

ISSF Sustainability Guidelines

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Preamble

Leading up to Tokyo 2020 the International Olympic Committee (IOC) signaled that it would support the seventeen Sustainable Development Goals (SDG) of the United Nations by embracing the SDG's in their day to day operations and the delivery of the Games and by encouraging stakeholder organizations to likewise embrace the SDG's in their own sport delivery. The IOC's strategic intent for 2030 identifies the IOC as a role model, leveraging the host cities to be at the forefront of adopting the SDG's and inspiring and assisting Olympic Movement stakeholders in developing sustainable sport worldwide and to leverage the inspirational power of athletes and the Olympic symbol for promoting sustainability through sport.

To that end the ISSF has embarked on identifying how it can contribute to the UN SDG's and the IOC's strategic intent and provide guidance to our membership by identifying and rewarding improvement as we too embrace the SDG's as a responsible stakeholder in sport. Movement towards sustainability is everyone's responsibility and ISSF wants to be a leader in this area.

While ISSF recognizes that many sports shooting complexes are isolated facilities fitted with special equipment to manage environmental impacts, ISSF events should only be conducted at complexes that adequately manage their environmental risks.

Disclaimer

The information in this publication is intended to provide our members with general guidance only. It summarizes public and scientific knowledge gathered and synthesized. It is neither a scientific publication nor a complete guide to creating and managing environmentally sustainable facilities. It is important that ISSF member organizations work with their local authorities to ensure that their shooting ranges follow all environmental obligations of their country.

This document was prepared by the 2021 ISSF Sustainability Committee (Claudia Dall'Agnol, Andreas Friedrich, Sandra Honour, Hamed Jalalzade, Tunçlag Purevsambuu, Stefano Rosi, Anastasiya Saidova, Daria Yablonskaya) building upon the work of the 2019 ISSF Ad-Hoc-Committee for Sustainability (Jörg Brokamp, Frank Göpper, Demetris Lordos, Robert Mitchell, Dr. Neda Nozari, Stefano Roris, Peter Underhill) .

Environmental Sustainability

Relationship to UN Sustainable Development Goals (UNSDG's) and IOC Sustainable Focus Area (IOCSFA's)

The ISSF shooting disciplines can take a leadership role in making changes to how we minimize our impact on the environment, promote the connection between people and nature and provide opportunities to enhance the natural surroundings on shooting ranges. This section on Environmental sustainability identifies ways the ISSF and its members can support water quality (UN SDG 6), life below water (UN SDG 14) and on the land (UN SDG 15), and promote responsible consumption (UN SDG 16) of products through recycling, reducing, and enhancing the surroundings.

The principles ISSF follows is to first and foremost ensure the safety of participants of any event and then to promote the reduction of or recycle as many components used in our sport as possible.

The ISSF has a history of working toward these principles in our sport. We have moved from providing paper copies of event information in duplicate or triplicate for participating countries to reduce paper wastage at our sponsored events providing electronic access to scheduling, announcements and results. The rifle and pistol events are now shot and scored on electronic scoring systems whenever possible further reducing the use and requirement for paper products. Clay targets used in the Olympic Games, World Championships, World Cups, World Cup Finals and Junior World Cups must be eco-friendly targets that comply with appropriate international standards.

And from that foundation the ISSF must continue to provide leadership and direction to further improve the sports contribution to sustainability.

ISSF event shooting ranges should minimize potential impact on humans and the environment, protect groundwater, surface water, wetlands and wildlife, prevent soil erosion and manage the sound pollution.

1. Ammunition interaction with the environment

1.1. Behavior in the environment (see appendix A)

- 1.1.1. The activity of sports shooting ranges is accompanied by the dispersion of a significant amount of metal ammunition (bullets and shot) on the range. Upon contact with air, precipitation, and soil, metals are exposed to spontaneous destruction processes because of chemical, electrochemical or physicochemical interaction with the environmental components. These processes are called metal corrosion.
- 1.1.2. The result of corrosion of lead ammunition is the formation of a poorly soluble protective film on the metal surface - capsulation. During capsule formation (10-14 days), lead ions may enter the soil solutions and accumulate in the soils. Encapsulation prevents further lead corrosion. Thus, chemically inert ammunition can stay in the soil as mechanical contamination. However, a change of environmental conditions can provoke the metal "de-encapsulation" and the beginning of the entry of lead ions into the soil. Therefore, regular removal of the lead and control the pH of atmospheric and soil waters at the shooting range is desired.
- 1.1.3. Corrosion of steel ammunition is a continuous process, during which both the formation of a poorly soluble rust crust on the surface of the steel and the mineralization of the metal until it is destroyed. As a result, the metal is transformed into rust form, a constant source of iron ions and dispersed rust particles migrating in soil waters and accumulating in soils. In addition, the aggregation of corrosion products of steel ammunition is the cause of a change in soils' physical and mechanical properties, which leads to a violation of the air and water migration regime of soils and an increased likelihood of runoff from the range

2. Ammunition containment and recycling

2.1. Management

- 2.1.1. All shooting ranges are unique and there are many ways to manage metal contamination. Facility specific risk assessment and choices to manage the risks as well as local regulations all should be taken into consideration when managing the impact of the range on the environment. All ammunition (lead, steel, bismuth, tungsten etc) should be contained and recycled whenever possible to support the circular economy and minimize the impact to the environment through recycling.
- 2.1.2. Small arms training and competition ranges use projectiles made of metals and metalloids which can include lead (most popular in competitive shooting), antimony, copper, nickel, zinc, chromium, tungsten, mercury, and arsenic. The use of metals on shooting ranges can result in contamination of soils, sediments, surface water, and

groundwater both local to specific sites and off-site. Upon exposure to the atmosphere, the metals and metalloids initially are oxidized, form secondary mineral phases, and subsequently release oxidized species into soil solution. The mobilization of metal is impacted by factors including pH, oxidation-reduction (redox) environment, presence of colloids and/or soil organic matter (SOM), soil type and hydraulic characteristics, temperature, and water infiltration.

- 2.1.3. Lead, the most common metal ammunition used in ISSF competitions, can provide the source of lead in soil, air and water. Acidic conditions hasten the breakdown and migration of lead. Fragmented bullets and pellets provide increased surface area for the environment to break down the lead allowing it to become dust and smaller particles carried by soil particles in runoff surface water, enter groundwater or be taken up by plants and animals.
- 2.1.4. Lead is a metal that can be detrimental to human and animal health; impacting brain and organ function when exposure becomes internal. It is particularly impactful on young children and pregnant women. This internalization can come from ingestion of plants and animals who have been fed on contaminated plants and animals, contaminated dirt and dust, and inhalation of vapourized or dust particles of lead. Shooters and workers at shooting facilities must be protected from long term exposure of lead. Additionally lead should be contained and when at all possible, harvested and recycled.

2.2. Rifle Pistol

- 2.2.1. Containment
To contain the lead, each range understands its environment, assesses the risks and manages them effectively. It should look at its water flows and drainage, and extent of projectile reach (including ricochet and fragments). When harvesting spent ammunition, workers should be protected from dust inhalation and skin contamination using personal protective equipment (PPE) suitable to filter the lead particles. Ventilation in indoor facilities should be adequate to provide uncontaminated air to those using the facility.
- 2.2.2. Low velocity indoor/ outdoor
 - 2.2.2.1. To control the lead contamination in low velocity pistol and rifle sports, bullet traps and soft backstops should be used. This will allow the harvesting and recycling of the lead in an environmentally sustainable and safe manner. When cleaning the traps, workers should have appropriate Personal Protective Equipment (PPE). Indoor facilities should be designed with professional engineering of the ventilation system and have dust control protocols to minimize the lead in the air.
- 2.2.3. High velocity (outdoor)
 - 2.2.3.1. Lead and other metal contamination at high velocity outdoor ranges will have a wider potential zone of contamination due to fragments, ricochets and poor shots. Water drainage should be

understood and controlled to maintain any contaminated water in the facility.

- 2.2.3.2. To minimize the metal migrating off the shooting range, the design of the facility should have berms to effectively eliminate bullets from escaping the facility and berms should be made up of materials that do not increase the fragmentation of the bullet more than necessary. The design should also manage the water movement during both normal and likely flood conditions to contain the lead that might move with the water flow.
- 2.2.3.3. Ranges can also be designed with capture systems that limit water contact with the spent ammunition.
- 2.2.3.4. Chemical treatment of the soils, to reduce the breakdown of metals to salts that migrate may be prudent.
- 2.2.3.5. If agricultural crops are within the bullet or bullet fragment fall zone or water drainage area, the facility should understand the propensity of the crops to uptake the metals and consider whether there is a need to suspend the harvest of crops within the metal contaminated zone. Soil and water sampling can be done to determine the extent of the zones as well as the extent of the management measures taken to reduce the lead contamination however to do this effectively professionals should be engaged.

2.2.4. Recycling

- 2.2.4.1. Additionally routine clean up of spent ammunition in the trap, backstops and berms should be planned. For larger lead pieces this can be done by sifting and density separation of the lead from lighter gravel and soil.
(<https://ultrascreeners.com/screening-bullets-out-of-sand/>)

2.2.5. Alternatives

- 2.2.5.1. Affordable alternatives for precision rifle and pistol shooting are not yet developed. Some metals can pose less risk to the environment however ISSF ranges should plan to contain and recycle any ammunition used.
The ISSF will continue to work with the firearm industry as they develop lead bullet and pellet alternatives. Until such time that the alternatives provide adequate accuracy, ISSF expects its membership to manage the lead and other metals through safe containment and recycling at all pistol and rifle ranges.

2.2.6. Education

Education of the workers and those people that frequent the shooting ranges should be a top priority. Personal hygiene (hand washing and showering) should be stressed and when appropriate, adequate masks, gloves and protective clothing should be required by those with a repetitive likelihood of lead exposure. Parents should understand the risk of lead contamination to children.

2.3. Shotgun

2.3.1. Containment

The ISSF shotgun sports are shot in confined ranges that have great potential to contain and recycle the lead shot used. The lead shot used in the ISSF sports may contain trace amounts of antimony, arsenic and other metal and the sizes used can fall to distances of ~200 m; This should be considered when the range is developing its containment and recycling plans.

- 2.3.1.1. Physical berms made of soil +/- geotechnical fabric can reduce the shot fall area and assist in containment and reduce cost of recycling.
- 2.3.1.2. Curtains that shorten the shot fall range allow for the collection of much of the lead at the base with the additional benefit of providing a consistent background for shooting.
- 2.3.1.3. Acidic soils allow the breakdown of lead and so harvesting frequencies should be designed based on the risk of the soil pH.
- 2.3.1.4. Management of soil erosion and water movement should be engineered to reduce amounts of lead that may leave the shooting range as dust or in water.

2.3.2. Recycling

2.3.2.1. Options for recycling include:

1. Using soil screening machinery to pick up the top layers of soil and separate the lead from the other lighter soil particles.
2. Lining the shot fall zone with geotechnical fabric that catches the lead for easy harvesting has also been successfully built into the design of ranges.
3. Ranges have also been designed to allow industrial vacuums to harvest the lead and plastic wads and targets from the field to be separated and recycled.

All of this machinery should be run safely and be cognizant of additional noise and dust production.

2.3.3. Shooting over wetlands and water

2.3.3.1. Due to the propensity of waterfowl to use metal shot as grit (usually small stones) in their digestive tracts and the difficulty that wetlands pose for shot harvesting, the ISSF will not host a ISSF championship on a range that shoots over a wetland or water body. We strongly encourage our national sport organizations to similarly make decisions to not sanction ranges that shoot over water bodies or wetlands.

2.3.4. Agricultural crops

2.3.4.1. If agricultural crops are within the shot fall zone or water drainage area, the facility should understand the propensity of the crops to uptake lead and other metals and consider whether there is a need to suspend the harvest of crops within the lead contaminated zone. Soil and water sampling can be done to determine the extent of the zones as well as the extent

of the management measures taken to reduce the lead contamination however to do this effectively professionals should be engaged.

2.3.5. Alternatives

2.3.5.1 The ISSF is currently collecting information to consider alternatives and potential rule changes in the coming years. It should be recognized however that alternative shot materials will still need to be contained and recycled.

3. Targets

3.1. Pistol/ Rifle

3.1.1. Electronic targets have already reduced paper usage

3.2. Shotgun clays

3.2.1. Historically clay targets contained polycyclic aromatic hydrocarbons (PAH) as they are made from limestone matrix, oil and petrol production products.

3.2.2. Hydrocarbon to Biodegradable

Since 2017 Clay Targets must meet 18 PAH standards set out by the ISSF. (Refer to ISSF rule interpretation for 2017 ISSF rules 6.3.6 Definition Eco Friendly.pdf) From 2022 on all Organisations hosting ISSF events must comply with this definition and use only this type of target on the range throughout the year.

4. Paper

4.1. Pistol/ Rifle*

4.1.1. ISSF has already reduced the use of administrative paper at world cups providing electronic information for delegations where possible.

4.1.2. Paper targets for shorter distance rifle and pistol events have been replaced by electronic targets. In events that use electronic targets, ISSF will now accept electronic files rather than paper copies of the results.

4.1.3. EST systems have to use paper strips at target line and present data on log print for calculation by RTS range officers or juries (if necessary). At least 4 m of paper is used for each 10 m shooting event/each. ISSF recommend that using of paper (black paper strip and log print) be confined for Pre-Event EST Target Check and 10m event only as paper is not necessary for other stages because there is neither formal protest nor formal calculation.

4.1.4. Paper used should be reduced to only that which is needed for potential proof for appeals/ protests .

4.1.5. Where paper targets or paper lining is required, industry manufacturers and organizers of events should make every attempt to shift the paper used to unbleached and use recycled or post consumer materials,

- 4.1.6. Organizers should convert the results to electronic and send the spent sheets for recycling after the match is complete and the electronic results can no longer be protested.

5. Plastics

- 5.1. Shotgun shell cases. While there are some shotgun shell casings (hulls) made of metal and paper, the majority of hulls are made of metal and plastic. In some countries the hulls can be reused by individuals that reload. The plastics and metals are both useful recyclable materials and can contribute to the circular economy.
 - 5.1.1. Recycle plastic/metal hulls
Machinery has been engineered allowing spent hulls to be poured into hoppers that position the hull to be separated into plastic and metal components that can be sent for industrial recycling. ISSF also encourages manufacturers to safely incorporate recycled plastics into the hulls thus additionally contributing to recycling.
- 5.2. Plastic wads
 - 5.2.1. Shotgun shell wads may cause plastic waste issues at shooting ranges. This plastic waste can spread from a shooting range and litter other areas. Currently, most shotgun shell wads are made from non-degradable plastics such as polyethylene and thus all ISSF ranges should have the ability to collect and recycle the plastic wads.
 - 5.2.2. While alternatives to plastic wads are being used and further developed, the ISSF will continue to work with the industry to determine if a shift to these alternatives is warranted.

6. Food and fluid containers at events

The ISSF encourages event facilities to reduce the use of single-use plastics and provide vessels to collect and recycle plastics used for food packaging and service.

7. Sound

- 7.1. Noise pollution is generally defined as regular exposure to elevated sound levels that may lead to adverse effects in humans or other living organisms. According to the World Health Organization, sound levels less than 70 dB are not damaging to living organisms, regardless of how long or consistent the exposure is. Exposure for more than 8 hours to constant noise beyond 85 dB may be hazardous. Many other industries and activities produce loud sounds.
- 7.2. ISSF shooting ranges should require appropriate hearing protection on the range and reduce the impact of the sound of shots being fired through design and location.

* Technical regulations may need to be adjusted to allow for these recommendations

Equity, Health and Wellbeing - (data to be collected in 2021-22 to complete this section for a 2023 version of the guidelines)

Relationship to UN Sustainable Development Goals (UNSDG's) and IOC Sustainable Focus Area (IOCSFA's)

Shooting is such an amazing sport as it transcends gender, ethnicity, age and stereotypes of body types. Outdoor facilities, often in rural settings, support local economies by, bringing money to rural areas, providing local jobs, and developing and supporting technologies for recycling thus contributing to the ever increasingly important circular economy. These guidelines towards Equity, health and wellbeing objects will support good health and wellbeing (UN SDG 3), gender, age and ethnicity equality (UN SDG 5,10), safe, quality jobs (UN SDG 8)

8. Heritage and Cultural significance
9. Gender, visible minority and age and body stereotype equity
10. Rural economic development
11. Protecting green spaces
12. Employment equity and jobs
13. Occupational Safety

Appendix A -

The activity of sports shooting ranges is accompanied by the dispersion of a significant amount of metal ammunition (bullets and shot) on the range.

Upon contact with air, precipitation, and soil, metals are exposed to spontaneous destruction processes because of chemical, electrochemical or physicochemical interaction with the environmental components. These processes are called metal corrosion.

The intensity of the metal corrosion process depends on internal and external factors.

Internal factors are mainly determined by the composition and structure of the metal.

External factors are related to the environmental conditions in which the metal is located.

These include temperature, the concentration of ambient gases: oxygen, carbon dioxide, sulfur dioxide, etc., amounts of rainfall, acidic and redox parameters of rainfall and soil water, type of soil, organic matter content in the soil.

Depending on the environment where the metal is located, the main types of corrosion are distinguished:

- atmospheric corrosion: metals react quickly with the ambient gases, are covered with a metal oxide coating; with an increase in humidity, corrosion processes intensify, especially in the presence of sulfur compounds and chlorine in the atmosphere.

- soil corrosion: when metals contact soil, they undergo oxidation and dissolution processes, transforming them into compounds that can easily dissolve and diffuse into the environment. Corrosion processes intensify with increased humic acids and mineral salts (sulfate, carbonate, chloride) in the soil.

As the result, the metal surface is covered with a film or crust of poorly soluble oxidized metal forms that slow down the corrosion process. However, changes in environmental factors can lead to its intensification again.

Lead

The transformation pattern of lead ammunition in natural conditions consists of four stages and is characterized by cyclicity.

Stage 1.

The soil surface lead ammunition (bullets or shot) reacts with the ambient air and is covered with an oxide coating (PbO). When exposed to air, the chemical inactivity of metallic lead and extremely low solubility of its oxide result in the absence of impact on the environment.

Stage 2.

Under the influence of environmental factors, such as the acidity of precipitation and soil water, their saturation with carbon dioxide and organic acids, the oxide coating begins to dissolve, lead ions are released into the soil and may reach groundwater.

Stage 3.

The process continues until the metallic lead surface is "encapsulated" by a coating of poorly soluble lead compounds - hydroxide $Pb(OH)_2$, carbonate $PbCO_3$, sulfate $PbSO_4$. The most active dissolution of the lead oxide coating occurs in the first 10-14 days, then a protective capsule of poorly soluble lead compounds is formed on the metal surface and slows down lead corrosion.

Stage 4.

This condition potentially persists until natural or anthropogenic variations of aerial or aqueous environment factors. In this case, the "capsule" begins to dissolve, lead ions are released into the soil and may reach groundwater, and metallic lead is further oxidized.

Steel

The transformation pattern of steel ammunition in natural conditions consists of four stages and is characterized by continuity.

Stage 1.

The soil surface, steel ammunition (bullet or shot) reacts with the ambient air and is covered with a thin black-brown film of primary oxidation, consisting of iron (II) and (III) oxides. Air humidity determines the transformation of iron (II) and (III) oxides to poorly soluble iron (III) hydroxides of red color. As a result, a loose corrosion crust of poorly soluble iron (III) hydroxide (rust) is formed on the steel surface. Detachment of particles of this crust from the steel surface will lead to the mechanical accumulation of fine iron (III) hydroxide particles in the soil.

Stage 2.

Under the influence of soil solutions saturated with carbon dioxide and organic acids, the solubility of iron (III) hydroxide increases, which leads to the activation of metal corrosion processes. In this case, both iron (II), (III) complexes with organic acids and dispersed particles of rust will move with the soil water. At the same time, the process of steel mineralization (the growth of the primary oxidation film inside the bullet or shot) goes on.

Stage 3.

A secondary crust of steel corrosion products is formed. It consists of aggregations of iron (III) compounds with mineral and organic soil particles. Rust particles enter the soil as mechanical inclusion and the iron-organic complexes are migration with soil solutions.

Stage 4.

The growth of the iron aggregations and the contact between them lead to the formation of dense moisture- and air-tight iron-soil conglomerates, inside which the process of steel (metallic iron) mineralization takes place until the metal is destroyed and transforms into rust (iron (III) hydroxides). The flow of corroded metal particles into the soil as mechanical inclusion, the migration of iron-organic complexes in soil solutions will continue.

Summary

The result of corrosion of lead ammunition is the formation of a poorly soluble protective film on the metal surface - capsulation. During capsule formation (10-14 days), lead ions may enter the soil solutions and accumulate in the soils. Encapsulation prevents further lead corrosion. Thus, chemically inert ammunition can stay in the soil as mechanical contamination. However, a change of environmental conditions can provoke the metal "de-encapsulation" and the beginning of the entry of lead ions into the soil. Therefore, it is essential to control the pH of atmospheric and soil waters and their composition at the shooting range.

Corrosion of steel ammunition is a continuous process, during which both the formation of a poorly soluble rust crust on the surface of the steel and the mineralization of the metal until it is destroyed. As a result, the metal is transformed into rust form, a constant source of iron ions and dispersed rust particles migrating in soil waters and accumulating in soils. In addition, the aggregation of corrosion products of steel ammunition is the cause of a change in soils' physical and mechanical properties, which leads to a violation of the air and water migration regime of soils and an increase in surface runoff from the territories of rifle activity.

Some of the key references used for these Guidelines

International Shooting Sport Federation- Towards an environmental sustainable shooting sport - Working Paper of the ISSF Ad-Hoc-Committee for Sustainability 2019 . Jörg Brokamp, Frank Göpper, Demetris Lordos, Robert Mitchell, Dr. Neda Nozari, Stefano Rosi ITA, Peter Underhill.

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Metal(loids) small arms ranges EnviroWiki

[https://www.enviro.wiki/index.php?title=Metal\(loid\)s - Small Arms Ranges](https://www.enviro.wiki/index.php?title=Metal(loid)s_-_Small_Arms_Ranges)

Management of Environmental Risks Related to the Use of Lead Ammunition at Outdoor Sports Facilities (Shooting Ranges)

https://www.issf-sports.org/theissf/environment_protection/interaction_with_echa.ashx

8 Things to Know and Understand About Iron Corrosion. By Shivananda Prabhu, 2021

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Preprint Experimental Study of Steel Shot and Lead Shot Transformation Under the Environmental Factors Vladimir Lisin , Valentina Chizhikova , Tatiana Lubkova , Daria Yablonskaya

Lead Management and OSHA Compliance for Indoor Shooting Ranges ©2011 National shooting Sports Federation

Environmental Management at Operating Outdoor Small Arms Firing Ranges 2005
The Interstate Technology & Regulatory Council Small Arms Firing Range Team; Interstate Technology & Regulatory Council 50 F Street NW, Suite 350, Washington, DC 20001

Best Management Practices for Lead at Outdoor Shooting Ranges

Environmental Protection Agency-902-B-01-001, Revised June 2005, Region 2 [Link](#)