measure deviations beneath the straight edge. This test method provides quantifiable measurements of surface irregularities, ensuring that the playing surface meets the required standard of flatness.

18.2 Test apparatus

18.2.1 A straight edge with the following characteristics:

a. Length: 3,000±20mm; width: 75mm ±25mm; height: 40±10mm.

b. Minimum weight: 6.6kg. The weight of the test device may need to be increased if the straight edge does not sit on top of the infill due to resilient yarn. Add enough weight for the straight edge to sit on top of the infill.

c. Linearity of the straight edge: ±2mm.

d. Rigidity of the straight edge: 2mm (minimum).

e. Sliding side on the surface: 75±25mm x 3,000±20mm.

f. A means to pull the straight edge along, typically a rope. This can be attached to the straight edge directly or passed through a hollow core in the straight edge. The length of the rope should be sufficient to allow the technician to pull the straight edge in a straight line and observe the potential deviations under it. The technician must be at a distance of a minimum of 3.0m and a maximum of 5.0m from the straight edge when pulling it.

18.2.2 Wedge (slip gauge)

a. Length: 200.0mm (minimum). If the 200mm wedge is too big, a small wedge or small ruler may be used to assess the deviation.

b. Width: 15.0mm (minimum).

c. Height: 2-18mm (minimum).

d. Angle of the wedge: 5±1°.

The slip gauge should be graduated on its upper surface at intervals corresponding to a 1.0mm increase in height.