



Sustainable Sport Flooring Guide

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1 | INTRODUCTION

The Rio 2016 Organizing Committee for the Olympic and Paralympic Games undertook the commitment of transforming the Olympic and Paralympic Games, with the integration of sustainability criteria throughout the management cycle of the Games, from design and planning to implementation, review, and post-event activities.

Sustainability will be achieved through the implementation of three sustainable development principles ratified by the United Nations Conference on Environment and Development (UNCED) - Rio 92, which are being utilized as a basis for Rio 2016:

- Planet: reduction of the environmental impact caused by the projects related to the Rio 2016 Games, thereby enabling a reduced environmental footprint.
- People: planning and staging of the Rio 2016 Games in an inclusive manner, delivering Games for everyone.
- Prosperity: contribution to the economic development of the state and city of Rio de Janeiro, planning, managing, and reporting the projects involved in the Rio 2016 Games, with accountability and transparency.

Within this context, the Committee developed the Guide to a Sustainable Supply Chain, which considers the environmental, social, ethical, and economic aspects that are present throughout the life cycle of the products and services that will be contemplated by procurement and licensing processes and integrated into our business practices¹.

Based on this principle, the Sport Flooring Guide addresses the best practices in the use of floors such as natural grass, synthetic grass, sand and the rubber floors that will be used during the Rio 2016 Olympic and Paralympic Games.

¹ The Sustainable Supply Chain Guide is available at the Rio 2016 Supplier Portal: <http://portaldesuprimentos.rio2016.com>.



The Guide is divided into four main parts, which will address the use of each floor type as well as the respective recommendations of Rio 2016.

2 | BACKGROUND

The quality of the sports floor is essential to good sporting practice and athlete performance. In this case, health and safety are also considered, because a poorly installed or low-quality floor increases the risk of injuries and accidents.

To be suitable to sport practice and its safety, the floor must be durable, easy to maintain, impact absorbing and adherent. The table below shows the floor used in each Olympic and Paralympic sport discipline.

OLYMPIC SPORTS	FLOOR
Athletics	Natural Grass Sand Synthetic floor (rubber)
Badminton	Synthetic floor (rubber)
Basketball	Synthetic floor (rubber)
Cycling	Wood floor
Fencing	Synthetic floor (rubber)
Football	Natural grass Synthetic grass Sand
Artistic Gymnastics	Synthetic floor (rubber)
Rhythmic Gymnastics	Synthetic floor (rubber)
Golf	Natural grass
Handball	Synthetic floor (rubber)
Equestrian dressage	Natural Grass Sand
Equestrian Eventing	Natural grass Sand
Equestrian jumping	Natural grass Sand
Field Hockey	Natural grass
Judo	Synthetic floor (rubber)
Weightlifting	Synthetic floor (rubber)

OLYMPIC SPORTS	FLOOR
Wrestling	Synthetic floor (rubber)
Modern pentathlon	Natural grass
Rugby	Natural grass
Taekwondo	Synthetic floor (rubber)
Tennis	Synthetic floor (rubber)
Table tennis	Synthetic floor (rubber)
Archery	Natural grass
Archery	Natural grass
Beach volleyball	Sand
Volleyball	Synthetic floor (rubber)

PARALYMPIC SPORTS	FLOOR
Athletics	Natural grass Sand Synthetic floor (rubber)
Bocce	Synthetic floor (rubber)
Goal ball	Synthetic floor (rubber)
Wheelchair Basketball	Synthetic floor (rubber)
Wheelchair Fencing	Synthetic floor (wood and rubber)
Weightlifting	Synthetic floor (rubber)
Football 5-a-side Football 7-a-side	Synthetic grass
Equestrian	Natural grass Sand
Judo	Synthetic floor (rubber)
Road Cycling	Asphalt
Para-cycling track	Wood floor
Wheelchair tennis	Synthetic floor (rubber)
Table Tennis	Synthetic floor (rubber)
Wheelchair rugby	Synthetic floor (rubber)
Archery	Natural grass
Shooting	Natural grass
Sitting volleyball	Synthetic floor (rubber)

3 | GRASS

3.1 NATURAL GRASS

Grass planting in Brazil began in the mid-seventies. Since then, although the country still ranks among the world's major grass producers, the sector has been posting high growth rates. Currently, the production of grass is mainly concentrated in the states of São Paulo and Paraná. Some of the major consumer markets are public works, industrial parks, sports facilities (mainly football and golf) and residential gardens.

Each grass species has specific characteristics such as hardiness, plasticity, resistance to trampling, capacity to develop in poor lighting areas, regrowth capacity, etc., allowing for different types of use and handling. In other words, the choice of the type of grass to be used depends on the use of the space available.

Football fields, for example, require dense and resistant grass. The field must have a flat, even surface, which requires an efficient surface and underground drainage system for situations of heavy rainfall in Games time.

3.2 NATURAL GRASS REQUIREMENTS

Grass is an agricultural product; in order to sell its production, grass producers must follow certain rules set by the Ministry of Agriculture, which regulates the production of seedlings through laws, and establishes the following requirements:

- Keep up with social responsibilities and register employees in compliance with the labour laws
- The property must be duly registered in compliance with the land use law of its state and forest code
- Taxes must be collected for every invoice issued
- Meet certain technical requirements such as the need to have a technician responsible for the production and provide certification on the origin of each species produced

This set of practices of the grass production chain (hereby understood as input suppliers, producers, regulatory bodies, and trade) are essential to legalise the grass market and ensure delivery of a product from reliable sources.

The control of natural grass pests and diseases is also critical to maintain the grass attributes. The herbicide eventually used must comply with the current legislation (Law of Pesticides 7,802/89) and the user must know how to use it properly with the use of the Personal Protection Equipment (PPE) suitable for its handling. In addition, one must consider the products whose use is prohibited or restricted by Rio2016, which may be found in the *Harmful Substances and Materials Guide* developed by the Committee.

3.3 REQUIREMENTS ON NATURAL GRASS AND ITS ORIGIN

Currently, there is little oversight in the natural grass market; therefore, a large volume of grass is sold without levy of the due taxes, which arise from extraction in prohibited areas by the forest code, without compliance with the requirements of the Ministry of Agriculture.

One way to curb such illegalities and ensure the quality in the purchase of grass from reliable sources is to verify whether the supplier is enrolled with the RENASEM - National Register of Seeds and Seedlings - through the Ministry of Agriculture, Livestock and Food Supply according to Law 10,711 of August 5, 2003, which provides for the National System of Seeds and Seedlings (SNSM). This information must appear on the invoice.

Another way to avoid the risk of purchasing low-performance mixed grass with different colours and ensure the purchase of a quality product is to obtain certification on the genetic purity of the grass. Accordingly, an external inspection institution verifies the source of the planted material, pursuant to the specification of the type of grass requested, following the pre-set standards published by the *International Turfgrass Genetic Assurance Programme* (ITGAP - Programme for International Health Security) (check whether Rio2016 follows this pattern in the functional specification).

Regarding the grass irrigation practice, a rational irrigation system requires planning through a technical project and monitoring, which allow for an efficient water-consumption environment, thereby avoiding waste. The decision on "when and how" to apply water to a crop is critical to the irrigation system process.

Some types of equipment in the market support this decision, and precisely monitor the irrigation "when and how." This equipment consists of soil precipitation and soil humidity that allow determining if humidity levels are acceptable for good crop development. In addition, it is possible to use technology to monitor air humidity and temperature, which helps to determine the evapotranspiration (amount of water lost to the atmosphere in the form of vapour). Such control tools may represent savings of 30% to 50% of water in irrigation.

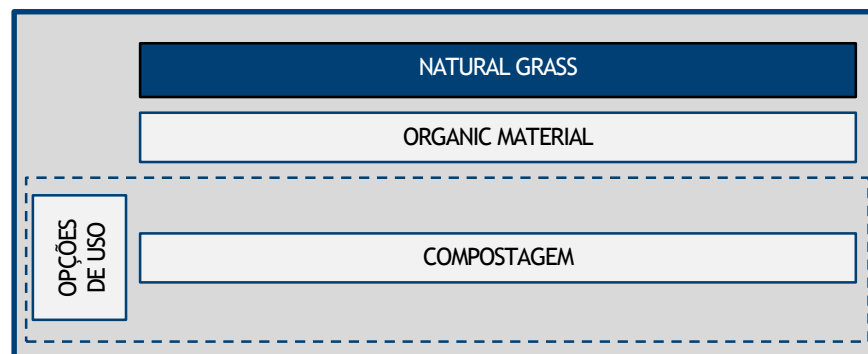
It is also important to know the soil conditions for irrigation and prevention of excess fertilization, so that nutrients applied to the soil are not leached, i.e., transported to the groundwater. In addition to causing damages to the farmer, this fact turns into damage to the environment due to groundwater contamination.



3.4 RIO 2016 REQUIREMENTS ON NATURAL GRASS AND ITS USE

As for the use of grass in the post-Games after the end of its useful lifecycle, Rio 2016 recommends that cut or disposed grass be sent for compost or feedstock for

production of renewable oil. Accordingly, this organic product may be reused as raw material for other supply chains, thereby reducing the volume disposed in landfills.



4 | SYNTHETIC GRASS

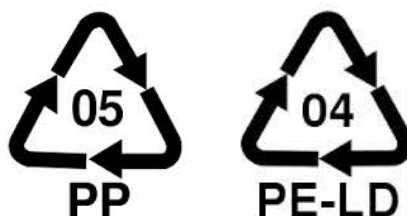
The first synthetic lawn in history was installed in 1965 in the field of the Astrodome Stadium in the U.S., which staged football and baseball competitions. Between the sixties and the seventies, many covered stadiums were built, and the lack of sunlight prevented natural grass cultivation. Given this context, synthetic grass has proven to be a solution, which contributed to the expansion of its use also in outdoor stadiums.

However, the products used in grass production resulted in a surface considered hard and uncomfortable for the practice of sports, causing disapproval of many athletes to synthetic grass, and to the consequent prohibition of its use by football regulatory associations. Until the early 2000s, with the development of technology, a new synthetic surface with sand and rubber filling was created to cushion falls and prevent slippage, so that the practice of sport could be developed in the best possible way. Accordingly, the so-called "third-generation artificial grass" is regarded as safe for athletes as far as natural grass is concerned.

Thus, synthetic grass has become increasingly viable as an alternative to natural grass. The following are some of the main factors:

- It offers higher durability, so the space where the grass is installed for the games may be used for other types of events without compromising its quality
- It allows for more intense and frequent use of the field and enables its regular use
- It has lower maintenance costs, since it does not require special care such as: irrigation, use of pesticide, fertilizer and frequent mowing
- It is quite resistant to weather effects such as heat, cold, humidity
- Its maintenance does not require sunlight, and may therefore be used in fields and or indoor locations

The textiles have been widely used in sport infrastructure, particularly for use in synthetic grass. The yarn supplied by the market today are made of polyethylene (PE) and polypropylene (PP).



Polypropylene (PP) fibre is made of plastic, which is characterised by being a more "dry" fibre. This fibre has a lower cost and reasonable yield in the football fields. Polyethylene (PE) is a more "noble" fibre with an advanced formulation that brings as main characteristics the softness and silkiness of the yarn. Its appearance is very similar to natural grass; it is less abrasive; it ensures better visual appearance over the years, enabling comfort and proper performance conditions to athletes.

4.1 REQUIREMENTS ON SYNTHETIC GRASS

Quality synthetic grass has a lasting useful life, ranging from eight to 12 years under normal conditions. Some good practices on grass that may be adopted:

- One way to ensure that its manufacturing maintains a good quality level is to seek compliance with ABNT NBR 8810/85 norms for textile floorings and ABNT NBR 8430/84 for color change reference
- The material must not contain heavy metals such as lead, zinc or cadmium in their composition, and must comply with all environmental requirements
- Meet the requirements and standards approved by the FIFA in Quality Concept for football fields (check whether it applies to Rio2016 according to the functional specification)
- Be manufactured to allow for recycling

- Contain ultra-violet rays and flame-retardant protection (for colour loss prevention and fire protection), low abrasiveness (for comfort, not to retain dirt)

A reliable synthetic grass system must also have an adhesive layer to maintain the yarn structure. This material may be based on polyurethane (PU), which offers the following advantages:

- Low cure temperature, thereby reducing energy consumption
- Higher production speed
- High durability of synthetic grass, especially when in contact with water.

4.2 REQUIREMENTS ON SYNTHETIC GRASS AND ITS ORIGIN

Rio 2016 recommends the use of materials currently available in the market, polyethylene (PP) and polypropylene (PE) recycled for synthetic grass. Use of recycled material:

- Reduces energy consumption and the use of raw materials from a non-renewable source (oil), according to traditional plastic production;
- Promotes an efficient plastic selective collection programme, which minimizes the environmental footprint caused by the disposal of waste in nature and allocation to landfills.

Grass made of recycled material has the same functional characteristics as non-recycled synthetic grass. The supplier is responsible for monitoring the raw material used and the production process to ensure the quality of the final product.

Similarly, the granulated rubber used on the synthetic grass surface must also be non-toxic and result from recycled material such as tires.

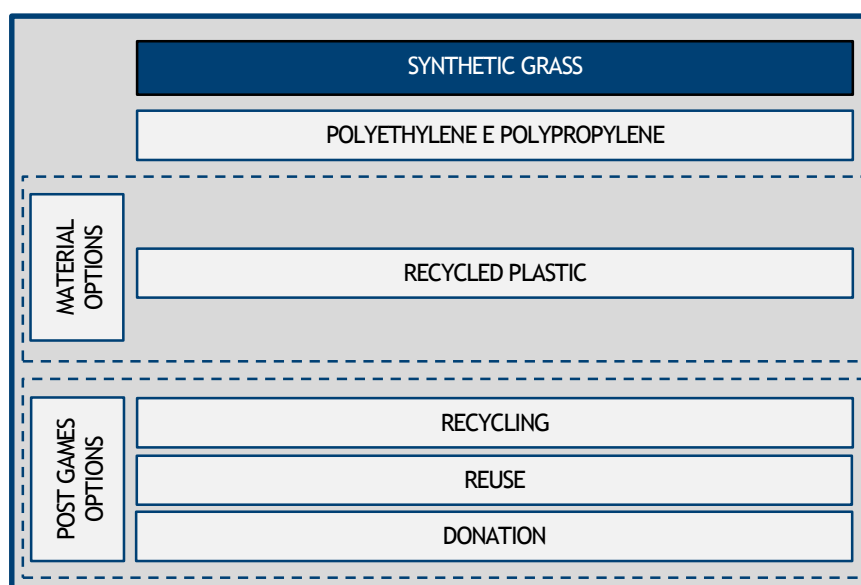
Regarding the use of glue or adhesive for installation of synthetic grass, the supplier is responsible for providing a Material Safety Data Sheet (MSDS), a document

normalised according to ABNT NBR 14725). The sheet must contain health, safety, and environmental aspects related to the substance used. For other considerations on the use of chemicals, it is advisable to check the Guide on Substances and Hazardous Materials developed by the Committee.

4.3 REQUIREMENTS ON SYNTHETIC GRASS AND ITS DESTINATION

Regarding the destination of grass in post-use, after the end of its useful life, Rio 2016 recommends that it be sent for recycling. Many companies that produce synthetic grass have a good practice of accepting the return of the product in its post-use to reuse it in the production of new units.

If the synthetic grass floor quality is good for use and Rio 2016 does not reuse it, a good practice would be to direct it to be reinstalled and reused for some NGO, school, or other needy institution that may benefit directly from the product.



5 | SAND

Sand mining is an economically important activity in the country, mainly because it offers materials for the industry and civil construction, in addition to sports fields, in the case of Rio 2016.

The extraction of sand may eventually occur in permanent preservation areas (PPAs), as it requires places with deposition of sedimentary materials located in areas near rivers. According to the 2012 Forest Code and Resolution 302/2002 of the National Environmental Council (Conama), the PPAs must remain untouched. However, according to Resolution 369/2006 of Conama, the use of these areas is allowed for social activities, as in the case of sand mining. Therefore, sand mining, despite being regulated, may cause environmental impacts, of which the main ones are:

- Destruction of the riparian forest with the installation of a mining company;
- Reversion of the river courses and their siltation caused by deposition of soil at the bottom of the river due to the lack of riparian vegetation to hold the margins' soil;
- Soil compaction caused by deforestation and transit of machines;
- Soil erosion, as it has been degraded and unprotected by the removal of trees;
- Escape of fauna as a result of local noise and movement;
- Pollution of waters and soils with inadequate use of fossil fuels;
- Fires

Rio 2016 hopes that the sand used in the venues of the Olympic and Paralympic Games is from properly regulated shores, and that supply of the product complies with the legislation and socio environmental quality criteria.



5.1 REQUIREMENTS ON SAND

Despite being required, sand mining alters the landscape of the mined site and degrades the environment. In this context, it is recommended to develop actions for minimising its impacts and restoring the degraded area. Rio 2016 mainly recommends that the sand supplier:

- Ensures that all environmental licenses and practices for the operation of the shore are legally compliant
- Ensures that the sand supplied meets the parasitological and microbiological standards in order to ensure the health and well-being of athletes
- Monitors the logistics of transporting the sand to its delivery location to prevent that sand residues are wasted and get onto the path, through the use of restraints in the vehicle, such as stakes and protection tarps
- Use alternative fuels such as ethanol and biodiesel in the transportation of sand, following the hierarchy of fuels available in the Rio 2016 Sustainability Management Plan
- Perform ecological compensation of the area devastated by the shore with native species, aiming to stimulate the recovery of the local flora and fauna;
- Comply with Article 55 of Law 9,605/98 and Article 2 of Law 8,176/91 that criminalises all extraction, transportation, storage, and sale of sand or any

other mineral, without the authorisation of the competent bodies. In the case of extraction, the site must be authorised by the National Department of Mineral Production - DNPM - environmental license and invoice with the origin of the material.

Regarding the disposal of waste generated in the sand extraction process, a good practice is the use of rejected clay as feedstock in the generation of other products such as building blocks, tiles, and ceramic.

6 | RUBBER FLOORING

Rubber in its natural state comes from the sap of rubber trees, referred to as a polymer. In the XX Century, synthetic rubber was developed in Germany from petroleum. In Brazil, approximately 70% of all manufactured rubber is destined to tire production. The other portion serves as input to the manufacture of footwear, flooring and surgical instruments.



6.1 RUBBER FLOOR REQUIREMENTS

A good option of raw material for production of rubber flooring is the consumption of rubber recycled from other products. Normally, disposed tires are the main source of recycled rubber. The tire is traditionally composed of 10% natural rubber (latex), 30% of oil (synthetic rubber), and 60% of steel and canvas fabrics. Its recycled rubber is used to manufacture coverages for leisure areas and sports courts, car mats, shoe soles, adhesives, air chambers and cleaning supplies such as squeegees and bushings, among others.

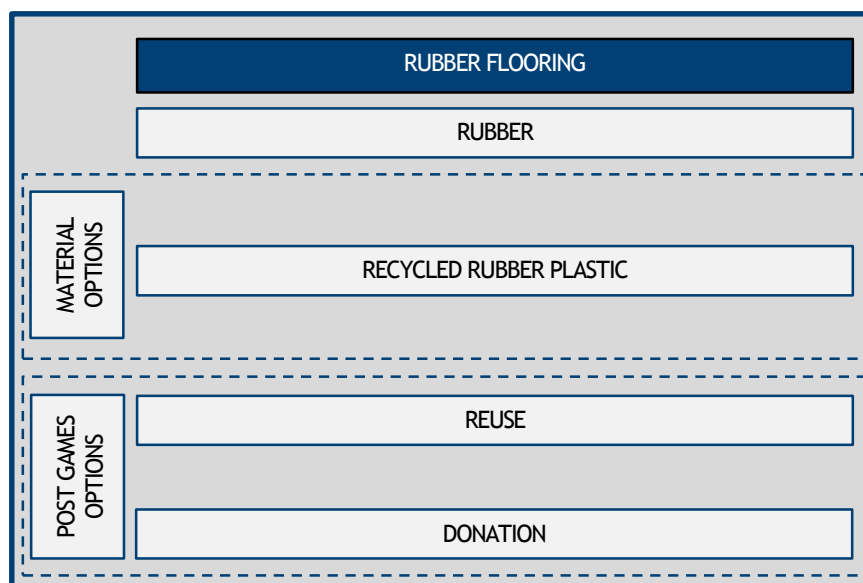
Once it consists of durable, waterproof, and soft material, the reuse of tires is an economically viable and attractive activity. This recycling also represents a socially, environmentally, and economically beneficial process, because:

- It saves raw material from a non-renewable source;
- It reduces the amount of non-biodegradable and contaminant material sent to landfills;
- It generates a source of income for the people involved in the recycling chain;
- It eliminates water build-up in the tires upon their disposal, and avoids the consequent spreading of diseases;

The supply of floors made of rubber recycled from tires is already a common practice in the market. The recycled rubber floors have the same functional characteristics as the conventional rubber floor, if the supplier monitors the origin and processing of its raw material in order to maintain the quality of the end product.

Regarding the use of glue or adhesive for floor installation, the supplier is responsible for providing the Material Safety Data Sheet (MSDS), a document normalised according to ABNT NBR 14725). The data sheet must contain the safety, health, and environmental aspects regarding the substance used. For other considerations on the use of chemicals, check the guide on Substances and Hazardous Materials developed by the Committee.

If the rubber floor is in good use conditions and Rio 2016 does not reuse it, a good practice would be to direct it to be reinstalled and reused for some NGO, school, or other needy institution that may benefit directly from the product.



7 | FINAL CONSIDERATIONS

Rio 2016 wants the market to evolve in order to meet its procurement demands pursuant to its sustainability guidelines, which promote the reduction of impacts and environmental restoration, development and recognition of people, as well as conservation and prosperity of the business.

Rio 2016 believes that it is extremely important that the Brazilian supplier market get prepared to such challenges, enabling:

- Development and stimulation of the Brazilian economy;
- Promotion of capacity development of local labour;
- Reduction of demands which include imports of products that are characterized by: complex logistics, higher emissions of greenhouse gases, difficult tracking of social and environmental practices of the place of origin.

Finally, taking into account the sustainable practices of its suppliers, both in its operation and in the destination of products sold in the post-use of the Olympic and Paralympic Games, Rio 2016 aims to have a relationship with and monitor its supply chains to encourage and stimulate good market practices as part of its Olympic and Paralympic legacy.

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