



Hailstorm

April 5th, 2025

STORM Robotics Challenge Competition Rules

Version 3

ou.edu/scr/storm



2025 Hailstorm Rules

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1. Introduction

1.1 *STORM* - The Student Tele-Operated Robotics Mission

STORM is an interscholastic robotics competition designed for university students. 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 for all university-level students or educators interested in robotics as a way to teach real-world engineering. When compared to many other university-level robotics competitions, *STORM* is of the lowest in both cost to compete and barrier to entry. This makes this competition ideal for student organizations and for capstone design courses. By competing at *STORM*, students 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 the students will encounter in their futures.

Join the *STORM* Discord server for updates and questions at <https://storm.soonerrobotics.org/discord>

1.2 *Hailstorm*

Hailstorm is the 2025 *STORM* challenge and is inspired by the real-world problem of studying hailstones. For this mission, robots will have to navigate a dangerous storm to collect hail. Controlled by remote drivers, robots will leave their transport, navigate damage, collect and sort hail, and report information.

1.3 Registration

STORM 2025 is scheduled to take place on **Saturday, April 5th 2025**. Registration is free and open to teams associated with a university¹. There is no limit to the number of teams from each university, but each team must register separately. Each team is only allowed one robot. Teams must be entirely composed of students currently registered in at least one course during the Fall 2024 or Spring 2025 semester.

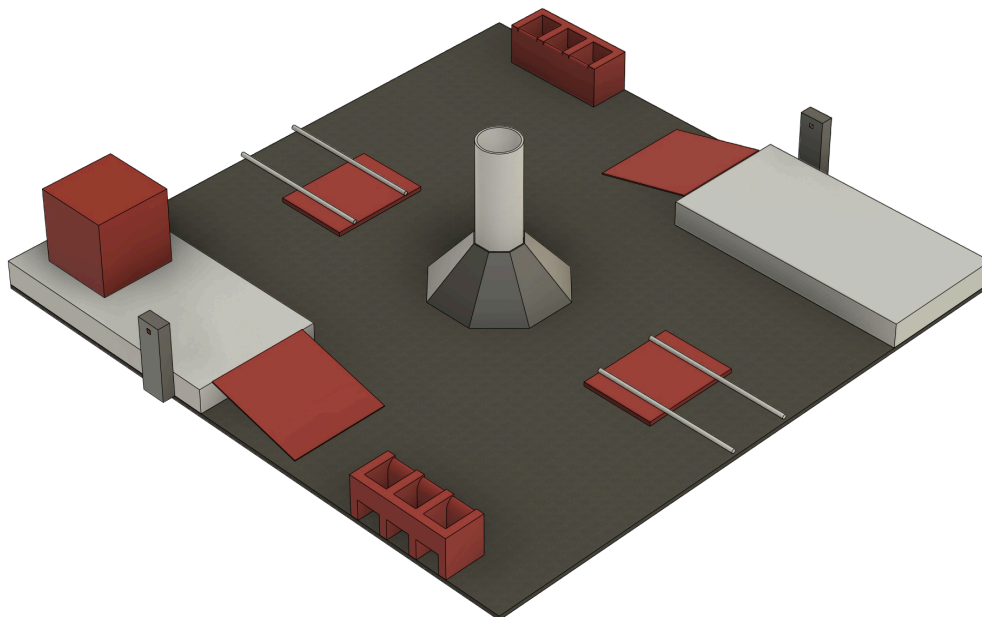
Registration is now open at <https://storm.soonerrobotics.org/>

Registration requires a team captain, an advisor, and a robot. The team captain must be 18 years or older. The advisor may be any staff or faculty associated with the team's university.

¹ Or any post-secondary institution



2. The Field



The Field for *Hailstorm* is defined by a 12' x 12' square area. The surface of the Field consists of interconnected foam mats. 12" high opaque walls sit on the perimeter of the course (not shown above). Field dimensions are available in the [8. Appendix](#).

2.1 Van

The Van is a 5' x 2'6" space where Robots will begin and end each Match. The Van has 1/4" thick walls except for on one end where there is a door. The walls are not shown above. The door falls down during the Match to become a ramp onto the Field (see [3.3.1 Safe Deployment](#)). The door is about 24.7" tall such that it has a height of 6" and a length of 24" when it is acting as a ramp (a slope of 14 degrees). The floor of the Van as well as the drivable side of the door will have foam attached to make traversal easier.

The Van has green LEDs surrounding the entire interior. The LEDs are off until the Match starts. The LEDs should be used by the Operator to identify when a Match starts. The Van contains a button that the robot can press to open the Van door. The button will be a 1" square button recessed 1" into a frame and placed 10" off of the ground to the center of the button.

2.2 Hail Dropper

In the center of the Field is the Hail Dropper which distributes Hail across the field. The Hail is made of foam balls 2", 3", and 4" in diameter. Hail will fall from at least 3' off the floor onto the Field randomly within a 42" radius of the center. Approximately 36 pieces of Hail (12 of each size) will drop throughout the Match.



2.3 Collection Bins

On the side of each Van will be three hail Collection Bins. Each bin will be labeled in large font with the size of the hail that is expected. The three bins will be 6"-interior square containers that are 10" tall. Hail will fall out the back of each bin to allow for unlimited hail in each bin.

2.4 Street Signs

Signs are placed on hinges which allow them to be lifted vertically. When lifted, they will rest in the vertical orientation. Each sign will weigh between 5 and 10 pounds. The board will be made of ¼" acrylic and the poles will be made of 1" outer diameter PVC pipe. See the [8. Appendix](#) for additional dimensions.

2.5 IR Transmitter

The IR Transmitter is a device that will transmit the IR signals described in [3.3.4 Receive Reports](#). Two transmitters will be placed in each corner near the Collection Bins such that all locations on the field will be in line-of-sight.

3. Playing a Match

3.1 Match Overview

A *Hailstorm* Match is played on a legal Field and may consist of one Team or two Teams. Matches played with one Team are Scoring Matches, while Matches played with two Teams are Competitive Matches. During each Match, each Team may place one Robot on the field. During a Match, Teams have four minutes to earn as many points as they can.

Competitive Matches are not combat robotics and Operators are strongly discouraged from controlling their Robot in a way which could damage the opposing Robot. Competitive Matches exist to encourage teams to have fast and effective robots.

3.2 Match Setup

Before each Match, each Team Captain will place their Robot on the Field inside their Van. Each Robot must be placed at least 24" away from the Van's Door. The Team Operators will move to the Operation Center room where they can connect to the network and control their Robots. The Match will begin after both Team Captains say that their Team is ready.



3.3 Scoring

3.3.1 Safe Deployment

Robots start each match placed inside the Van. During the first twenty seconds of the match, teams may earn (10) points by pressing the Door Release button. After the button is pressed or twenty seconds pass, the door will open. Teams earn (5) points when their robot leaves the Van for the first time. Robots may earn an additional (5) points if they end the match inside the van. Teams may only earn these additional (5) points if their robot also earned the points for leaving the van.

3.3.2 Collect the Hail

Hail will begin falling 15 seconds after the start of the match. New Hailstones arrive continuously throughout the rest of the Match.

Teams earn (2) points for each piece of Hail that their Robot collects and deposits into the Collection Bins next to their Team's Van. Teams earn an additional (3) points for each piece of Hail that their Robot sorts into the correct bin based on size. There are three possible Hail sizes that will hit the course: 2", 3", and 4" diameter.

Each Robot may only control 2 pieces of Hail at a time, either directly or transitively through other objects. If a Robot is controlling 3 pieces of Hail more than momentarily, the Team will receive a (5) point penalty.

3.3.3 Navigate Damage

Due to high winds prior to the Match, two street signs have fallen onto the field and block routes. Lifting a sign off the ground and into the vertical resting position for the first time earns the team (10) points. Robots are allowed to drive over the signs while they are down.

3.3.4 Receive Reports

A nearby weather station reports information about the current storm. Reports are transmitted as IR signals using the NEC protocol and consist of 16 bits per message. Robots should receive these messages and relay them to the Operator. Each Match will have three different, randomly generated messages. Every twenty seconds, one of three messages will be broadcast following a cycle. At the end of the match, drivers can report the messages they collected. For each message correctly reported, the team will receive (5) points.

3.4 Scoring Summary

Task	Leave the Van (1x)	Press the Button (1x)	End inside the Van (1x)	Collect Hail Unsorted (unlimited)	Collect Hail Sorted (unlimited)	Lift the Sign (2x)	Receive Report (3x)
Points	5	10	5	2	5	10	5



4. Rules

4.1 Event Rules

- 4.1.1 Teams should be quick in preparing their Robot for a Match. Teams should ensure their Robot can communicate with their Operator before each Match.
- 4.1.2 There will be two or more Referees who will oversee each Match for fairness and adherence to the Rules. One Referee will watch the Field and one Referee will watch the Operator (primarily for [3.3.4 Receive Reports](#)).
- 4.1.3 There will be no mandatory inspections before each Match.
- 4.1.4 A Referee may require a Team to present their Robot for inspection if a Referee believes it is violating a Rule.

4.2 Team Rules

- 4.2.1 A Team may consist of any number of Team Members. Each Team must have one Team Captain and one Team Operator but these may not be the same Team Member. The Team Operator may be changed at any time except during a Match.

4.3 Match Rules

4.3.1 Match

- 4.3.1.1 Each Match is four minutes long. A Match begins on the Referee's signal.
- 4.3.1.2 Robots are allowed to move before a Match begins to test teleoperation, but Robots must stay within the starting area (as defined in [3.2 Match Setup](#)) 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.
- 4.3.1.3 A Disqualification towards a Match will cause the final score of the Team to be 0 points for the Match.

4.3.2 During a Match

- 4.3.2.1 Egregious or excessively repeated Penalties will cause the Team to be Disqualified from this Match. Do not intentionally break rules to gain advantage.
- 4.3.2.2 Robots earn points as described in [3. Playing a Match](#). The final accumulated number of points earned during the Match is the Team's final score for the Match.
- 4.3.2.3 Teams may be issued Penalties for violating rules. Each Minor Penalty will deduct (3) points from the final score. Each Major Penalty will deduct (10) points from the final score. If a final score is less than 0 points after all Penalties are applied, the final score becomes 0 points.
- 4.3.2.4 Team Captains must be at their Match's Field.
- 4.3.2.5 Team Operators must be at the Operation Center.
- 4.3.2.6 Team Operators may not communicate with any other Team Members.



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- 4.3.2.7 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.
- 4.3.2.8 Robots must not damage the Field or any game pieces. The Team will receive a Minor Penalty for each instance of excessive damage to a game piece and a Major Penalty for instance of excessive damage to the Field.
- 4.3.2.9 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.
- 4.3.2.10 Teams may not intentionally remove game pieces from the Field. Teams violating this rule will receive a Minor Penalty for each violation.

4.3.3 Competitive Matches

- 4.3.3.1 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 Disqualified from this Match.
- 4.3.3.2 Do not force the opposing Robot to cause penalties. Teams violating this rule will receive a Minor Penalty and the opposing team will receive no penalty.
- 4.3.3.3 Do not emit infrared light with the intent to obstruct or mask the infrared signals from the Weather Stations. Teams violating this rule will be Disqualified from this Match.
- 4.3.3.4 Do not prevent the opposing Robot from playing. While it is okay to use your Robot to block space, it is against the rules to pin the opposing Robot against the Field, block the Van entrance, or add weight to a Sign. Teams violating this rule will receive a Major Penalty for each violation and may be upgraded to a Disqualification if intentional and excessive.
- 4.3.3.5 Do not intentionally force the opposing Robot to lose control of Hail they have control of. Teams violating this rule will receive a Major Penalty for each violation.

4.4 Robot Rules

- 4.4.1 Robots must fit within an 18" x 18" x 18" cube. During a Match, robots may expand and this restriction instead becomes a 24" x 24" x 24" cube.
- 4.4.2 Robots must weigh no more than 50 pounds.
- 4.4.3 Robots must be ground vehicles - they must maintain contact with the ground at all times. A Robot may temporarily leave the ground if it is resting on game pieces.
- 4.4.4 Robots must be battery powered.
- 4.4.5 Robots must stay in one piece.
- 4.4.6 Robots may only externally communicate using the provided WiFi network.



4.5 Robot-Operator Communication

- 4.5.1 The Robot and the Operator will be in separate rooms during a match.
- 4.5.2 The Robot and the Operator may only communicate through the provided network. No external communication such as cellular networks or radio are allowed. Internet access will be available on the network for convenience, but it is against the rules for anyone other than the Operator to have any connection to the Robot at any time. Teams breaking this rule may be disqualified from all remaining Matches.
- 4.5.3 The Robot may only connect to the provided network through the competition WiFi access point. The SSID and password will be relayed to teams at competition.
- 4.5.4 The Operator may connect to the provided network either using WiFi or ethernet available in the Operation Center.
- 4.5.5 The provided network will reside on the 10.10.1.0/24 subnet. DHCP will be available for automatic IP address assignment, but static assignment is also allowed with the exception of IP 10.10.1.0 which will be the gateway address.
- 4.5.6 Any ports may be used.



5. Design Challenge

In addition to building a robot, teams will be required to submit a short Design Report describing the development of their *STORM* 2025 robot. Design Reports should be no longer than 5 pages not including title pages or appendices. Teams should include the following information:

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

Design Reports are due two weeks before the competition date with a 10 point penalty applied for each day late. The reports should be submitted in PDF format and sent to oustormcompetition@gmail.com. Each report will be judged by a committee consisting of faculty and industry professionals. The scoring rubric is described in the table below. Reports should be written to emphasize the engineering process and decisions made while creating the robot.

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



6. Competition Format

6.1 Tournament

The 2025 *STORM* competition will be split into two periods: Ranking and Playoff. During the Ranking period, robots will compete solo in Scoring Matches. Each team will be offered at least three matches during the Ranking period. After the Ranking period concludes, teams will be seeded based on the highest score they achieved during any Scoring Match. The Playoff period will consist of Competitive Matches following a double elimination bracket based on the seeding of each team. The final match will determine the First and Second Place winners.

6.2 Awards

Four awards will be given out at *STORM* 2025:

- First Place
- Second Place
- Highest Score
- Best Design

6.3 Day-of Schedule

The *STORM* 2025 competition will take place during a single day and will roughly follow the below schedule. A detailed itinerary, day-of instructions, and parking directions will be provided prior to the competition to all registered teams.

8:00 AM - Registration and Setup

9:00 AM - Welcoming Ceremony

9:15 AM - 12:00 PM - Ranking Matches

12:00 PM to 1:00 PM - Break

1:00 PM to 4:00 PM - Competitive Matches

4:00 PM - Closing Ceremony and Awards



7. Updates, FAQs, and Commentary

7.1 Updates

Version 1 - August 12th 2024

- Preliminary rules with final tasks released

Version 2 - September 2nd, 2024

- Registration open
- Field size corrected to 12' x 12'
- Appendix added
- Several rules added and changed

Version 3 - January 15th, 2025

- Penalties have been simplified into Minor and Major Penalties
- Added additional Penalties for actions that majorly disrupt the challenge
- Rule clarifications

7.2 FAQs

Are the rules final?

The tasks are final, but the details of the rules are likely to receive minor changes throughout the year. Any changes made will prioritize making sure robot designs do not also need to change. A robot designed with any version of the rules should be able to compete with the final rules. Any changes made to the rules will be advertised immediately through all *STORM* media channels.

7.3 Developer Commentary

We are thrilled to present *Hailstorm* and we hope that reading this document has given each team lots of inspiration to build novel and interesting robots. We started this competition with the purpose of inspiring students to think of interesting ways to challenge real problems. We are still new to creating rules and we are sure there are many inconsistencies and contradictions in this document, so please send us any questions or comments you have! We want to make this competition fun and interesting for every team.

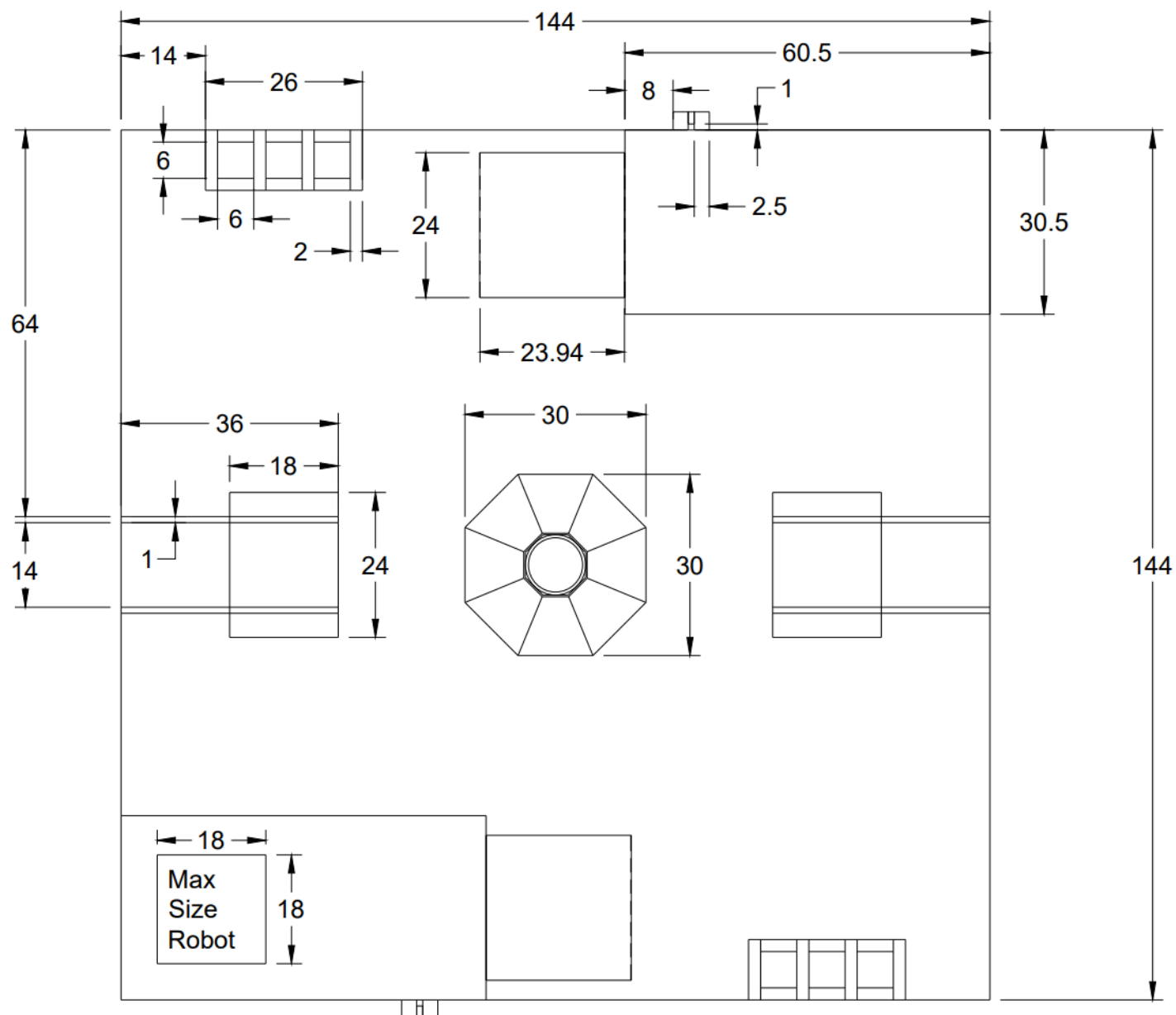
For those who have read the *STORM* 2024 rules, you may notice that this challenge is quite different and focuses heavily on one main scoring piece. The goal of this change was to be more familiar to students who may have backgrounds in FIRST, VEX, or BEST while maintaining the core identity of having the robot operator in a separate location from the robot. We will continue to explore new approaches to game design in future *STORM* games based on the feedback we receive each year.

Noah Zemlin - University of Oklahoma, Sooner Competitive Robotics Advisor



8. Appendix

8.1 Field Dimensions (inches)





8.2 Where to Purchase Field Elements

Below are examples of where the committee has purchased field elements during play testing. Materials were intentionally chosen such that teams should also be able to easily find very similar pieces at local stores.

Field surface

<https://www.amazon.com/dp/B01IDRWPGI/>

“Hail” may consist of any 2”, 3”, and 4” polystyrene balls. We have tested several different brands and all behaved nearly identically.

Acrylic used for nearly all surfaces and walls:

https://www.estreetplastics.com/Colored_Plexiglass_Sheets_s/109.htm

Foam (Black 6mm EVA foam) used for the surface of the ramp and for padding on the walls.

<https://www.amazon.com/MEARCOOH-Cosplay-Premium-Density-Projects/dp/B0C6977S4Q/>