

IAAF PERFORMANCE SPECIFICATIONS FOR SYNTHETIC SURFACED ATHLETICS TRACKS (OUTDOOR)

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IAAF Track and Field Facilities Manual 2003

3.1.3 TESTING

Systems developed for athletics tracks should always undergo a programme of laboratory testing before being introduced by manufacturers and installers. These tests would have the following principal aims:

- to ensure the compatibility of all the raw materials in the formulation
- to ensure that the system can be successfully installed in most normal climatic conditions
- to ensure that the surface has satisfactory durability
- to ensure that the performance characteristics of the surface are satisfactory for athletics
- to ensure that the formulation has no unsatisfactory environmental characteristics with respect to its raw materials ingredients, method of installation, or long-term performance

All of these aspects may be investigated by suitable laboratory tests. The likely durability can be predicted by accelerated tests for abrasion, spike resistance, compaction, the effects of UV, water and varying temperatures, etc.

However, most of the tests which have been developed will only assess one aspect of durability. In practice, of course, these surfaces deteriorate under the action of combined wear and environmental factors. For this reason, observations on actual installations of products, preferably several years old, are invaluable.

The performance of the surface for athletics is obviously of paramount concern to the IAAF, and the requirements which they stipulate in this respect are detailed earlier in this Chapter. The precise methods by which an athletics track is tested for these various parameters is given below. It cannot be stressed too highly that the testing and investigation of these facilities is a very specialised activity, requiring complicated test apparatus and considerable experience in its use and the interpretation of the results generated. It is for this reason that the IAAF have enlisted the assistance of a network of test laboratories around the world, all suitably equipped and experienced in athletics track testing. The list of current IAAF accredited laboratories for testing synthetic track surfaces can be found on the IAAF website.

The best check of the quality of the finished track facility is to have an in-situ performance test undertaken by an IAAF accredited laboratory. Such a test is mandatory for a facility seeking an IAAF Class 1 certificate. Where an in-situ test is not being undertaken, it is recommended that for quality assurance purposes the surfacing installer is instructed to prepare control samples at the rate of one sample per 600m² of installed surface. The samples should be cast beside the track using the same materials and techniques. The thickness of the samples should be the same thickness as listed on the IAAF Product Certificate for the synthetic material. The size of the samples should not be less than 600mm x 600mm. If the completed facility is undergoing full testing, the quality assurance samples should still be prepared to enable the tensile properties to be measured without the need to cut out areas of new surface. In this case, each sample size can be 300mm x 300mm.

3.1.3.1 Imperfections

Requirement

No surface imperfections such as bubbles, fissures, delamination, uncured areas etc., shall be acceptable.

Method

A thorough visual examination of all areas of synthetic surface should be conducted, and the positions of all imperfections noted on a plan of the facility.

Where appropriate, photographs may be taken of any imperfections, in order to illustrate the test report.

Note: in some cases uncured areas may not be identified until the thickness survey is undertaken (see 3.1.3.3). For instance uncured material might only be detected for the first time when a thickness probe is withdrawn from the surface and is found to be smeared with sticky resin. This may happen with multi-layer systems where one or more of the lower layers is uncured but the upper layer appears sound. It is important that the extent of any area of uncured material is fully identified.

3.1.3.2 Surface Flatness

Requirement

The surface shall be installed so that on a localized level, there shall be no high spots or depressions beneath a 4m straightedge exceeding 6mm. Depressions beneath a 1m straightedge shall not exceed 3mm. There shall be no step-like irregularities greater than 1mm in height. Particular attention is to be paid to seams and joints in the surface. The intent is to ensure the safety of the athlete and provide an even running surface.

Method

Place the 4m straightedge on the surface over lanes 1-3 at 90° to the kerb and drag it around the entire circuit. Move it out to the next three lanes and repeat the drag around the entire circuit. For circuits with more than 6 lanes, continue until all lanes have been dragged. Turn the straightedge through 90°, place on the surface in lane 1 (parallel to the kerb) and drag it to the outer kerb. Move it along 4m and drag it back to the inner kerb. Move it along 4m and drag it back to the outer kerb. Repeat until the entire circuit has been dragged.

On runways, place the 4m straightedge on the surface parallel to the kerbs and in the centre of the runway and drag it from one end to the other.

On fan areas, drag the 4m straightedge across its width, move it along 4m and repeat the drag back across its width. Repeat again until the full width of the fan has been dragged. Repeat the entire process along its length.

Use continual visual observation to determine if a gap exists under the straightedge. Should a gap exist, verify that both ends of the straightedge rest on the surface, moving the straightedge if necessary, then use a calibrated wedge to determine the actual size of the gap.

The intention is that the entire area of surface should be dragged with the 4m straightedge. Placing the straightedge on a regular 'grid' of individual locations is not an appropriate method for assessing the entire surface.

Whenever, during the 4m straightedge survey, a step-like or other irregularity is visually identified which gives a wedge reading below the maximum permitted, but which is considered to be likely to give a wedge reading above the 1m straightedge maximum, the 1m straightedge should be placed across the irregularity and its exact height measured using the calibrated wedge.

Any location where a gap is found exceeding the maximum permitted, is recorded on a plan of the facility. The record should also identify whether the deviation is a high spot or a depression.

Note: sometimes in moving the straightedge slightly to find the maximum gap, it becomes clear that the irregularity is a high spot rather than a depression. In order to find the magnitude of the high spot, place the centre point of the 4m straightedge on the high spot and rotate the straightedge through 360° until the maximum gap is obtained under one end of the straightedge by pressing the other end down against the surface (see figure 1). Measure the gap beneath the elevated end of the straightedge and then divide this figure by two to give the magnitude of the high spot.

3.1.3.3 Thickness

Requirement

The durability of the surface and the safety of the athlete can be affected by the thickness of the surface. The use of spikes enhances this requirement for a minimum thickness. There will be specifically designed areas such as in the javelin runway or other high stress areas where the safety of the athlete and the durability of the surface will dictate that the thickness be greater than the minimum. This additional thickness shall not affect the flatness of the surface.

The thickness of the surface shall be determined to meet force reduction and vertical deformation requirements hereunder. The IAAF Product Certificate for a synthetic surface material indicates the thickness at which a sample of the material, tested in a laboratory, complied with the IAAF Performance Specifications. The thickness laid will probably have to be greater to ensure that no in-situ test result will fail. The total area over which the thickness falls more than 10% below the thickness given in the IAAF Product Certificate for the material used shall not exceed 10% of the total surface area. The high stress areas with a deliberately thickened surface shall not be taken into account in computing these percentages. Note that force reduction and vertical deformation performance requirements take precedence over the thickness requirements.

The thickness shall not be determined to the top of the surface crumb or texture but by the method of test given below.

Method

A calibrated 3-prong depth-measuring probe is used to determine the thickness of the surface. Care must be taken not to penetrate the asphalt or bitumen-macadam base beneath the surface. The thickness is measured by starting at the finish line and taking sets of readings at 10m intervals around the circuit. The first set of readings is to be taken in the even lanes (2, 4, 6, 8) and the next set in the odd lanes (1, 3, 5, 7), alternating between even and odd lanes every 10m around the circuit. Readings shall be taken in the centre of each lane. At the 110m start position on each straight, readings shall be taken in the centre of each lane. Runways including the steeplechase lane on the circuit shall be probed at 3m intervals centred along the length. The fan areas shall be probed at 5m intervals along parallel axes in two directions.

Where thin areas are detected, additional probe readings shall be taken in all directions until an acceptable thickness is measured. Additionally, the exact extent of over-thickness (reinforced) areas shall be determined by probe readings in the same way as above. All measurements taken are recorded (but see next paragraph) and the test points listed in the test report.

At a number of locations a core (10mm to 25mm in diameter) is removed and measured using the following method to make the final determination as to the actual thickness. At least four cores shall be removed, but more than this number are required if the surface is thin over large areas. All core holes to be repaired immediately. The surface texture of the core is abraded with a grade 60 abrasive for approximately 50% of the surface area of the core. The thickness of the abraded area of the core is measured using a thickness gauge fitted with a 0.01mm accuracy dial, a plunger with a flat measuring surface of 4mm diameter and with a measurement force between 0.8N and 1.0N. The measurement is recorded to the nearest 0.1mm.

The difference in thickness between the actual surface and the abraded surface is calculated and the difference deducted from all of the actual probe measurements. These amended figures are recorded as the thickness of the surface for the purpose of the report.

All readings should be noted on a plan of the facility.

3.1.3.4 Force Reduction

Requirement

The dynamic interaction between the athlete and the surface is significant to the performance and safety of the athlete. Therefore the ability of the surface to reduce force (absorb energy) is important. The force reduction shall be between 35% and 50%, at any surface temperature between 10°C and 40°C. If, at the time of measurement, the temperature of the surface is outside

this range, it shall be permissible for the results obtained to be corrected for temperature, by interpolation from a graph of force reduction against temperature for the precise surfacing system installed, previously obtained by laboratory testing.

Because of the fact that it is usual to install greater thicknesses of synthetic surface at take-off areas and at the ends of runways, it is possible that results obtained in these areas may fall outside the above range.

Method

The force reduction of the installed synthetic surface may be measured using the apparatus described below and shown schematically in figure 3.1.3.4.

This method utilises the 'Artificial Athlete' BAA. A mass of 20kg is allowed to fall onto an anvil, which transmits the load via a spring to a test foot with a spherical base resting on the surface. The foot is fitted with a force transducer that enables the peak force during the impact event to be recorded. The peak force is compared with the result obtained on a rigid (concrete of at least 150mm thickness) floor, and the percentage force reduction calculated for the synthetic surface.

Figure 3134

The BAA must have a current valid Certificate of Compliance from the International Association for Sports Surface Sciences (ISSS), obtained under their BAA Certification Programme procedures. The apparatus consists of the following essential components:

- a) Falling weight, 20 ± 0.1 kg with a hard striking surface, which is guided so as to fall smoothly and vertically with minimum friction.
- b) Spiral spring, whose characteristic, when mounted in the assembly described below, is linear with a spring rate of 2000 ± 60 N/mm over the 0.1 kN to 7.5 kN range. The spring is fitted with a hard upper plate (anvil) and has an outer diameter of 70.0 mm or less. It is recommended that the spring be manufactured by milling from the solid.
- c) Adjustable supporting feet, no less than 250 mm from the point of application of the load.
- d) Steel base plate, with the rounded lower side having a radius of 500mm, radius of the edge 1 mm, diameter 70.0 ± 0.1 mm, thickness 10mm minimum.
- e) Metal guide tube, interior diameter 71.0 ± 0.1 mm.
- f) Electrical force-sensing device, with a capacity of 10kN, class 0.2.
- g) Test foot, consisting of the flat and round (diameter of 70 ± 0.1 mm) steel base plate (see above), force sensing device, spring and upper plate, funnelled into the guide tube. The total weight of the testing foot (without guide tube) should be 3.0 ± 0.3 kg.
- h) A means of supporting the weight, allowing it to be set to the fall height with an uncertainty no greater than ± 0.25 mm.
- i) A means of conditioning and recording the signal from the force sensing device and the sensors, and a means of displaying this signal. The ISO 6487 channel frequency class of the conditioning amplifier shall be ≥ 1 kHz.

Care shall be taken to ensure anti-aliasing does not occur. This may be achieved by applying an analogue prefilter with a cut-off frequency of approximately 500 Hz, to prepare the signal for final filtering.

The conditioning amplifier shall be followed by or shall incorporate a low-pass filter having a 9th order Butterworth characteristic with a -3 dB frequency of 120 Hz. Filtration may be implemented in hardware or software. The response of the system at any given frequency

shall be within ± 0.5 dB of the expected response, calculated on the basis of the Butterworth function.

Where digital recording means are employed, the word length shall be ≥ 12 bits, the amplitude of the signal shall be no less than 25 % of the equipment full scale and the sampling frequency shall be ≥ 2 kHz or twice the upper frequency response limit of the amplifier/filter system preceding the digital system, whichever is greater.

- j) A rigid, non-vibrating, smooth, level and even concrete floor on which a peak force (F_{max}) of between 6.60 ± 0.25 kN is achieved.

The apparatus is set vertically. The drop height of the weight on to the anvil is set to 55mm plus or minus 0.25mm. The weight is allowed to fall on to the force measurement assembly and the peak force applied to the surface in the course of the impact is recorded. After a not-recorded pilot test, two further measurements are taken. Each individual test procedure is repeated at intervals of 60 ± 10 seconds. It is important to lift the weight from the anvil within five seconds after impact, in order that the surface is not loaded for too long.

The force reduction is calculated as follows:

$$\text{Force Reduction (\%)} = \left(1 - \frac{F_s}{F_c}\right) \times 100$$

where F_s = measured maximum peak force on synthetic surface, in Newton (N)
 F_c = measured maximum peak force on concrete, in Newton (N)

Calculate the mean of the force reduction results from the second and third impact. Report the initial and mean results to the nearest whole percentage, e.g. 37%.

The accuracy of this method is calculated at plus or minus 1%.

At least one measurement shall be made for every 500m² of normal thickness synthetic surface, with a minimum of twelve (12) measurements over the facility. The test positions shall be as follows:

- At the discretion# of the test laboratory in any lane around the first radius*
- In the centre of lane 2 at the 130m mark on the back straight
- In the centre of lane 5 at the 160m mark on the back straight
- At the position of lowest thickness on the back straight*
- At the discretion# of the test laboratory in any lane around the final radius*
- In the centre of lane 1 at the 320m mark on the main straight
- In the centre of lane 4 at the 350m mark on the main straight
- In the centre of the outer lane at the 390m mark on the main straight
- At the position of lowest thickness on the main straight*
- At the discretion# of the test laboratory at any position (except the high-jump take-off point) over the semi circular area. Where there are two semi circular areas, a test shall be performed on each of them.
- At the discretion# of the test laboratory at any position (except the reinforced areas) on each of the runways (long jump/triple jump, pole vault, javelin) and in the steeplechase lane.

#Whenever the selection of the test location is left at the discretion of the laboratory, that location must be close to the average thickness of the track as a whole.

*For the purposes of testing, the first radius is defined as 10m to 100m, the back straight as 110m to 200m, the final radius as 210m to 300m, and the main straight as 310m to 400m.

If the area of synthetic surface is exceptionally large (for example 10 or 12 lane straights), any necessary additional tests shall be at locations selected by the test laboratory.

At each location, the temperature of the surface shall be measured with a needle temperature probe and recorded. Each test position shall be recorded on a plan of the facility with the results recorded in the report.

Note: if the surface temperature is outside the permitted range of 10°C to 40°C, temperature correction of the results may be employed on the basis of interpolation from laboratory results as described in the first paragraph. However, it is sometimes possible to avoid the need for this, by conducting the testing at a different time of day. For instance, if the facility is in a hot region, testing early in the morning or in the evening can result in the surface temperature falling to within the above range.

3.1.3.5 Vertical Deformation

Requirement

The dynamic interaction between the athlete and the surface is significant to the performance and safety of the athlete. Therefore the ability of the surface to deform under load is important. Too high a deformation can affect the safety of the athlete through instability of the foot, while the inability of the surface to deform can cause injuries due to impact forces. The vertical deformation shall be between 0.6mm and 2.2mm, at any surface temperature between 10°C and 40°C. If, at the time of measurement, the temperature of the surface is outside this range, it shall be permissible for the results obtained to be corrected for temperature, by interpolation from a graph of vertical deformation against temperature for the precise surfacing system installed, previously obtained by laboratory testing.

Because of the fact that it is usual to install greater thicknesses of synthetic surface at take-off areas and at the ends of runways, it is possible that results obtained in these areas may fall outside the above range.

Method

Vertical deformation is measured using the apparatus described below and shown schematically in figure 3.1.3.5. The apparatus consists of the following essential components:

- a) Falling weight of 20 ± 0.1 kg with a hard striking surface guided in such a way as to fall smoothly and vertically with minimum friction.
- b) Single coil spring which, when mounted in the assembly described below, is linear with a spring rate of 40 ± 2.5 N/mm over the 0.1kN to 1.6kN.
- c) Adjustable supporting feet, no less than 250mm from the point of application of the load.
- d) Steel base plate, with a flat lower side; radius of the edge 1 mm, diameter 70.0 ± 0.1 mm; thickness 10 mm min.
- e) Test foot, consisting of the flat and round (diameter of 70 ± 0.1 mm) steel base plate, two horizontal projections attached to the testing foot for the sensors, force sensing device, spring, and upper plate. The total weight of the testing foot (without guide tube) shall be 3.5 ± 0.35 kg.
- f) Metal guide tube, interior diameter 71.0 ± 0.1 mm.
- g) Two sensors e. g. electronic pick-ups with a measuring range of no less than 20 mm and an uncertainty no greater than 0.05 mm. The distance between the sensors shall be less than or equal to 300 mm. The sensors shall be mounted on a separate stand from the falling weight, etc.
- h) A means of supporting the weight, allowing it to be set to the fall height with an uncertainty no greater than ± 0.5 mm.

- i) A means of conditioning and recording the signals from the force sensing device and the sensors, and a means of displaying these signals.

The ISO 6487 channel frequency class of the conditioning amplifier for the force signal shall be $\geq 500\text{Hz}$. It shall be followed by or shall incorporate a low-pass filter having a 9th order Butterworth characteristic with a -3 dB frequency of 120 Hz. Filtration may be implemented in hardware or software. The response of the system at any given frequency shall be within ± 0.5 dB of the expected response, calculated on the basis of the Butterworth function.

The signal conditioner for the deformation signal shall have a -1 dB measuring range of min. 100 Hz (-1 dB upper frequency response). The individual signals of the two deformation sensors shall be superposed before calculating the vertical deformation.

Where digital recording means are employed, the word length shall be ≥ 12 bits, the amplitude of the signal shall be no less than 25 % of the equipment full scale and the sampling frequency shall be ≥ 0.5 kHz.

Figure 3135

Set the apparatus so that it is vertically positioned on the surface.

Adjust the sensors (deformation pick-ups) so they are equi-spaced either side of the falling weight axis. Under this condition the force measurement assembly shall give a constant pressure of 0.009 ± 0.001 N/mm² and a corresponding deformation of the surface which equates to the zero position.

Adjust the deformation pick-ups so they contact the horizontal projections on the test foot.

Set the height of the lower face of the impact mass so that it is 120 ± 0.5 mm above the top plate of the spring.

Allow the mass to fall onto the testing foot. Catch the weight as it rebounds to prevent a second impact of the test foot and the surface.

Record the force applied to the surface and the resulting deformation of the initial impact.

Repeat the procedure three times at intervals of 60 ± 10 seconds without moving the test apparatus, giving a total of four impacts on the same spot, catching the mass after the first impact of each measurement.

Calculate the vertical deformation VD from the expression:

$$VD = \left(\frac{1500}{F_{\max}} \right) \cdot d_{\max}$$

where

d_{\max} is the maximum deformation of the surface in the axis of impact, in millimetres (mm), calculated from the mean of the two sensors (electronic pick-ups).

F_{\max} is the maximum force (peak value) in Newton (N).

The test result is the mean value of the last three impacts.

Report the result to the nearest 0.1mm e.g. 1.5mm. The accuracy of this method is calculated at plus or minus 0.1mm.

At least one measurement shall be made for every 500m² of normal thickness synthetic surface, with a minimum of twelve (12) measurements over the facility. The test positions shall be as follows:

- At the discretion# of the test laboratory in any lane around the first radius*
- In the centre of lane 2 at the 130m mark on the back straight
- In the centre of lane 5 at the 160m mark on the back straight
- At the position of lowest thickness on the back straight*
- At the discretion# of the test laboratory in any lane around the final radius*
- In the centre of lane 1 at the 320m mark on the main straight
- In the centre of lane 4 at the 350m mark on the main straight
- In the centre of the outer lane at the 390m mark on the main straight
- At the position of lowest thickness on the main straight*
- At the discretion# of the test laboratory at any position (except the high-jump take-off point) over the semi circular area. Where there are two semi circular areas, a test shall be performed on each of them.
- At the discretion# of the test laboratory at any position (except the reinforced areas) on each of the runways (long jump/triple jump, pole vault, javelin) and in the steeplechase lane.

#Whenever the selection of the test location is left at the discretion of the laboratory, that location must be close to the average thickness of the track as a whole.

*For the purposes of testing, the first radius is defined as 10m to 100m, the back straight as 110m to 200m, the final radius as 210m to 300m, and the main straight as 310m to 400m.

If the area of synthetic surface is exceptionally large (for example 10 or 12 lane straights), any necessary additional tests shall be at locations selected by the test laboratory.

At each location, the temperature of the surface shall be measured with a needle temperature probe and recorded. Each test position shall be recorded on a plan of the facility with the results recorded in the report.

Note: if the surface temperature is outside the permitted range of 10°C to 40°C, temperature correction of the results may be employed on the basis of interpolation from laboratory results as described in the first paragraph. However, it is sometimes possible to avoid the need for this, by conducting the testing at a different time of day. For instance, if the facility is in a hot region, testing early in the morning or in the evening can result in the surface temperature falling to within the above range.

3.1.3.6 Friction

Requirement

When measured using either the British Transport and Road Research Laboratory Portable Skid Resistance Tester or the apparatus and method described below, the synthetic surface friction shall be nowhere less than 0.5 when wet.

Note: This corresponds to a scale reading of 47 on the TRRL machine.

Method

Two methods are considered suitable for measuring the friction of installed synthetic track surfacing.

Method A involves the use of the portable skid resistance tester illustrated in figure 3.1.3.6a. A standard smooth rubber slider, spring-loaded beneath a foot mounted on the end of a pendulum arm, is allowed to swing down from a fixed position at 90° to the surface, slide along the surface for a pre-set distance, and swing through taking a "lazy pointer" with it, which remains at the top of the swing against a fixed scale.

The apparatus is set level on the surface, with the legs supported on "spreader" plates to prevent localised deflection of the surface beneath the legs as the pendulum swings through its arc. The head is raised so that the pendulum swings clear of the surface. The arm is allowed to swing freely from its normal release position and the scale reading noted. If this is not zero, the friction

rings (E) are adjusted and the process repeated until a zero reading is consistently obtained.

Lower the arm and adjust the height setting until the slider just touches the surface, from one side of the vertical to the other side, a distance of between 125mm and 127mm. Lock the height setting in this position and re-check the distance of travel. Place the pendulum in the release position.

Figure 3136a

Flood the test area with clean water, release the pendulum and ignore the first reading. Release the pendulum five further times and record the scale reading obtained after each swing. Calculate the mean of all five readings. This is the wet result.

If the surface appears to have a directional pattern or texture, additional results should be obtained with the apparatus set in such a way that the slider traverses the same area of surface at 90° and at 180° to the original direction of travel used for the first set of readings.

Method B involves the use of the sliding test apparatus shown in figure 3.1.3.6b.

A vertical shaft of diameter 20mm is arranged in a frame, the lower part of which is designed as a threaded spindle (of pitch 12mm/turn). The shaft is guided at the top by a plain bearing and at the bottom by a ball bearing having a radial and axial action so that the shaft moves downwards when turned clockwise and upwards when turned anticlockwise. At the lower end of the shaft a test foot is mounted on a pivoted mound (ball joint) such that rotation of the shaft is transferred to the test foot.

Figure 3136b

The ball bearing is arranged in a bracket on the frame, so as to permit vertical movement of the ball bearing, downward movement being limited by a stop. A circular flange is fixed to the middle part of the shaft, on which weights can be placed. A constant torque is applied to the shaft by means of a steel wire wound on the shaft by means of a winding drum of 63mm diameter, and which runs over a guide pulley and is tensioned by a freely suspended 5kg weight. This torque drives the shaft.

The test foot contains a strain gauge or piezo-electric device for measuring the torque. The test foot consists of a lower and an upper part, between which the measurement sensors are arranged. The lower surface of the test foot has three skids, in the form of segments of a 100mm diameter, 20mm high, cylinder, arranged as shown. These skids are covered with leather which is finished with 100 grade abrasive paper (grinding procedure with the sliding direction).

The leather shall be old tanned with a Shore D hardness of 60 plus or minus 5.

The leather skid soles should be 2mm thick.

The weight and the polar moment of inertia of the shaft, of the weights and of the test foot, must be as follows:

$$\begin{aligned} \text{weight} &= 20 \text{ plus or minus } 1 \text{ kg} \\ \text{moment} &= 3000 \text{ plus or minus } 200 \text{ kg cm}^2 \end{aligned}$$

Required measurement range for torque is 0 to 4 Nm with an accuracy of 0.5%

The apparatus is placed on the synthetic surface, and the shaft is raised causing the steel wire to wind on to the drum. The synthetic surface is thoroughly wetted with clean water. The shaft is then released so that the weights drive the shaft downwards. As the test sole contacts the surface, the rotation of the shaft is braked by the frictional resistance between the sole and the surface and this is measured as torque, which is continuously plotted with a recording device (Fig 3.1.3.6b).

The total weight of the shaft, weight and test foot is set to 20kg. The shaft is turned far enough upwards before the measurement to ensure that the test foot contacts the surfacing after one rotation. Three measurements are carried out at each test position, and the test sole and the surface must be cleaned

of abraded material between each test.

The measurement plots consist of a curve of torque against time and a curve of normal load against time. To determine the coefficient of sliding friction, the friction resistance at the transition from the initial sliding to steady sliding is used. The sliding friction coefficient is determined from the friction resistance at the point of intersection as follows:

$$E = 0.30 \frac{D}{V}$$

where D = relevant friction resistance (N cm)
and V = normal force in N

In each case, the arithmetic mean is calculated from the three individual measurements made at each location. The results must be reported to two decimal places.

Figure 3136c

Using either method, at least one measurement should be made for every 1000m² of normal thickness synthetic surface, with a minimum of six measurements over the facility. The test positions shall be as follows:

- At the discretion of the test laboratory in any lane around the first radius*
- At the position of apparent lowest texture in any lane on the back straight*
- At the discretion of the test laboratory in any lane around the final radius*
- At the position of apparent lowest texture in lane 1 on the main straight*
- At the discretion of the test laboratory at any position (except the high jump take-off point) over the semi circular area. Where there are two semi circular areas, a test shall be performed on each of them
- At the discretion of the test laboratory at any position on one of the runways

If the area of the facility is exceptionally large (for example 10 or 12 lane straights), any necessary additional tests shall be performed at locations selected by the test laboratory.

Each test location shall be marked on a plan of the facility with the results recorded in the report.

3.1.3.7 Tensile Properties

Requirement

When determined using the method described below, the synthetic surface shall have a minimum tensile strength of 0.5MPa for non-porous surfaces and 0.4MPa for porous surfaces. For all surfaces, the elongation at break shall be a minimum of 40%. The test shall be conducted on a minimum of four specimens and the result quoted is the average of the four results.

Method

In the case of newly installed tracks, it is sometimes acceptable to conduct this test on sample "trays" of synthetic surface prepared by the contractor as work proceeds, or in the case of prefabricated surfaces on samples cut from individual rolls of material on site. However, in the event of dispute or if the quality of the installed surfacing is suspect, samples must be taken from the track itself.

If it is necessary to cut samples of surfacing from the track for this test, these should obviously be removed, where possible, from non-critical areas of the facility such as run-outs at the ends of straights, at the corners of fan areas etc. In the event that samples must be removed from a specific location because a defect is suspected, these samples should be cut from a low-wear area within that location.

In the case of prefabricated products, it is recommended that samples are removed across a

number of the bonded seams, in order that the strength of the bond can be assessed.

It may prove necessary to remove some of the wearing course of the macadam base, if a cohesive sample of the synthetic surface is to be obtained.

All areas from which samples have been removed, should be repaired immediately with fresh synthetic surfacing.

The tensile strength and elongation at break shall be determined on dumbbell bars stamped or cut from a full thickness sample of the surfacing. The shape of the specimens shall be as shown in figure 3.1.3.7 sample A, although specimens shaped as sample B may be used in some circumstances. The bars shall be conditioned at 23°C for 24 hours and then stretched at a constant strain rate of 100mm/minute until they break. A stress/strain curve may be plotted during the test.

Figure 3137

In the case of synthetic surfacing formed with the use of single-component, moisture-curing polyurethanes, at least 14 days curing time should be allowed before conducting tensile strength tests. If such a system fails to meet the stipulated limits, repeat tests should be conducted on further samples after another 14 days, or after a period of accelerated curing in the laboratory.

Each test location shall be marked on a plan of the facility and the results obtained on samples from each location included in the test report.

3.1.3.8 Colour

Requirement

The evenness of the colour of the running surface assists in the concentration of the athlete and provides a focus in relation to the line and event markings. The colour must be consistent within the design of the surface and when fading occurs, this must occur evenly. The colour shall be uniform to within one position on the recognised colour reference card or plate system used. For deliberately designed multi-colour facilities each discrete colour shall be similarly uniform.

Method

There are a number of different assessment systems for colour. Most utilise some form of colour chart or series of colour cards or plates. Any system used for assessing colour must be capable of identifying and if necessary quantifying, the consistency of the colour of the surface over the facility.

Areas of inconsistent colour shall be marked on a plan of the facility.

3.1.3.9 Drainage

Requirement

Water in excess of the height of the texture of the running surface can effect the safety and performance of the athlete. When completely covered with water and allowed to drain for 20 minutes, there shall be no area of synthetic surface where the depth of residual water exceeds the texture depth of the surface.

Method

The synthetic surface is flooded with water by any appropriate means and the 20 minutes is measured from the time the flooding stops. After that time, the surface is examined for standing water. Locations with standing water exceeding the top of the surface texture of the synthetic surface are noted on a plan of the facility and included in the report.

Note: It is sometimes difficult to deliver the necessary quantities of water to the surface, from a hose supply. In this event, it may be necessary to evaluate this parameter just after heavy rainfall, if at all possible. Alternatively, selective watering from a hose supply should be applied to those

areas of the facility which are particularly susceptible to water run-off problems, such as the fan areas.

3.1.3.10 General

The above programme of testing is considered adequate for a facility in good condition. Where the surface is showing evidence of problems, it may be necessary to extend the testing to other areas, to increase the frequency of tests, or to modify the procedures employed to properly identify the nature and extent of the surfacing defects. These are matters best left to the professional judgement of an IAAF accredited test laboratory.

3.1.4 REPAIRS AND REFURBISHMENT

No facility lasts for ever, but it is entirely reasonable to expect the foundation of an athletics track to continue to function effectively over a time period that may encompass several replacements of the synthetic surface. To do this it is necessary to ensure that a very good standard of road construction is employed. The total depth of base necessary to ensure long term stability of the finished track surface will depend upon the nature of the site on which it is to be built. It should be noted that, even on the most ideal site, a minimum of 150mm of free-draining aggregate below a minimum of 60mm bitumen/macadam will prove to be necessary. The macadam would typically comprise a base course 40 to 60mm thick and a wearing course 25 to 30mm thick. Great attention must be paid to the accuracy of the final macadam layer because of the very strict requirements for surface flatness and minimum thickness of the synthetic surface .

It is recommended that a geotechnical survey of the ground conditions over the site is carried out at an early stage, and the results of such a survey should be made available to an independent consultant engineer in order that an adequate base to the track can be designed. It is important that, during construction, quality control of ALL aspects of the work is rigorously adopted. This should extend from the installation of the drainage system, through the entire project, to the application of the finished synthetic surface and line markings. The assistance of an independent, suitably experienced and competent test laboratory should be sought, in particular for the quality control of the synthetic surface and to conduct a comprehensive inspection of the finished facility in order to ensure compliance with the performance parameters. When selecting such a laboratory, the specialised requirements of this IAAF Specification must be carefully considered.

After a number of years of use, typically somewhere between 5 and 12 years, it would be expected that an athletics surface would be in need of some repair, or even complete renovation if usage levels have been high. Naturally the extent of wear which the synthetic surface experiences will depend upon the degree and type of usage. Use levels vary enormously from one facility to another.

In the case of porous surfaces, wear will be most apparent as a loss of the textured surface coating, leading to the resin-bound rubber crumb base mat showing through and becoming more exposed to increased spike damage and weathering effects. Naturally this will first become apparent in the high wear areas of the track. If identified early enough, it may be possible to reduce the rate of further wear by the spray application of an additional textured paint coating. The areas to be repaired should be thoroughly cleaned and if necessary high pressure washed and allowed to dry before the application of further textured coating. If significant damage to the base mat has already occurred then at this stage it would best to cut out all those damaged areas down to the bitumen/macadam and reinstate with fresh base mat before applying the new textured coating.

Non-porous systems tend to have a superior resistance to abrasive and spike wear. Composite systems with an upper surface of cast elastomer also have this characteristic, although once this upper layer is penetrated by spikes, wear occurs more rapidly in the underlying base mat than it would if the system was solid rubber. This is one of the reasons why a thickness of at least 4mm is preferable for the upper cast layer of a composite surface. When loss of texture has reached a point where the surface is in need of repair, the usual way of doing this is to grind off the upper rubber layer and granular texture and apply a fresh flood-coat layer of polyurethane resin with overcast granules in

the usual way. If this is done on a patch repair basis it is inevitable that the appearance of the surface will be very noticeably different on the repaired areas compared to the existing surface. Eventually the time will come when the condition of the majority of the upper surface over the facility has deteriorated to the point where it is necessary to completely re-top all the synthetic surfacing. In this case the entire track surface down to a depth of perhaps 3 or 4 mm would be ground off, and then a new flood-coat surface applied in the usual way. When applying overcoats of fresh poured resin, it is most important that a minimum thickness of new material is maintained otherwise delamination becomes a significant possibility. In order to avoid this potential problem of inter-layer delamination, any cast resin layer should be a minimum of 4mm thick.

For a composite system, such re-topping is also possible provided care is taken not to grind off so much of the upper surface that the base mat is exposed. Naturally the risk of this happening is much reduced if the originally installed upper cast layer is at least 4mm thick.

Not all repairs that are necessary will be due to wear. A surface may 'harden' over a period of time to an extent where it no longer meets the dynamic properties laid down by the IAAF. In such a case, grinding off some of the thickness and over-topping with fresh surfacing may be an option. It is recommended that a trial area is installed first to demonstrate the acceptability of the technique in bringing the dynamic properties back within the specified range.

Another problem that can occur in tracks of some age is slight shrinkage of the synthetic surface away from the edge kerbing to leave a gap. If this occurs to any significant extent, the full thickness of the surface should be cut back from the kerb a minimum distance of 75mm and fresh material re-instated to full thickness after the application of a suitable primer to the kerb edgings.

Eventually the synthetic surface will have deteriorated to the point where patch repairs or a complete overcoat of cast resin or spray-applied textured paint are no longer adequate to bring the facility back into good condition. When this time comes it is necessary to undertake the complete removal of the old synthetic surface and its replacement with new. An adequate budget should always be allowed for such a major resurfacing operation, with a significant contingencies sum for possible extras. When removing the old synthetic surface it is quite likely that damage will be caused to the wearing layer of the underlying bitumen/macadam. If this occurs over large areas, it will be necessary to plane off the wearing course and reinstate with new before the replacement synthetic surface is installed. If much disturbance to the edge kerbings occurs during this operation, it may also be necessary to re-set these or to install new edge kerbings to the facility. The usual care must be taken during this process to ensure the maintenance of levels and gradients as specified by the IAAF. It is best to employ all the usual quality control and key stage checks during such an operation to ensure a successful job.