



Loose Cannons
STORM 2027
Competition Rules

Version 1.0
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ou.edu/scr/storm

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0.1 Introduction

0.1.1 *STORM* - The *STORM* Tele-Operated Robotics Mission

STORM is a robotics competition open to anyone 18 years of age or older. In this competition, teams build a teleoperated robot capable of interacting with a real-world environment. However, the operator will not be able to see what the robot is doing and instead will operate from a separate location. Teams must consider how to maximize their robot's mechanical design, sensors, and operator control to win.

The mission of *STORM* is to be accessible to anyone interested in robotics as a way to teach real-world engineering. When compared to many other robotics competitions, *STORM* is among the lowest in both cost to compete and barrier to entry. This makes this competition ideal for student organizations, hobbyist teams, and capstone design courses. By competing at *STORM*, participants will learn robot design, mechanical mechanisms, electrical sensors, human machine interface (HMI) design, control theory, and more. These skills are directly applicable to the real-world engineering challenges participants will encounter in their futures.

Join the *STORM* Discord server for updates and questions at
storm.soonerrobotics.org/1/discord

Questions? Email the *STORM* committee at storm@ou.edu

0.1.2 *Loose Cannons*

YARGH! A flash flood has dominated the region and never dried out. What was once dry land is now open water and full of pirates. Each team controls a Robot armed with a cannon taking aim at the enemy's rudder, hull, and masts. As the Robots hurry to complete their tasks, strong currents threaten their ships, and they must climb aboard before they are swept away.

0.1.3 Registration

STORM 2027 is scheduled to take place in March or April 2027. Registration is free and open to anyone. There is no limit on the number of teams that may register, although each team is only allowed one Robot.

Registration requires a team captain and a Robot. All team members must be 18 years of age or older as of the competition date. Teams are not required to be represented by a University or School.

Registration is available at storm.soonerrobotics.org and will open alongside the release of the rules. Registration will close on February 28th, 2026 at 11:59pm CST.

0.1.4 Glossary

The following terms are used throughout these rules with a specific, capitalized meaning.

Field

The 16' x 8' playing area, including all Zones, Ships, Waves, and Game Pieces. See [Section 0.2](#).

Match

A single four-minute competition period between two Teams. See [Section 0.3](#).

Team

A group of Team Members fielding one Robot, consisting of one Technician and one or more Operators. See [T1](#).

Technician

The Team Member responsible for the Robot at the Field during a Match, including Field Setup and returning scored Cannonballs. See [T2](#).

Operator

The Team Member responsible for controlling the Robot from the Operation Center during a Match. See [T3](#).

Robot

The physical machine built by a Team to compete in a Match, subject to the size, weight, and construction limits in [Section 0.4.4](#).

Zone

One of the defined areas of the Field: Team Zone, Staging Zone, Neutral Zone, or Protected Return Zone. See [Section 0.2.1](#).

Ship

The scoring structure at each end of the Field, containing the Rudder, Hull, and Masts entry points. See [Section 0.2.2](#).

Cannonball

The 6 inch foam ball used as the sole scoring Game Piece. See [Section 0.2.4](#).

Rope

The polypropylene rope on each Ship used for Climb scoring. See [Section 0.2.5](#).

Damaged

The status of a Ship entry point once it has been hit by 5 or more Cannonballs during a Match. See [Section 0.3.4](#).

Climb

The act of a Robot fully suspending itself on the opposing Ship's Rope, off the ground, by the end of a Match. See [Section 0.3.4](#).

Field Management System (FMS)

The *STORM*-operated system that governs Match timing, scoring, and Robot movement authorization. See [Section 0.4.5](#).

Loss of Signal

The state a Robot enters when it can no longer communicate with its Operator or the FMS, requiring an immediate halt of motion. See [R7](#).

Minor Penalty

A rule violation that deducts six (6) points from a Team's final score. See [M6](#).

Major Penalty

A rule violation that deducts fifteen (15) points from a Team's final score. See [M6](#).

Disqualification

A ruling that sets a Team's final score for the Match to zero (0) points. See [M3](#).

0.2 Field and Game Elements

The Field for *Loose Cannons* is defined by a 16' (foot) x 8' (foot) rectangular area. The surface of the Field consists of interconnected foam mats. 12" (inch) tall polycarbonate walls form the perimeter of the Field alongside two Ships. All dimensions are available in the [Section 0.7](#) as well as through the Field CAD available at storm.soonerrobotics.org/1/field-loose-cannons.

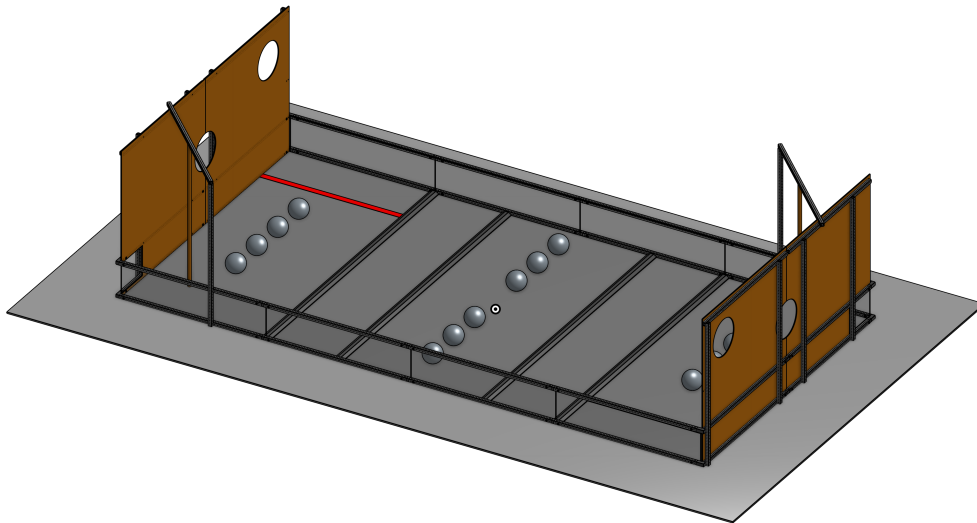


Figure 1: Isometric view of the *Loose Cannons* Field.

0.2.1 Zones

In this game, Zones are separated by Waves ([Section 0.2.3](#)). On each long side of the field is a Team Zone. Each Team Zone contains their team's Ship and Protected Return Zone. Each Team Zone contains 4 Cannonballs at the start of each match. Technicians may place Cannonballs into their Return Zone, but may not do so while a Robot is inside the Return Zone. Technicians must do their best to avoid blocking their team's scoring entry points.

Beside each Team Zone is a Staging Zone. Each Staging Zone contains a Team's Robot at the start of the match. In-between each Staging Zone is the Neutral Zone. The Neutral Zone contains 6 Cannonballs at the start of each match.

0.2.2 Ships

In each of the Team Zones is a Ship. One Ship belongs to the Red Team and the other to the Blue Team. Each Ship spans 8 ft in width and is centered on its end wall, standing 4 ft tall.

Each Ship contains three scoring entry points and one gamepiece re-entry (reload) location:

- **Rudder:** 10 inch tall and 12 inch wide rectangular hole, 1 inch above the ground.
- **Hull:** Centered in the middle of the ship, 24 inches above the floor, and 48 inches from the front of the ship.



Figure 2: Top-down diagram of Field Zones, including Team Zones, Staging Zones, Protected Return Zones, and the Neutral Zone.

- **Masts:** Centered, 36 inches above the floor and 12 inches from the front of the ship.

0.2.3 Waves

There are four (4) Waves on the field, each a physical ramp/bump spanning the full 8 ft width of the Field. Waves are approximately 4 inches wide and 2 inches tall with sloped edges. Waves are positioned at roughly the 4, 6, 10, and 12 ft marks along the Field's 16 ft length.

0.2.4 Cannonball

Cannonballs are the only game piece used for Ship scoring. Cannonballs are 6 inch diameter foam balls. There are twenty-four (24) allotted per Match. Each team is provided three (3) pre-loaded balls.

0.2.5 Rope

A 1 inch diameter, 3.5 ft high polypropylene rope is attached to the top of each Ship and barely touches the floor in front of the ship.

0.3 Playing a Match

0.3.1 Match Overview

A *Loose Cannons* Match is played on a Field and consists of two Teams, each with one Robot. During a Match, Teams have four minutes to earn as many points as they can. The team with the most points at the end wins the Match.

Ways to Score

Action	TeleOp	Autonomous	Notes
Leave Staging Zone	–	5 pts	Autonomous only
Rudder hit	2 pts	4 pts	Per Section 0.3.4
Hull hit	4 pts	8 pts	Per Section 0.3.4
Masts hit	5 pts	10 pts	Per Section 0.3.4
Climb (hang on opposing Rope)		12 pts	End of match only
Damaged entry point		+5 pts each	Only if also Climbing

Table 1: Overview of all scoring actions in *Loose Cannons*. See [Section 0.3.4](#) for full scoring rules.

0.3.2 Match Setup

Matches are set up by performing Field Setup and Operator Setup. Field Setup and Operator Setup may occur at the same time. Once Field Setup is complete, Operators may not return to the Field until after the Match ends. The Match will begin shortly after Field Setup and Operator Setup are complete.

Field Setup

Each Technician places their Robot within their assigned Staging Zone. For instance, the Red Team’s robot is placed in the Red Staging Zone, adjacent to the Blue Team’s Zone, and vice versa.

Twenty-four (24) Cannonballs are set up on the field as described in [Fig. 2](#): 4 in each Team Zone, 6 in the Neutral Zone, and 3 pre-loaded per Robot. Any of a team’s 3 assigned pre-loaded Cannonballs not loaded onto a Robot must be placed in the Protected Return Zone. Field Setup finishes once all Technicians indicate they are ready, all Referees determine the Field is in a legal state and are ready, and all Operators have left the Field.

Operator Setup

Operators will move to the Operation Center room where they can connect to the *STORM* network and control their Robots. Operator Setup finishes once all Operators indicate they are ready, all Referees determine the Operation Center is in a legal state and are ready, and all Operators are in the Operation Center.

0.3.3 Match Progression

Once a Match begins, it will enter the Autonomous Period, followed by a five (5) second Referee scoring period, followed by the TeleOp Period. A Match finishes once the TeleOp Period finishes. See [Fig. 3](#) for a visual breakdown.



Figure 3: Match timeline. Total Match length is 245 seconds: a 20 second Autonomous Period, a 5 second Referee scoring pause, and a 220 second TeleOp Period.

Autonomous Period

During the first twenty (20) seconds of each Match, Robots may only be operated autonomously (Operators will not be allowed to control their Robot). Operators may start their Robot's autonomous routine through a short, single action. Operators may also stop their Robot's autonomous routine during the Autonomous Period through a short, single action. Examples of legal Operator actions include pressing a single keyboard button, using a mouse to click a single button on a GUI, or pressing a single button on a gamepad. A Robot's autonomous routine may also be automatically started through information provided by the Field Management System.

TeleOp Period

After the Autonomous Period ends, the TeleOp Period begins and lasts two-hundred and twenty (220) seconds (i.e. 3 minutes and 40 seconds). Operators may control their Robots during this period.

0.3.4 Scoring

Autonomous Control

Points scored during the Autonomous Period are worth more than the same action during TeleOp:

- Any Cannonball entry point scored during Autonomous is worth double its TeleOp value (see [Section 0.3.4](#)).
- Climb scoring only occurs at the end of a match and thus is not applicable to Autonomous scoring.

Additionally, leaving the Staging Zone during the Autonomous Period is worth five (5) points.

Firing the Cannons

Teams can only score in their opposing team's Staging Zone and Team Zone. Balls enter one of 3 entry points on the opposing team's ship:

- Rudder - 2 Points
- Hull - 4 Points
- Masts - 5 Points

A ball that enters an entry point but bounces back out onto the Field does not score.

Once 5 balls enter the same entry point, that entry point is considered **Damaged**. Each entry point can only be Damaged once. A Damaged entry point does not award points on its own - Damaged status only becomes a scoring bonus in combination with Climbing, per [Section 0.3.4](#). Points can still be scored normally through an entry point once it is Damaged.

Climbing the Ships

At the end of a Match, if a Robot is hanging from the Rope on the opposing team's Ship, that Team scores twelve (12) points.

Additionally, **only if** a Team is Climbing at the end of the Match, that Team also scores five (5) points for each entry point that is Damaged on the opposing Ship. A Damaged entry point provides no bonus points if the Team does not Climb.

To count as **hanging**, the Robot must be suspended off of the ground and fully supported by the Rope. Referees make the final call on whether a robot is fully supported by the Rope and not touching the ground.

0.4 Rules

0.4.1 Event Rules

E1 Teams should be quick in preparing their Robot for a Match. Teams should ensure their Robot can communicate with their Operator before each Match. Teams will have five (5) minutes before a Match is scheduled to place and prepare their Robot. Teams who do not have their Robot ready three (3) minutes after a Match is scheduled will be **[Disqualification]** for the Match and must remove their Robot from the Field if it is on it.

E2 During the Playoffs period, each Team will receive one (1) Pre-Start Extension that they can redeem for an extra fifteen (15) minutes before a Match with their Team starts.

E3 There will be two or more Referees who will oversee each Match for fairness and adherence to the Rules.

E4 A Referee may require a Team to present their Robot for inspection if a Referee believes it is violating a Rule.

E5 Before a Robot may compete in any Matches, it must be inspected by a *STORM* Referee. Inspection will consist of a size test (**R1**), a weight test (**R2**), and a Loss of Signal test (**R7**, **R8**). The Loss of Signal test will be performed by a Referee cutting off WiFi while the Robot's Operator continuously drives the Robot around.

0.4.2 Team Rules

T1 A Team may consist of any number of Team Members. Each Team must have one Team Technician and one or two Team Operators. Team roles may change between Matches.

T2 Team Technicians must be at their Match's Field.

T3 Team Operators must be at the Operation Center.

T4 Team Operators may not communicate with any other Team Members outside of the Operation Center, unless through the Robot itself.

T5 Once a Ship is hit by a Cannonball, the opposing team's Technician is required to insert the Cannonball back into their team's Protected Return Zone. Technicians cannot hold more than 3 balls at once and must make their best effort to return the balls to the Field as quickly as possible. Violating either of these rules results in a **[Minor Penalty]** for the Technician's team.

0.4.3 Match Rules

Match Structure

M1 Each Match is four minutes long. A Match begins on the Referee's signal.

M2 Robots are allowed to move before a Match begins to test teleoperation, but Robots must stay within the starting area (as defined in **Section 0.3.2**) until the Match begins. A Robot which leaves this area after being placed on the Field, but before the Match begins, will receive a **[Minor Penalty]** towards the Match and must be manually placed again. The Match will not begin until both Robots are within the Staging Zone.

M3 A Disqualification towards a Match will cause the final score of the Team to be 0 points for the Match.

- M4** At the conclusion of a Match, Robots will experience a Loss of Signal (as defined in R7).
- M5** Egregious or excessively repeated Penalties will cause the Team to be **[Disqualification]** from the active Match. Do not intentionally break rules to gain an advantage.
- M6** Teams may be issued Penalties for violating rules. Each **[Minor Penalty]** will deduct six (6) points from the final score. Each **[Major Penalty]** will deduct fifteen (15) points from the final score. If a Team's final score is less than zero (0) points after all Penalties are applied, their final score becomes zero (0) points instead.

Zone & Field Conduct

- M7** Teams cannot enter the opposing team's Return Zone. If a Team enters an opposing team's Zone, they receive a **[Major Penalty]**.
- M8** During the Match, Robots cannot intentionally block their own team's entry points. Any violation of this rule results in a **[Minor Penalty]** for their team.
- M9** Each time a part of a Robot falls off, the Team will receive a **[Minor Penalty]**. Each time a fallen part is used to gain an advantage in scoring, the Team will receive a **[Major Penalty]**.
- M10** Robots must not damage the Field, Game Pieces, or Ships. The Team will receive a **[Minor Penalty]** for each instance of excessive damage to Game Pieces and a **[Major Penalty]** for each instance of excessive damage to the Field or Ships.
- M11** Robots may not extend outside of the Field during a Match. Each time a Team's Robot extends outside of the Field, the Team will receive a **[Minor Penalty]**.

Robot Interaction

- M12** Do not use your Robot to collide with another Robot with the intent to cause damage. Robot contact is expected but should only be incidental. Teams violating this rule will be **[Disqualification]** from the active Match.
- M13** Do not force the opposing Robot to cause penalties. Teams violating this rule will receive a **[Minor Penalty]** and the opposing Robot will receive no penalty.
- M14** Do not pin the opposing Robot into a position where it can no longer move. Robots performing intentional and sustained pins will receive a **[Major Penalty]**.
- M15** Do not use your Robot to make contact with an opposing Robot while it is in contact with a Rope. Teams violating this rule will receive a **[Major Penalty]**.
- M16** Do not drive your Robot under the opposing Robot while it is in contact with a Rope. Teams violating this rule will receive a **[Major Penalty]**; repeat offenses will result in **[Disqualification]**.

0.4.4 Robot Rules

- R1** Robots must be able to fit within an 18" x 18" x 18" cube at all times, including during a Match. Game Pieces are not included in the size limit.
- R2** Robots must weigh no more than 40 pounds.
- R3** Robots must locomote using only ground propulsion; air-propelled robots (i.e. drones) are not allowed.
- R4** Robots must have battery powered drivetrains. All battery chemistries are allowed.

R5 Robots must not contain any liquids (i.e. hydraulic fluid) except within batteries. Robots must not contain any harmful materials that are not sealed (i.e. a lead chassis is not allowed; SLA batteries are allowed).

R6 Robots may only communicate from the Field using the provided WiFi network and credentials. More information is described in [Section 0.4.5](#).

R7 Loss of Signal — When a Robot is no longer able to communicate with its Operator or the Field Management System (FMS), the robot is considered to have Loss of Signal. Robots must be able to detect Loss of Signal and must immediately halt all motion within one (1) second.

R8 Signal Light — Robots must include one clearly visible light that indicates Loss of Signal. The Signal Light should blink approximately once per second while the robot has signal. The Signal Light should be solid when there is Loss of Signal.

R9 Robots should not intentionally interfere with the opposing Robot's sensors. Robots should also not intentionally make unnecessarily loud noises or flash unnecessarily bright lights.

0.4.5 Robot-Operator Communication

Overview

During a Match, the Operator cannot physically see the Robot or the Field. The Robot and Operator are placed in separate rooms, and the Operator must rely entirely on information the Robot sends back over a wireless link. Building a Robot that operates reliably over a real, imperfect wireless connection, and that can detect and respond safely when a connection is lost, is a core part of the challenge.

Because everything depends on this network, the *STORM* team controls the network end to end and requires every Robot to maintain a connection to the Field Management System (FMS) at all times. The FMS does not control any Robot mechanically outside of declaring its ability to move.

Teams must only use the network and FMS provided by the *STORM* team. No private, personal, or alternate means of communication may be used by the Robot or the Operator at any time while competing. This includes radios, phone calls, Bluetooth, etc.

Network Rules

C1 The Robot and the Operator must exclusively communicate over the network provided by *STORM*.

C2 The Robot must connect to the *STORM* network wirelessly through the designated Field network. This network will be used for both practice and Matches.

C3 The Operator may only connect to the *STORM* network either wirelessly or via a single dedicated wired Ethernet connection in the Operation Center, at the Team's discretion.

C4 The Robot may only have one device connected to the *STORM* network at a time.

C5 It is against the rules for anyone other than the Operator(s) to have any connection to the Robot at any time, through any means.

C6 Internet access will be available on the *STORM* network for convenience. Its availability does not change any of the above restrictions.

C7 *STORM* will provide WiFi credentials and further networking information to teams closer to the competition date.

C8 Network speeds will be limited to 8 megabits per second, enforced individually per Team. Specifically, teams will be assigned a VLAN and the VLAN will be limited.

C9 Teams may use any ports for their own communication between the Operator and Robot.

Team Network Assignment

C10 Each Team will be assigned an isolated VLAN and a corresponding subnet on the 10.10.x.0/24 range.

C11 VLAN assignment is automatic wherever possible through the MAC address of devices. Teams whose devices are not automatically recognized will be manually assigned.

C12 IP addresses within a Team's assigned subnet are issued automatically via DHCP, although static IP addresses can be assigned per request.

The Field Management System (FMS)

C13 Every Robot must establish and maintain an active connection to the *STORM* Field Management System (FMS) at all times while on the Field and during practice.

C14 The FMS is the Field's authority on Match timing, scoring, and whether a Robot is authorized to move. It does not relay Operator commands or control Robots directly.

C15 Robots must connect to the FMS and implement the published *STORM* FMS protocol. Full technical documentation, examples, and source code are published on our [github](#) and are considered part of these rules by reference.

C16 Once connected, a Robot must send the FMS a heartbeat message at an interval specified in the documentation. If this heartbeat is not met and the Robot loses connection, it is considered to have Loss of Signal and must immediately halt all motion, per [R7](#) and [R8](#).

C17 The FMS continuously informs each connected Robot of the current match phase (e.g. Autonomous, TeleOp, Disabled) and whether a Robot is currently allowed to move. A Robot must not move while the FMS reports it as disabled, regardless of any commands sent by the Operator. If a Robot is found breaking this rule, it will be **[Disqualification]** from its active Match if applicable.

0.5 Design Challenge

In addition to building a Robot, Teams will be required to submit a Design Report describing the design process of their *STORM* 2027 robot. Design Reports should be no longer than 5 pages, not including title pages or appendices. Teams should include the following information at a minimum:

- Team Organization and Team Members
- High-level Block Diagram(s) of the Robot
- Mechanical Design
 - Drivetrain Configuration
 - Mechanisms
- Electrical Design
 - Single-board Computer or Microcontrollers
 - Sensors
- Software Design
 - Operator Interface
- Safety and Reliability
- Bill of Materials

Design Reports are due exactly two weeks before the competition date, with a ten (10) point penalty applied for each day late. Reports are submitted on each team's dashboard. Each report will be judged by a committee consisting of faculty and industry professionals. The scoring rubric is described in [Table 2](#). Reports should be written to emphasize the engineering process and decisions made while creating the robot. Design reports from *STORM* 2025 and *STORM* 2026 are available on the *STORM* website.

Criteria	Maximum Points
Description of Team and Robot	30
Description of Mechanical Design	40
Description of Electrical Design	40
Description of Software Design	40
Description of User Operation	30
Novelty	10
Organization and Style	10
Total Points	200

Table 2: Design Report scoring rubric.

0.6 Updates and FAQs

This section documents all revisions made to the *Loose Cannons* rules since initial release. Each entry lists the version, date, and a summary of changes.

Version 1.0 - August 22nd, 2026

- Initial Release
- Version 1.1 will be released in September.

0.7 Appendix

0.7.1 Game Pieces

- 6 inch diameter dodgeball: **Single ball**
- 1 inch polypropylene rope: **Rope**

Other field elements such as the waves will be released with Version 1.1.

0.7.2 AprilTags

AprilTags are being finalized and will be released with Version 1.1. However, AprilTags will be part of the 6h11 family, have unique ids, and be 2 inches by 2 inches.