



AERIAL **DRONE** COMPETITION



MISSION 2023

BLACKOUT

2022-23

GAME MANUAL

ROBOTICS EDUCATION.ORG

VERSION 1.4

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W E L C O M E

Drones are quickly finding their way into our everyday lives, from search and rescue, to construction, utility line work, firefighting, and agriculture. Drones are even being used for space exploration. NASA's Dragonfly Mission is sending a drone to Titan (Saturn's largest moon) to look for life in 2026. Careers in drones and drone technology are increasing rapidly, and students with early and in-depth experience with drones will have a distinct advantage in their future careers.

The Aerial Drone Competition prepares our youth for these careers and for future jobs by strengthening the skills they'll rely on. Through its uniquely engaging combination of teamwork and problem-solving, you're executing a problem-solving process that resembles the same mindset used by engineers, designers, and virtually every other profession.

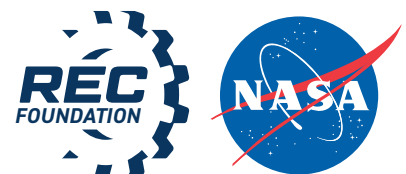
The Aerial Drone Competition is not just fun to play—it is a vehicle for teaching (and testing) teamwork and perseverance, and allows students to approach and solve new challenges with confidence.

Within this Game Manual are the rules that shape the Aerial Drone Competition Mission 2023: Blackout. They are balanced to promote fair play while encouraging competition. This game is designed to present a challenge, require teamwork, encourage innovation, and be fun. We believe the skills learned and grown in the Aerial Drone Competition will help students prepare for the challenges of tomorrow.

Good luck, and we will see you in the Flight Zone!

Sincerely,

The Aerial Drone Competition Game Design Committee
Members of the Robotics Education & Competition Foundation,
NASA, and the Dragonfly Mission



QUICK REFERENCE GUIDE

Scoring for Piloting Teamwork Matches (page 20)

<PS1>	Cleared Starting Lane
<PS2>	Owned Goal
<PS3>	Bonus Ball
<PS4>	Drone Landed on a Landing Pad
<PS5>	Drone Landed on Blackout Zone Floor
<PS6>	Drone Landed on a Large Landing Site
<PS7>	Drone landed in a Small Landing Site

Piloting Teamwork Match Rules (pages 27)

<PT1>	Qualification Matches
<PT2>	Qualification Match Rankings
<PT3>	Alliance Selection
<PT4>	Elimination Matches
<PT5>	Send a team representative to alliance selection
<PT6>	Each team may only be invited once to join an alliance
<PT7>	Each alliance gets one 'time out'

Autonomous Flight Skills Matches (pages 29)

<AFS1>	Liftoff
<AFS2>	Navigation
<AFS3>	Launch Balls
<AFS4>	Landed Drones

Autonomous Flight Skills Match Rules (pages 30)

<AF1>	Other game rules apply in most cases
<AF2>	Autonomous means "no humans."
<AF3>	Skills field layout
<AF4>	Stay on your side
<AF5>	All flight team members must remain in the pilot station
<AF6>	Blackout zones are protected
<AF7>	Autonomous Flight Skills ranking at an event
<AF8>	Autonomous Flight Skills rankings globally
<AF9>	Match stop time
<AF10>	Autonomous Flight Skills match schedule

Specific Game Rules (pages 34)

<SG1>	Starting position
<SG2>	Blackout zones are protected
<SG3>	Pilot stations
<SG4>	Visual observer stations
<SG5>	Flight rule
<SG6>	Keep balls in the field
<SG7>	No Electronic Communication Devices allowed

General Game Rules (pages 35)

<G1>	Treat everyone with respect
<G2>	The Aerial Drone Competition is student-centered
<G3>	Use common sense
<G4>	Practice sportsmanship
<G5>	The drone must represent the skill level of the team
<G6>	Be prepared to play
<G7>	Keep your drone together
<G8>	Drones cannot physically interact with the opposing alliance
<G9>	Drones cannot directly interfere with humans
<G10>	Stay off the floor.
<G11>	Flight team members are the only team members allowed at the field
<G12>	Stay out of the field during the match
<G13>	Offensive drones get the “benefit of the doubt”
<G14>	You can’t force an opponent into a penalty
<G15>	Be prepared for minor field variance
<G16>	Match replays are allowed, but rare
<G17>	It’s not over until it’s over
<G18>	The Q&A system is an extension of this game manual

The Tournament (page 40)

<T1>	The Head Referee has ultimate authority on ruling decisions during the competition.
<T2>	Head Referees must be qualified
<T3>	The flight team members are permitted to immediately appeal the Head Referee's ruling
<T4>	Students must be accompanied by an adult

Safety Rules (page 42)

<S1>	No flying of drones except in designated areas
<S2>	Stay in the pilot station or visual observer stations
<S3>	Control your drone
<S4>	Virtual ceiling
<S5>	Fly within the flight zone
<S6>	Batteries must be charged before launch
<S7>	Wear safety glasses

The Drone (page 43)

<D1>	Teams must use the Parrot Mambo or CoDrone EDU as their stock drone
<D2>	Drones and attachments must pass inspection
<D3>	Drones must be safe
<D4>	Drones must utilize four (4) motors with propellers attached
<D5>	Drones must utilize stock drone electronics
<D6>	Protect your props
<D7>	Teams must clearly identify their alliance during a match
<D8>	Drone customization is allowed
<D9>	Attachments are allowed
<D10>	Only registered teams may compete in Aerial Drone Competition Mission 2023: Blackout

OVERVIEW

Mission 2023: Blackout

Aerial Drone Competition Mission 2023: Blackout is played on a 24'x24' square field, set up as illustrated below and in figures throughout the game manual.

In Piloting Teamwork Matches, two alliances—one red and one blue, made up of two teams each—compete in 2-minute pilot-operated matches.

The object of Piloting Teamwork Matches in Mission 2023: Blackout is to attain a higher score than the opposing alliance by owning goals, scoring bonus balls, and ending the match on a landing pad or in the alliance blackout zone.

In Autonomous Flight Skills matches, a single team has 60 seconds of autonomous drone operation to score points by lifting off, navigating through arch and keyhole gates, removing balls from the starting lane, and ending the match on a landing pad or in the alliance blackout zone. All drone commands are pre-coded by the team, with no pilots allowed.



FIELD OVERVIEW

The Aerial Drone Competition Mission 2023: Blackout field consists of the following:

Four (4)	Keyhole gates
Four (4)	Arch gates
Four (4)	Landing pads, two per alliance
Two (2)	Blackout screens
Two (2)	Large landing sites, one per alliance
Two (2)	Small landing sites, one per alliance
Thirty-six (36)	Small red balls
Thirty-six (36)	Small blue balls
Two (2)	Large white balls
One (1)	PVC field perimeter
Four (4)	PVC starting lanes and accompanying structure
Five (5)	PVC goals and accompanying structure



QUESTIONS?

When first reviewing a new Aerial Drone Competition game, it is natural to have questions about situations which may not be immediately clear. Navigating the game manual and seeking out answers to these questions is an important part of learning a new game. In many cases, the answer may just be in a different place than you first thought. If there is no rule explicitly prohibiting something, then that usually means it is legal!

However, if a team is still unable to find an answer to their question after closely reviewing the relevant rules, then every team has the opportunity to ask for official rules interpretations in the Aerial Drone Competition Question & Answer (Q&A) System.

All responses in this Q&A system should be treated as official rulings from the Aerial Drone Competition Game Design Committee, and they represent the correct and official interpretation of the Aerial Drone Competition rules. The Q&A system is the only source besides the game manual for official rulings and clarifications.

The Aerial Drone Competition Q&A System can be found at <https://www.robotevents.com/ADC/2022-2023/QA>. Before posting on the Q&A system, be sure to review the Q&A Usage Guidelines, which can be found at <https://www.robotevents.com/ADC/2022-2023/QA/guidelines>

In brief:

1. Read and search the manual before posting.
2. Read and search existing Q&As before posting.
3. Quote the applicable rule from the latest version of the manual in your question.
4. Make a separate post for each question.
5. Use specific and appropriate question titles.
6. Questions will (mostly) be answered in the order they were received.
7. This system is the only source for official rules clarifications.

If there are any conflicts between the game manual and other supplemental materials, the most current version of the game manual takes precedence.

Similarly, it can never be assumed that definitions, rules, or other materials from previous seasons apply to the current game. Q&A responses from previous seasons are not considered official rulings for the current game. Any relevant clarifications that are needed should always be re-asked in the current season's Q&A.

SECTION 2: GENERAL DEFINITIONS

Adult

Anyone who is not a student.

All Clear

A signal given by the Head Referee that teams may retrieve their drones.

Alliance

A pre-assigned grouping of two (2) teams that are paired together during a given match.

Alliance Captain

A team that has earned the right to choose their alliance partner during alliance selection to play in Elimination Matches.

Alliance Partner

A team that is chosen by an alliance captain during alliance selection to play in an alliance during Elimination Matches.

Alliance Selection

The period of a tournament that happens after Qualification Matches. During this period, alliances are created to participate in Elimination Matches.

Arch Gate

A red or blue arched field element that acts as an obstacle during a match.

Attachment

Any drone component that is added to a stock drone.

Autonomous Flight Skills Match

A match in which a single team with one drone competes using only pre-programmed commands and no pilots.

Coach

See Mentor.

Co-Pilot

A member of the flight team who stands in the pilot station, near the pilot, and operates the drone during the match.

Disqualification

A penalty applied to a team for a rule violation. A team that receives a disqualification in a Qualification Match receives points and zero (0) win points for the match. When a team is disqualified in an elimination match, the entire alliance is disqualified and they receive a loss for the match. At the Head Referee's discretion, repeated violations and/or disqualifications for a single team may lead to its disqualification for the entire tournament.

Drone

A machine that has passed inspection, designed to execute one or more tasks autonomously and/or by remote control from a flight team member.

Elimination Bracket

A tournament bracket of Elimination Matches which happen after both Qualification Matches and alliance selection.

Elimination Match

A match used to determine the championship alliance as part of the elimination bracket.

Event Staff

Any volunteer that helps an event partner run an event.

Event Partner

The individual responsible for planning and running an Aerial Drone Competition event.

Field Element

Any part of the field setup that is not a game element. This includes arch gates, keyhole gates, landing pads, goals, and field perimeter. Note that PVC field elements are not included in the purchased set of field elements.

Field Perimeter

The PVC boundary of the field that acts as the outer boundary of the flight zone.

Flight Team Member

A student who is a pilot, co-pilot, or visual observer and who stands at the field during a match. Adults are not allowed to be flight team members.

Flight Zone

The area between the floor and the virtual ceiling, and bordered by the field perimeter, in which the drones are allowed to fly.

*General Definitions continued***Game Design Committee (GDC)**

The creators of the Aerial Drone Competition games, and the authors of the game manual.

Game Element

The thirty-six (36) red balls, thirty-six (36) blue balls, two (2) white balls, two (2) blackout screens, two (2) large landing sites, two (2) small landing sites that are used by teams during matches.

Grounding

A penalty applied to a team for a rule violation. A team that is grounded is not allowed to operate their drone for the remainder of the match. The pilot will be asked to land their drone, if the drone is not already landed, and place their controller on the floor.

Head Referee

An impartial volunteer responsible for enforcing the game rules as written. Head Referees are the only individuals who may discuss ruling interpretations or scoring questions with teams at an event.

Keyhole Gate

A yellow or green circular field element that acts as an obstacle during a match.

Match

A set time period in which teams play a defined version of Mission 2023: Blackout to earn points. Teams may compete in Qualification, Elimination, and Autonomous Flight Skills Matches.

Mentor

An adult who facilitates learning and supports a team. A mentor may not work on or handle the drone in any capacity without students present who are actively engaged/learning.

No-Fly Zone

Anywhere in or around a venue that is not a flight zone.

Pilot

A member of the flight team who stands in the pilot station and operates the drone during the match.

Qualification Match

A match used to determine rankings for alliance selection.

Stock Drone

The Parrot Mambo or CoDrone EDU.

General Definitions continued

Student

A person is considered a student if they meet both of the following criteria:

- Anyone who is earning or has earned credit toward a high school diploma, certificate, or other equivalent during the six (6) month period from December 2022 through May 2023. Courses earning credits leading up to high school would satisfy this requirement.
- Anyone born after May 1, 2003.

Middle school student - A student born after May 1, 2007. A middle school student may “play up” and compete as a high school student.

High school student - Any eligible student that is not a middle school student.

Eligibility may also be granted based on a disability that has delayed education by at least one year.

Team

One or more students make up a team.

- Aerial Drone Competition teams are either considered middle school or high school.
- A team is classified as a middle school team if all members are middle school (or younger) students.
- A team is classified as a high school team if any member is a high school student.
- Teams may be associated with schools, community/youth organizations, or a group of neighborhood students.

Team Representative

A student who represents a team during alliance selection.

Time Out

A break period of up to three (3) minutes requested by an Alliance between Elimination Matches during the Elimination Bracket.

Virtual Ceiling

A ten (10) foot high virtual barrier measured from the floor that acts as the top boundary of the flight zone. Teams that fly above the height of the top of the yellow keyhole gate (approximately 8.5 feet) may be subjected to additional scrutiny, and may be grounded by the Head Referee for safety reasons.

Visual Observer

A student on the team who helps the pilot navigate the course from the visual observer station.

General Definitions continued

Violation

The act of breaking a rule in the game manual.

- **Minor Violation** - A violation which does not result in a disqualification.

Accidental, momentary, or otherwise non-match affecting violations are usually minor violations.

Minor violations usually result in a verbal warning from the Head Referee during the match, which should serve to inform the team that a rule is being violated before it escalates to a major violation.

- **Major Violation** - A violation which results in a disqualification.

Unless otherwise noted in a rule, all match affecting violations are major violations.

Multiple minor violations within a match or tournament may escalate to a major violation at the Head Referee's discretion.

- **Match Affecting** - A violation which changes the winning and losing alliance in the match.

Multiple violations within a match can cumulatively become match affecting.

Determining whether a violation was match affecting can only be done once the match is complete and the scores have been calculated.

To determine whether a violation may have been match affecting, check whether the team who committed the violation won or lost the match. If they did not win the match, then the violation could not have been match affecting, and was very likely a minor violation.

Volunteer

An individual who is assisting an event partner in running an event, and who cannot also participate as a flight team member during the competition.

Warning

A verbal cue given to a team by a referee to indicate that their actions are in violation or in danger of being in violation of a rule.

Win Points

The first criteria for determining qualification ranking. Win points are earned through the results of Qualification Matches.

- Winning a match is worth two (2) win points.
- A match that results in a tie score is worth one (1) win point.

SECTION 3

GAME SPECIFIC DEFINITIONS

Ball

One of 72 spherical red or blue game elements that measure 40mm each. Also see Bonus Ball.

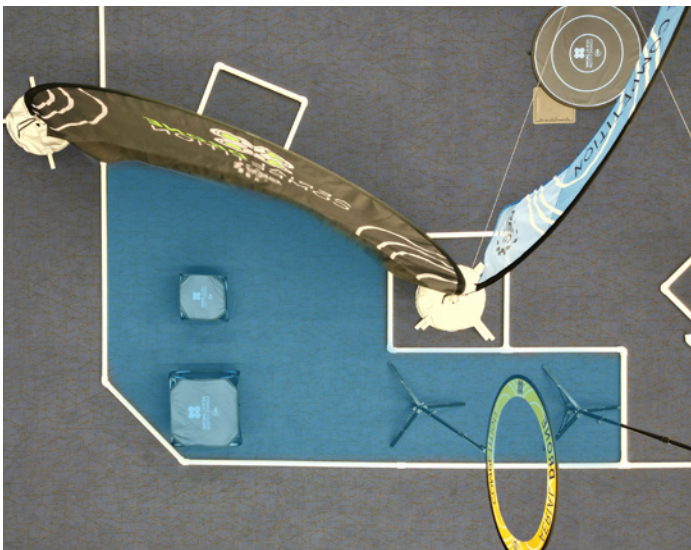


Blackout Screen

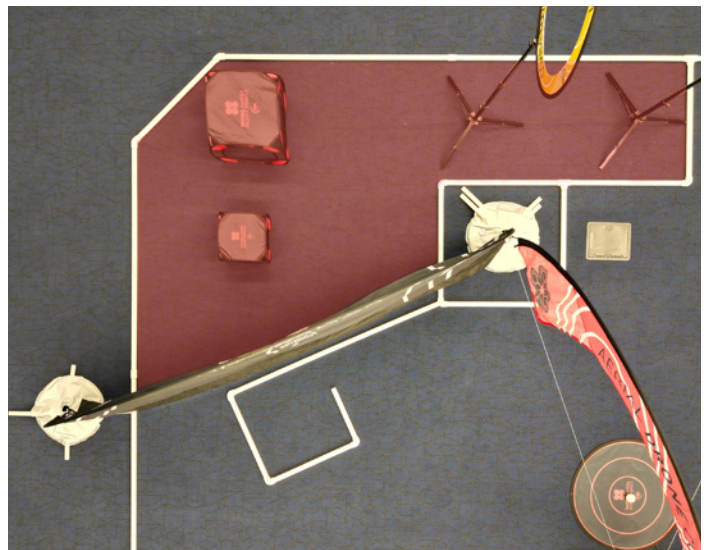
A black archway screen used to block the pilot's view of a section of the field.

Blackout Zone

An area of the field that is behind a blackout screen and that contains landing sites and a landing zone.



Blue Blackout Zone



Red Blackout Zone

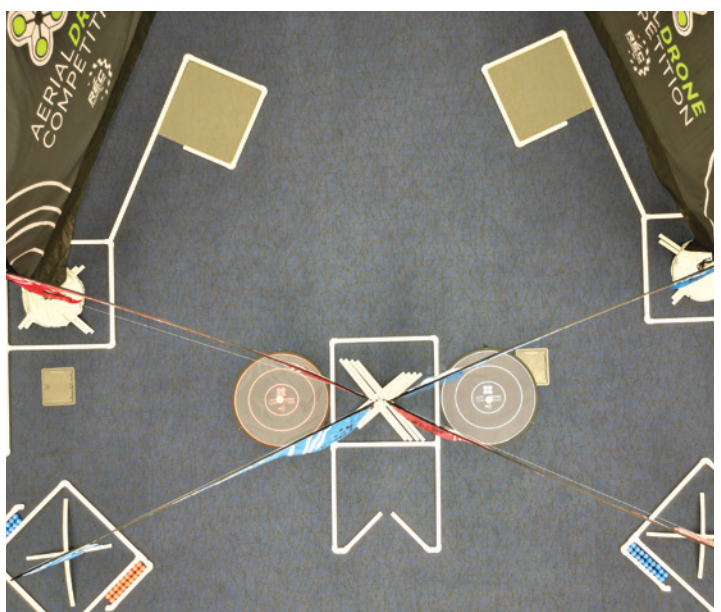
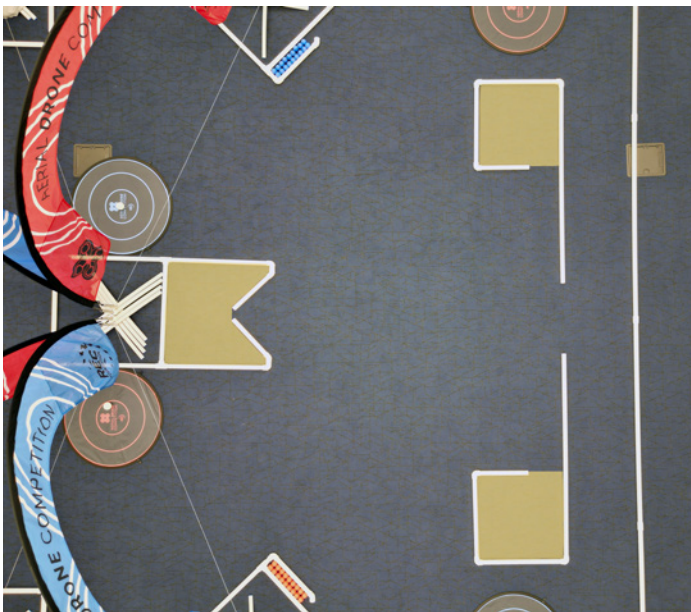
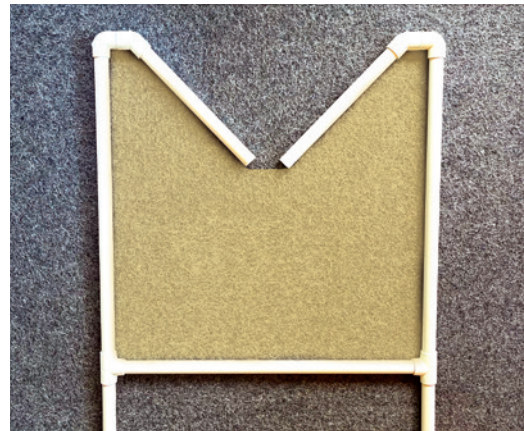
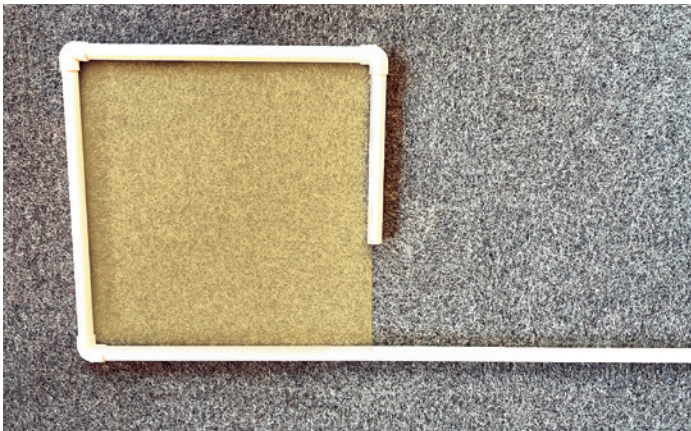
Game Specific Definitions continued**Bonus Ball**

One of two (2) spherical white game elements that measure 55mm each.

.....

Goal

One of five (5) areas of the floor of the field that is defined by the planes formed by the inner edge of the PVC pipe border as shown in the image below.



Game Specific Definitions continued

Landed

A drone state. See the Scoring criteria in the Piloting Teamwork Matches section for more details.

Landing Pad

One of the four (4) circular mats, two (2) red and two (2) blue, that are placed on the floor in the field.

Landing Site

- Small - A red or blue 12" cube that is placed on the floor in the corresponding blackout zone.
- Large - A red or blue 18" cube that is placed on the floor in the corresponding blackout zone.

Landing Zone

The floor of a blackout zone.

Owned

A goal status that can be used to score points. A goal is owned by the alliance with the higher number of their colored balls scored in that goal at the end of the match. If a goal contains an equal number of red and blue balls, it is not owned.



Above: Blue and Red Landing Pads



Above: Blue small and large landing sites

Pilot Station

One of the two (2) designated regions where the pilot(s) and co-pilot(s) must remain for the duration of the match. See the image below for the exact boundaries of the Mission 2023: Blackout Pilot Stations.

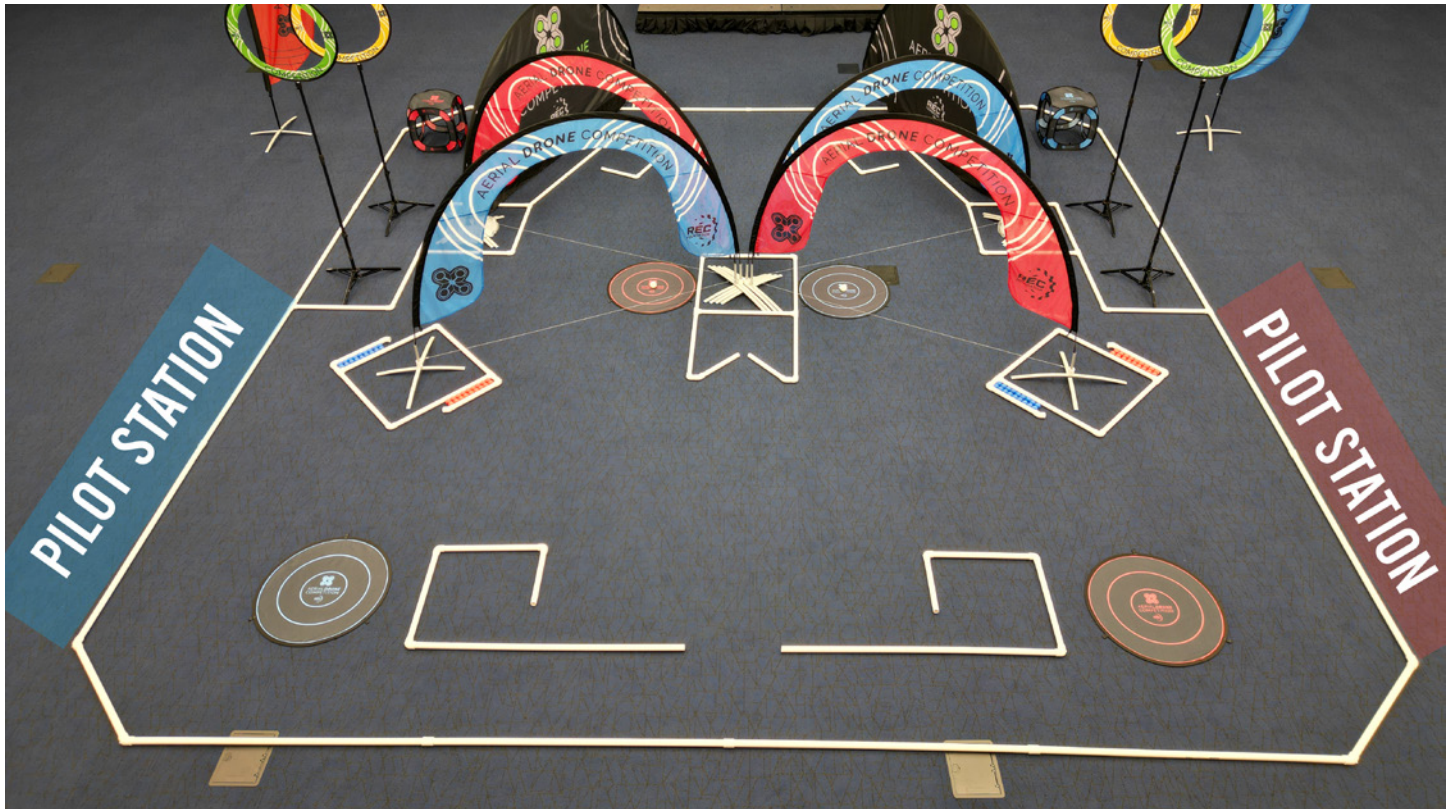
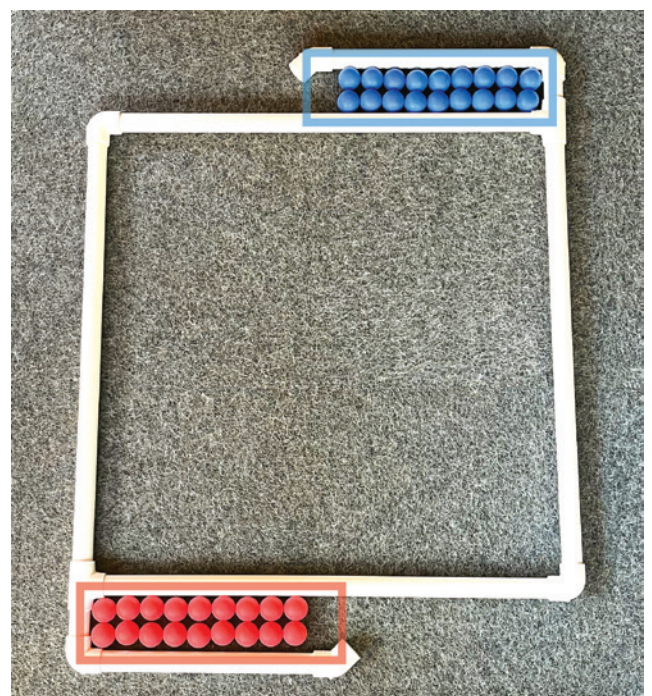


Figure 1.1

Starting Lane

A location on the field in which either red or blue balls begin the match. There are two (2) red and two (2) blue starting lanes. Note: event partners may wish to mark the back edge of each starting lane with red or blue tape/stickers to facilitate field reset between matches.

The starting lane is defined by the planes formed by the inner edge of the PVC pipe border to the inner edge of the 45 degree angle as shown in the image on the right.



Visual Observer Station

One of the two (2) designated regions where the visual observer(s) must remain for the duration of the match. See the image below for the exact boundaries of the Mission 23: Blackout visual observer stations.

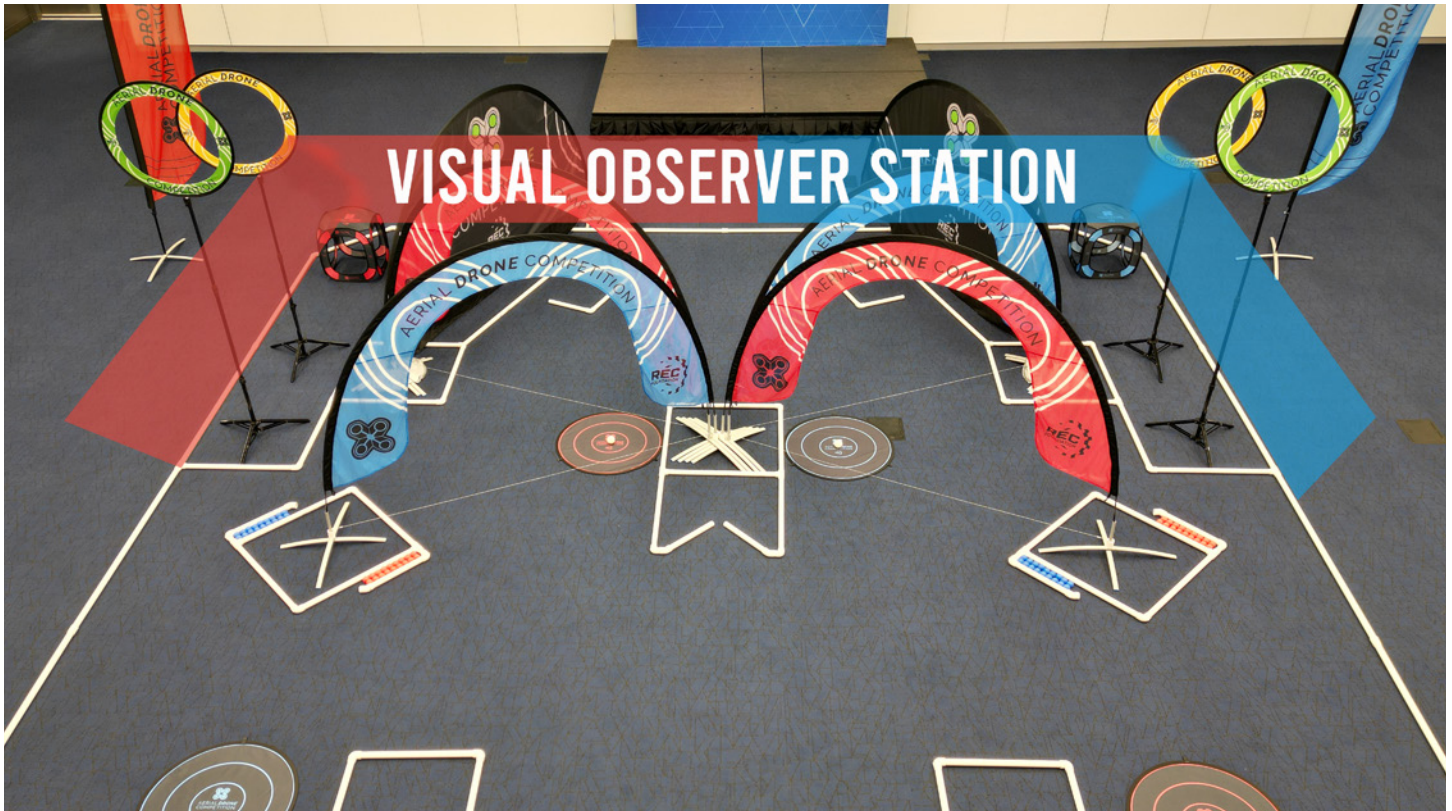


Figure 1.2



SECTION 4

PILOTING TEAMWORK MATCHES

In Piloting Teamwork Matches, two alliances—one red and one blue, made up of two teams each—compete in 2-minute pilot-operated matches.

The object of Piloting Teamwork Matches in Mission 2023: Blackout is to attain a higher score than the opposing alliance by owning goals, scoring bonus balls, and ending the match on a landing pad or in the alliance blackout zone.

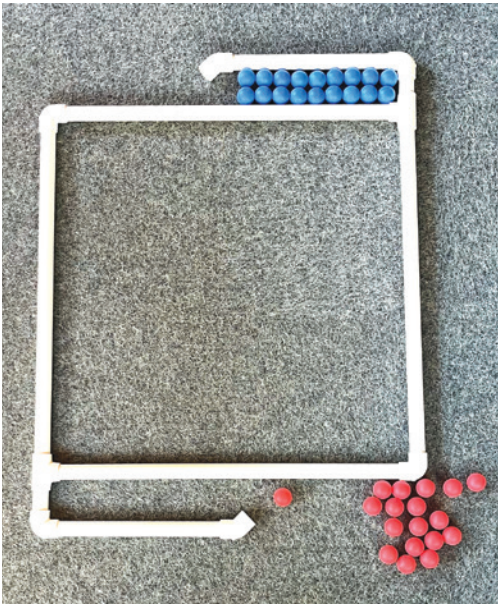
Scoring for Piloting Teamwork Matches

Cleared alliance starting lane	10
Owned goal	10
Bonus ball	11
Drone landed on a landing pad	5
Drone landed on the blackout zone floor	15
Drone landed on the large landing site	25
Drone landed on the small landing site	40

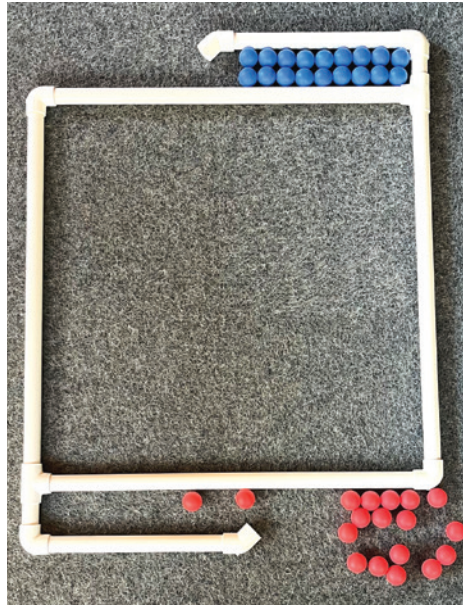
<PS1> Cleared Starting Lane

A Starting Lane is considered cleared when there are no alliance colored balls partially or fully in the starting lane at the end of the match. There are four (4) starting lanes: two (2) for the red alliance and two (2) for the blue alliance.

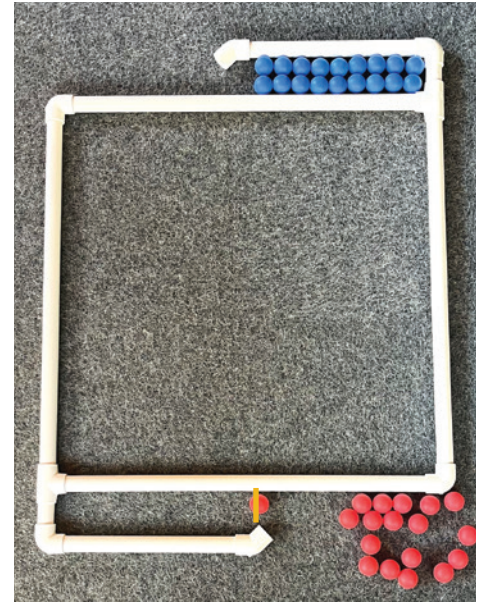
Piloting Teamwork Matches continued



Above: The red lane is considered clear, because all red alliance-colored balls have cleared the starting lane.



Above: This red starting lane is not considered clear, as one or more red alliance-colored balls have not cleared the front of the red lane.



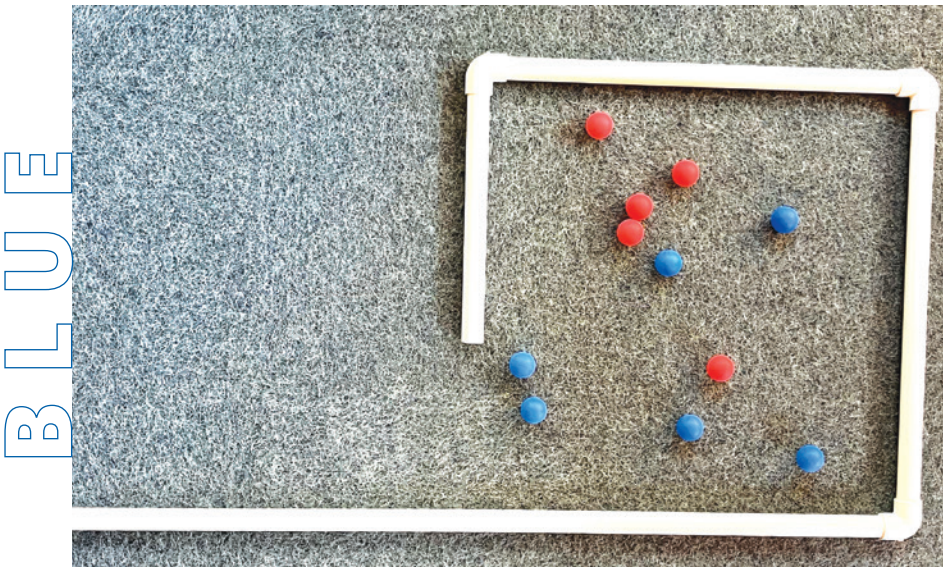
Above: This red starting lane is considered clear, since the last red ball has broken the plane of the inner edge of 45 degree angle



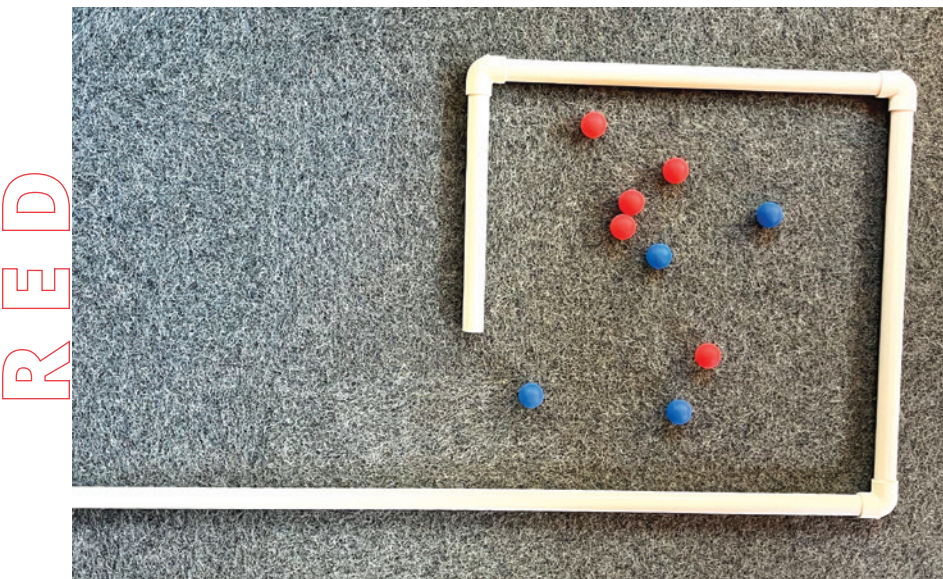
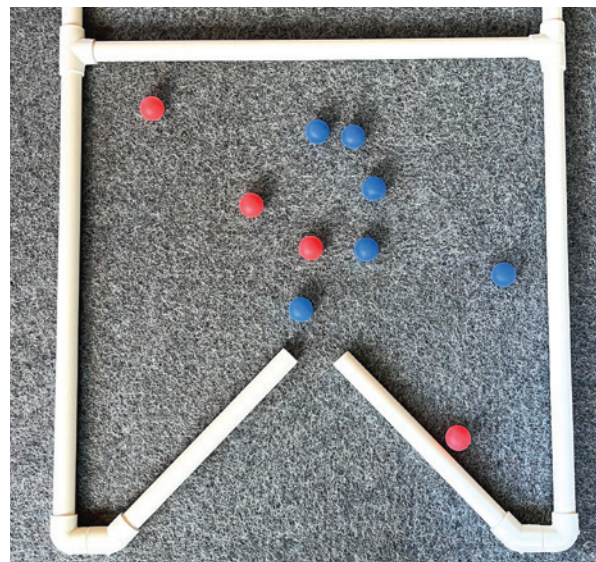
*Piloting Teamwork Matches continued***<PS2> Owned Goal**

The alliance with the higher number of their colored balls scored in a goal at the end of the match will own that goal. There are five (5) goals.

A ball must be partially or fully within the goal and touching the floor to be counted towards an owned goal.

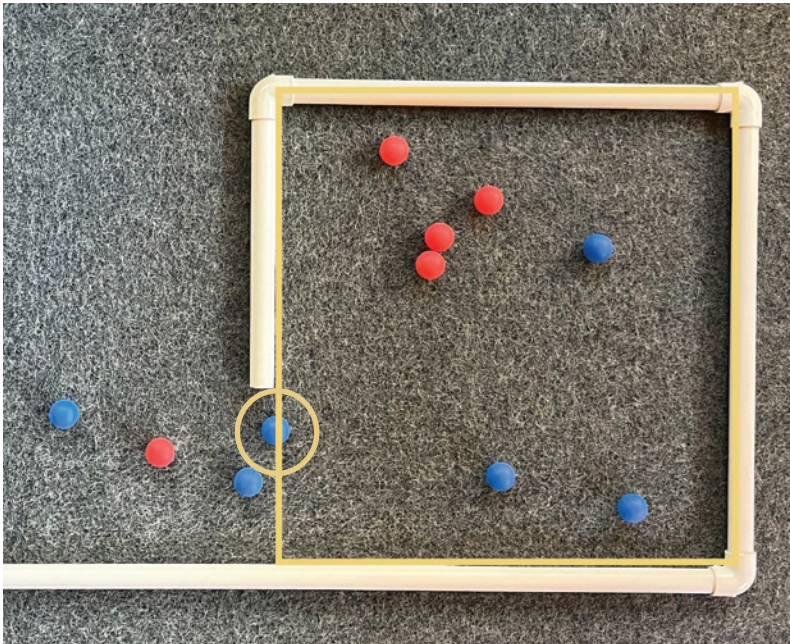


Above: goals are owned by **blue**



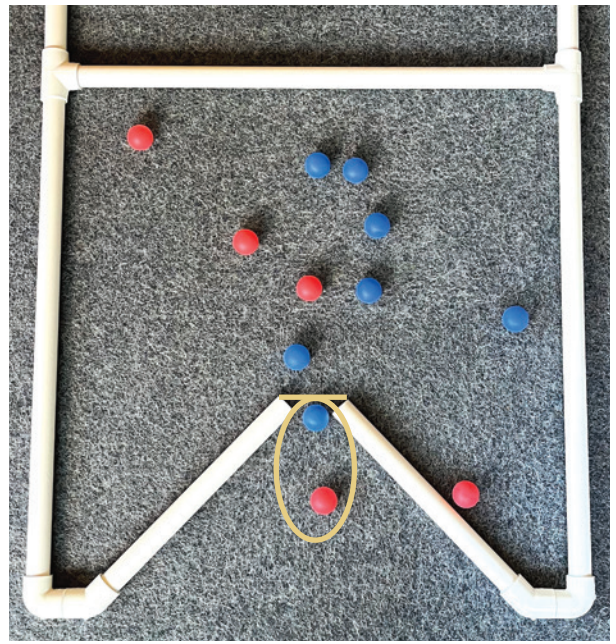
Above: goal is owned by **red**

Piloting Teamwork Matches continued

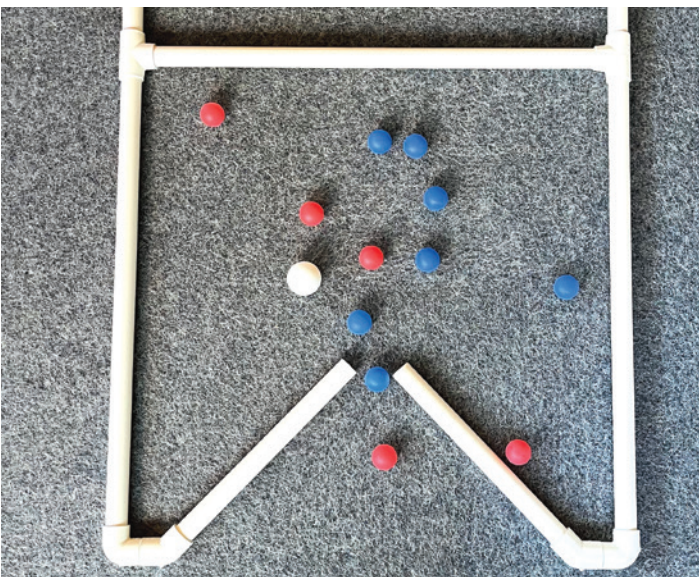


Above: The blue ball (yellow line) is considered scored since it breaks the plane of the inner edge of the PVC border.

There are 4 Red Balls Scored and 4 Blue Balls Scored, therefore no alliance owns this goal.



Above: The two balls in the yellow circle are **NOT** scored because the ball does not break the plane of the inner edge of the PVC pipe. This goal is owned by blue



<PS3> Bonus Ball

If there is one white ball in a goal at the end of the match, the alliance that owns that goal will earn bonus ball points. There are two (2) bonus balls. Only one bonus ball may be awarded in a goal. If the two bonus balls are in the same goal at the end of a match, only one bonus will be awarded. The bonus ball must be partially or fully within the goal and touching the floor to earn the bonus.

Left Image: The goal is owned by blue and has a white bonus ball in the goal, therefore the blue alliance will receive the points for owning the goal and the bonus ball.

*Piloting Teamwork Matches continued***<PS4> Drone Landed on a Landing Pad**

A drone is considered landed on a landing pad if at the end of the match:

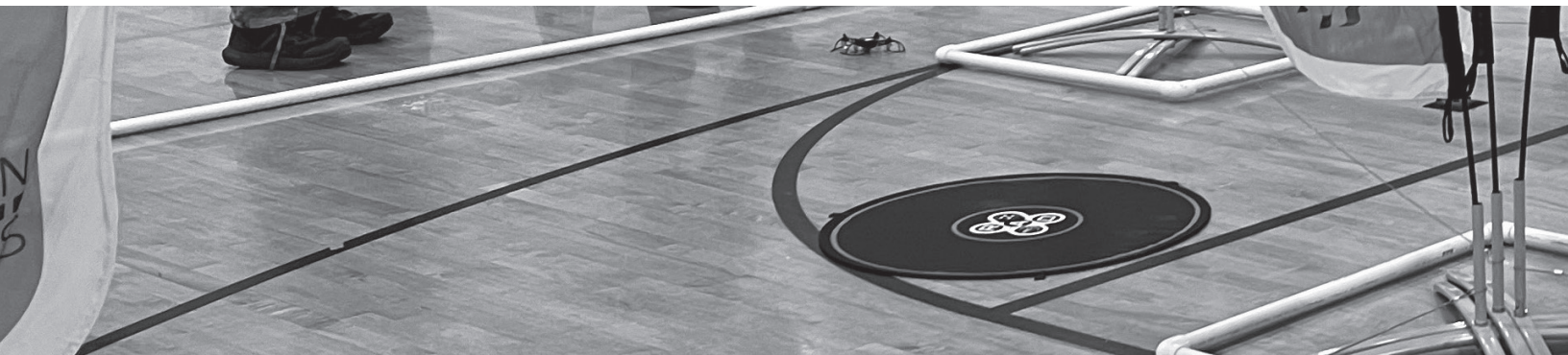
- The Drone is on a landing pad of the same color as its alliance
- The Drone is upright
- The Drone has all 4 propellers attached
- The Drone has all 4 hulls (Parrot Mambo) or all Propeller Guards (CoDrone EDU) attached
- The Drone must be fully on a landing pad of its alliance color before the match timer reaches zero, and may not be touching the floor



Above: This drone **is** considered landed on the landing pad



Above: This drone is **NOT** considered landed on the landing pad because it is not fully on the landing pad and is touching the floor



Piloting Teamwork Matches continued

<PS5> Drone Landed on Blackout Zone Floor

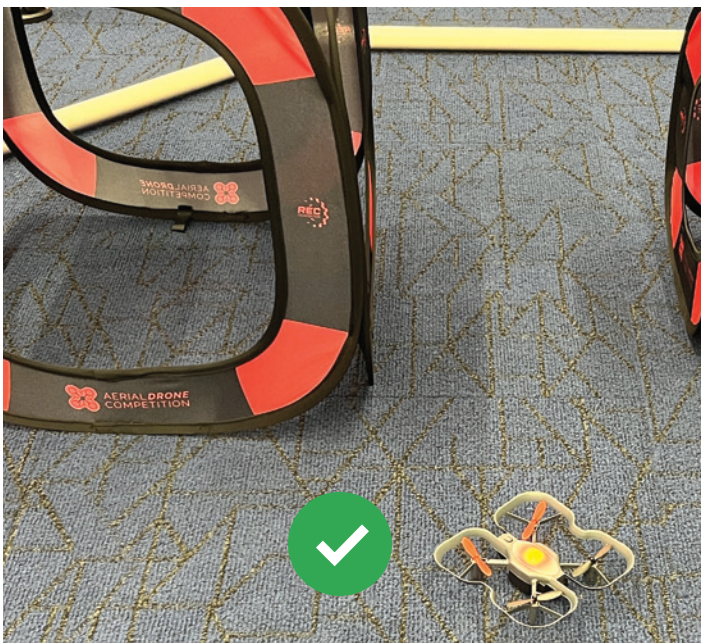
A drone is considered landed on the blackout zone floor if at the end of the match:

The drone is in the blackout zone of their alliance color

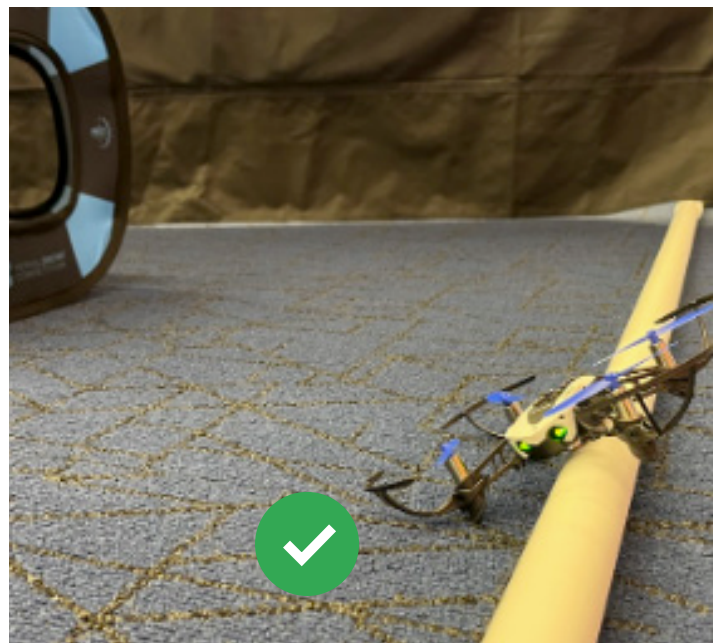
The drone entered the blackout zone during the final 45 seconds of the match by flying through both the green and yellow keyhole gates

The drone is touching the floor within the blackout zone of their alliance

The drone is not touching the floor outside blackout zone



Above: Drone above **IS** considered landed on the Blackout Zone Floor.



Above: Drone above **IS** considered landed on the floor of the blackout zone because it is touching the floor within the blackout zone and is **NOT** touching the floor outside the blackout zone.





<PS6> Drone Landed on a Large Landing Site

A drone is considered landed on the large landing site if at the end of the match:

- The drone is in the blackout zone of their alliance color
- The drone entered the blackout zone during the final 45 seconds of the match by flying through both the green and yellow keyhole gates
- The drone is touching the large landing site
- The drone is not touching the floor
- The drone is not touching the PVC field perimeter



<PS7> Drone Landed on a Small Landing Site

A drone is considered landed on the small landing site if at the end of the match:

- The drone is in the blackout zone of their alliance color
- The drone entered the blackout zone during the final 45 seconds of the match by flying through both the green and yellow keyhole gates
- The drone is touching the small landing site
- The drone is not touching the floor
- The drone is not touching the PVC field perimeter



Note: Landed drones will be scored based on the status of the drone when it comes to rest at the end of the match. For landings in the blackout zone, the drones do not need to be upright to be considered scored. Each landing pad and landing site may hold only one landed drone. If two drones share a landing pad or landing site, only one (1) will be scored. There can be two (2) drones in the blackout landing zone.

PILOTING TEAMWORK MATCH RULE

Piloting Teamwork Matches are played in a tournament format. Each tournament consists of the following:

- 1. Qualification Matches** – Matches composed of alliances competing to earn win point(s).
- 2. Alliance Selection** – Once qualification matches have concluded, alliance captains will select their alliance partner for elimination matches.
- 3. Elimination Matches** – A bracket format of matches used to determine the champion alliance.

<PT1> Qualification Matches

Qualification Matches follow the match schedule. A Qualification Match schedule will be available on the day of competition. The match schedule will indicate alliance partners, match pairings, and alliance colors for each match. For tournaments with multiple fields, the schedule will indicate which field each match will take place on. The match schedule is subject to change at the event partner's discretion.

<PT2> Qualification Match Rankings

Qualification Matches are used to determine the ranking for alliance selection. Qualification Match alliances are randomly assigned. The quantity of Qualification Matches is determined by the event partner. All teams will be ranked according to the same number of Qualification Matches.

Team rank is determined by the following criteria:

1. Average number of win point(s) earned per match
2. Highest average score
3. Highest match score
4. 2nd highest match score
5. Random electronic draw

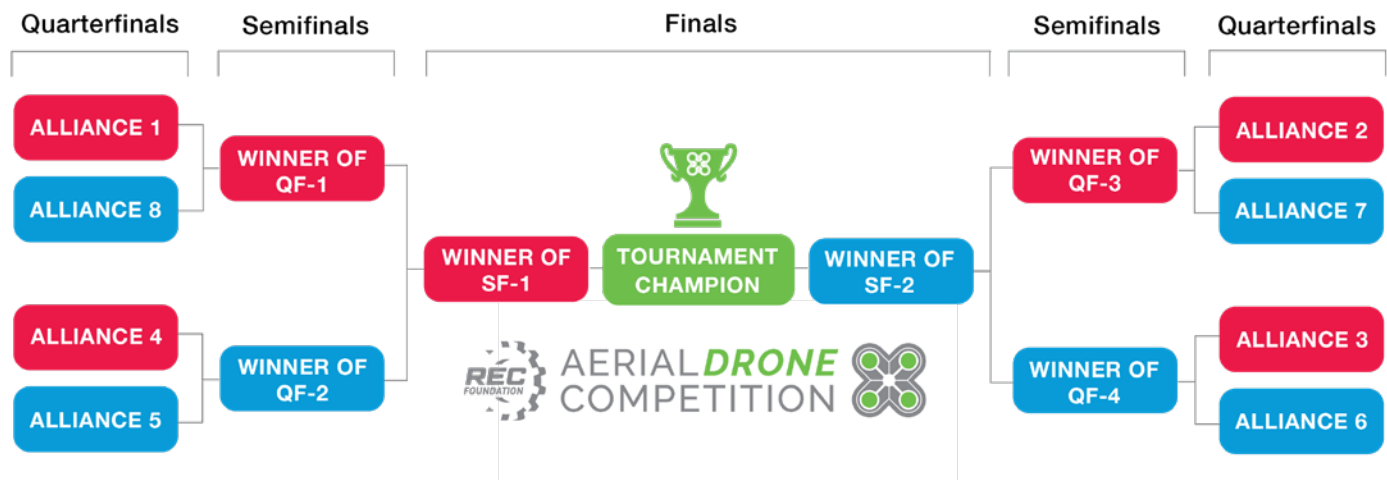
<PT3> Alliance Selection

The process of choosing the alliances for the Elimination Matches proceeds as follows:

1. The highest-ranked team at the end of Qualification Matches becomes the first alliance captain.
2. The alliance captain invites another team to join their alliance.
3. The invited team either accepts or declines as outlined in <PT6>.
4. The next highest-ranked team at the end of Qualification Matches becomes the next alliance captain.
5. Alliance captains continue to select their alliances in this order until all alliances are formed for the Elimination Matches.

*Piloting Teamwork Match Rule continued***<PT4> Elimination Matches**

Elimination Matches are played using a bracket format. Byes are awarded when fewer alliances are used.

**<PT5> Send a team representative to alliance selection**

Each team must send one (1) team representative for alliance selection. If no team representative reports to alliance selection, their team will be ineligible to participate in the alliance selection process.

<PT6> Each team may only be invited once to join an alliance

If a team representative declines an alliance captain's invitation during alliance selection, that team is no longer eligible to be selected by any other alliance captain. However, they are still eligible to play Elimination Matches as an alliance captain.

<PT7> Each alliance gets one 'time out'

Each Alliance may request one (1) 'time out' during the elimination bracket between Elimination Matches, as permitted by the Head Referee and event partner. Alliances may not use their 'time out' during a match.

SECTION 5: AUTONOMOUS FLIGHT SKILLS MATCHES

In Autonomous Flight Skills matches, a single team has 60 seconds of autonomous drone operation to score points by lifting off, navigating through arch and keyhole gates, cleared balls from the starting lane, and ending the match on a landing pad or in the alliance blackout zone. All drone commands are pre-coded by the team, with no pilots allowed.

Each Autonomous Flight Skills match uses one half (½) of a standard competition field with some modifications as noted below in <AF3>.

Scoring for Autonomous Flight Skills Matches

Successful liftoff	5
Navigating under an arch gate	5
Navigating through a keyhole gate	5
Cleared ball from starting line	1
Drone landed on a landing pad	5
Drone landed on the blackout zone floor	15
Drone landed on the large landing site	25
Drone landed on the small landing site	40

<AFS1> Liftoff

Teams will receive 5 points if they have successfully powered their drone so that no part of the drone is touching the floor.

<AFS2> Navigation

Teams will receive 5 points for going under each of the two (2) arch gates on their side of the field. Points will only be awarded for the first time you go under the arch gate (i.e. if you go under an arch gate multiple times, you will only receive points for the first time).

Teams will receive 5 points for going through each of the two (2) keyhole gates on their side of the field. Points will only be awarded for the first time you go through the keyhole gate (i.e. if you go through a keyhole gate multiple times, you will only receive points for the first time).

<AFS3> Launch Balls

Teams will receive 1 point for each ball that is cleared from the starting lane. A ball is considered cleared when it is not partially or fully in the starting lane at the end of the match.

<AFS4> Landed Drones

See <PS4> <PS5> <PS6> and <PS7> for definitions of landed drones in Section 4: Piloting Teamwork matches.

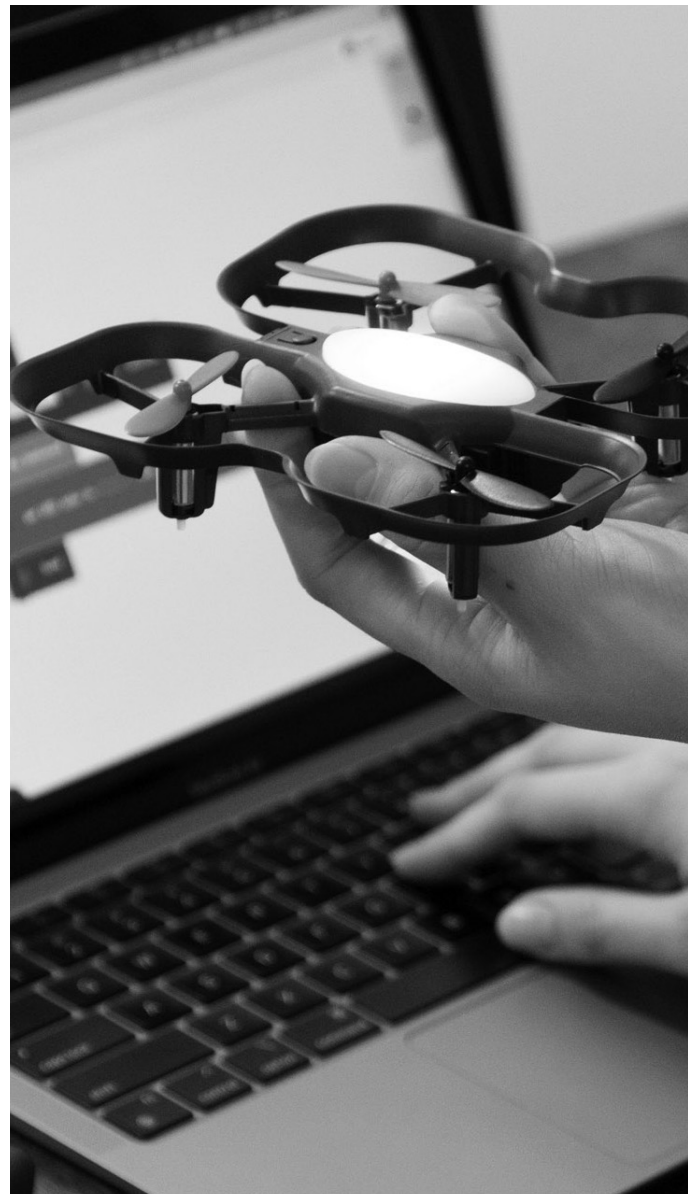
AUTONOMOUS FLIGHT SKILLS MATCH RULES

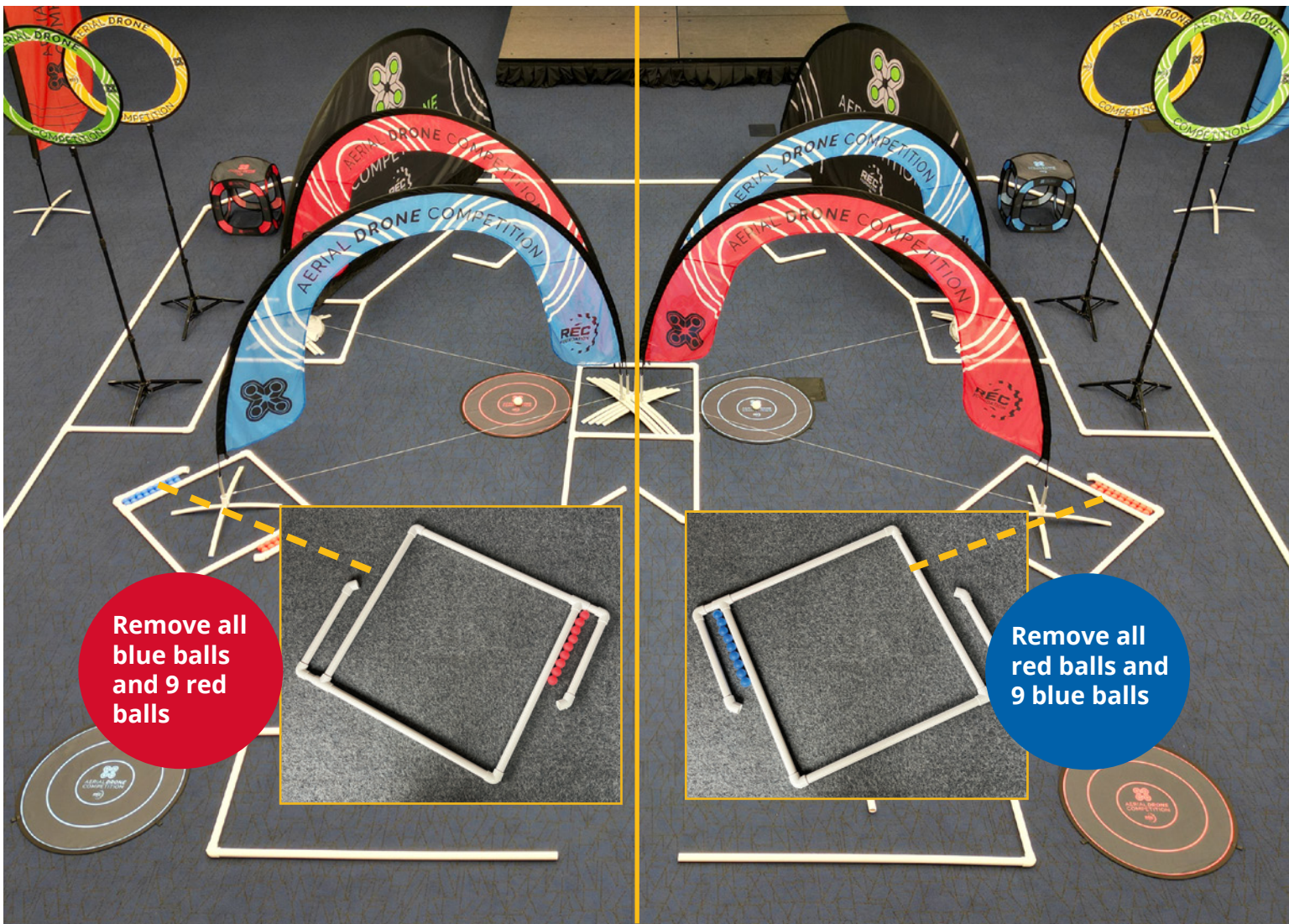
<AF1> Other game rules apply in most cases.

All rules in sections 6-9 of this game manual apply to Autonomous Flight Skills matches unless otherwise specified.

<AF2> Autonomous means “no humans.”

During an Autonomous Flight Skills match, drones must operate entirely using pre-written programming instructions. Team members are permitted to start their pre-written instructions from the programming device but are not allowed to interact with the drone in any other way.





<AF3> Skills field layout. Autonomous Flight Skills matches are played on one half of the 24'x 24' field with the following modifications:

- Both white balls are removed from the field
- All 18 balls are removed from the starting lane closest to the pilot station
- 9 balls are removed from the starting lane closest to the middle of the field
- 9 remaining balls are placed in along the edge of the longer PVC pipe in the starting lane as shown above.

Autonomous Flight Skills Match Rules continued

<AF4> Stay on your side. Drones are not permitted to fly outside their half of the field during an Autonomous Flight Skills match.

<AF5> All flight team members must remain in the pilot station. During Autonomous Flight Skills matches, the pilot, co-pilot, and visual observer must remain in the pilot station.

<AF6> Blackout zones are protected. Teams may only enter the blackout zone by flying through both green and yellow keyhole gates on their side of the field. Teams must pass through the green keyhole gate first, then the yellow keyhole gate second.

Teams may enter the blackout zone at any time during an Autonomous Flight Skills match.

<AF7> Autonomous Flight Skills ranking at an event. For each Autonomous Flight Skills match, teams are awarded a score based on the standard rules and scoring rules. Teams will be ranked based on their highest skills match.

Breaking Ties

In a scenario where two (2) or more Teams are tied for the highest Skills Match score, the following hierarchy will break ties:

1. Team's highest score
2. Team's second-highest score
3. Team's 3rd highest score
4. Team's match stop time for the team's highest score
5. Team's match stop time for the team's 2nd highest score
6. Team's match stop time for the team's 3rd highest score

<AF8> Autonomous Flight Skills rankings globally. Teams will be ranked globally based on their Autonomous Flight Skills scores from tournaments and leagues that upload results to RobotEvents.com, according to the following tiebreakers.

In a scenario where two (2) or more teams are tied for the highest Skills Match score, the following hierarchy will break ties:

1. Team's highest event score
2. Team's 2nd-highest event score
3. Team's 3rd-highest event score
4. Match stop time for the team's highest event score
5. Match stop time for the team's 2nd-highest event score
6. Match stop time for the team's 3rd-highest event score

Autonomous Flight Skills Match Rules continued

<AF9> Match stop time. The time remaining in the Autonomous Flight Skills match at the moment the drone is landed is recorded as the match stop time. If a drone fails to land, the match stop time is recorded as zero (0).

<AF10> Autonomous Flight Skills match schedule. Each Team will get the opportunity to play three (3) Autonomous Flight Skills matches.



Note: Teams should review the event agenda and their match schedule to determine when the best possible time is to complete their Autonomous Flight Skills matches. If the Autonomous Flight Skills area closes before a team has completed all three (3) matches, but it is determined that there was adequate time given, then the team will automatically forfeit those unused matches.

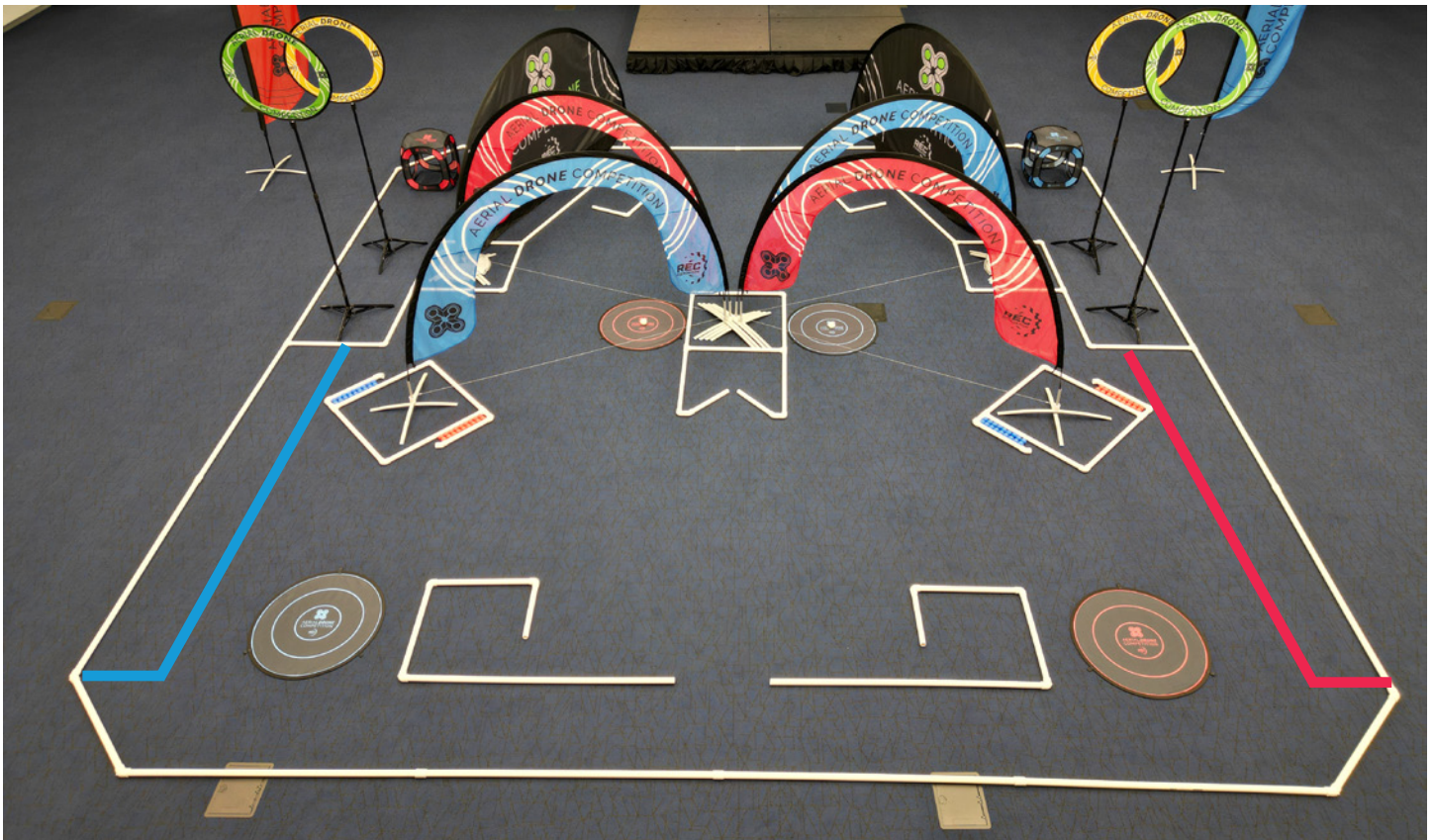


SECTION 6: SPECIFIC GAME RULES

<SG1> Starting position

Prior to the start of each match, each drone must be placed such that it is:

- Contacting the floor inside the field perimeter adjacent to the appropriate alliance pilot station
- Within 12 inches of the field perimeter
- Not contacting another drone



<SG2> Blackout zones are protected

Teams may only enter their blackout zone during the last 45 seconds of a match. To enter the blackout zone, a drone must fly through their alliance's green and yellow keyhole gates. Teams must pass through the green keyhole gate first, then the yellow keyhole gate second. Teams that violate this rule must stop all flight except to exit the blackout zone.

Teams may **NOT** enter the blackout zone of the opposing alliance.

<SG3> Pilot stations

During a match, the pilot and co-pilot must remain in their alliance's pilot station, which is approximately 10 feet long and 2 feet deep as shown in the image. (On page 18, Figure 1.1)

<SG4> Visual observer stations

During a match, the visual observer must remain in their alliance's visual observer station, which is approximately 20 feet long and 2 feet deep as shown in the image. (On page 19, Figure 1.2)

<SG5> Flight rule

Teams are allowed to fly under or over the red and blue arch gates to maneuver around the field. For safety reasons, drones must remain below an altitude of 10 feet at all times.

<SG6> Keep balls in the field

Balls that leave the field will not be returned. Teams may not intentionally remove balls from the field. Balls may leave the field accidentally, however, doing so intentionally or repeatedly would be a violation of this rule.

<SG7> No Electronic Communication Devices allowed.

Flight team members may not bring/use any sort of electronic communication device into/in the pilot station or visual observer station. Devices with communication features turned off (e.g., a phone in airplane mode) are allowed.

SECTION 7: GENERAL GAME RULES

<G1> Treat everyone with respect

All students and adults associated with a team are expected to conduct themselves in a respectful and positive manner while participating in the Aerial Drone Competition. If team members are disrespectful or uncivil to staff, volunteers, or fellow teams at an event, the team may be disqualified from their current or upcoming match. Judges may also consider team conduct and ethics when determining awards.

In all aspects of the Aerial Drone Competition, the students make the decisions and “do the work” with adult mentorship. The REC Foundation community prides itself on being a positive learning environment where no one is bullied, harassed, or berated. Teams should avoid placing unnecessary stress upon students and event volunteers; instead, challenging situations are viewed as teachable moments to model positive behaviors and good sportsmanship.

General Game Rules continued

This rule exists alongside the REC Foundation Code of Conduct. Violation of the Code of Conduct can be considered a violation of and can result in disqualification from a current match, an upcoming match, an entire event, or (in extreme cases) an entire competition season. The Code of Conduct can be found at <https://www.roboticseducation.org/codeofconduct>.

<G2> The Aerial Drone Competition is student-centered

The Aerial Drone Competition is a student-centered program. Adults may assist students in urgent situations, but adults may never work on or program a drone without students on that team being present and actively participating. Students must be prepared to demonstrate an active understanding of their drone and programming to judges or event staff. This rule operates in tandem with the REC Foundation Student-Centered Policy, which is available on the REC Foundation website for teams to reference throughout the season: <https://www.roboticseducation.org/studentcenteredpolicy>. Violation of this rule could be considered a violation of rule <G1> and/or the REC Foundation Code of Conduct.

<G3> Use common sense

When reading and applying the rules in this document, please remember that common sense always applies in the Aerial Drone Competition.

For example:

- If there is an obvious typographical error this does not mean that the error should be taken literally until corrected in a future update.
- When in doubt, if there is no rule prohibiting an action, it is generally legal. However, if you have to ask whether a given action would violate <S1>, <G1>, or <T1>, then that's probably a good indication that it is outside the spirit of the competition.
- In general, teams will be given the "benefit of the doubt" in the case of accidental or edge-case rules infractions. However, there is a limit to this allowance, and repeated or strategic infractions will still be penalized.

<G4> Practice sportsmanship.

Strategies aimed at forcing another team to violate a rule are not allowed. The best competition is when everyone is performing at their best. Sportsmanship also means showing up to every match and competing at your highest level.

*General Game Rules continued***<G5> The drone must represent the skill level of the team**

The drone must represent the skill level of the team. Each team must include pilot(s), programmer(s), and visual observer(s). No student may fulfill the role of pilot or programmer for more than one Aerial Drone Competition team in a given competition season. Students may fulfill the role of visual observer for more than one team.

1. Team members may move from one team to another for non-strategic reasons outside of the team's control.
 - a. Examples of permissible moves may include, but are not limited to, illness, changing schools, conflicts within a team, or combining/splitting teams.
 - b. Examples of strategic moves in violation of this rule may include, but are not limited to, one programmer "switching" teams in order to write programs for multiple drones, or one student piloting the drone for multiple teams.
 - c. If a student leaves a team to join another team, <G5> still applies to the students remaining on the previous team. For example, if a programmer leaves a team, then that team's drone must still represent the skill level of the team without that programmer. One way to accomplish this would be to ensure that the programmer teaches or trains a replacement programmer in their absence.
2. When a team qualifies for a Championship event, the students on the team attending the Championship event are expected to be the same students on the team that was awarded the spot. Students can be added as support to the team, but may not be added as pilots or programmers for the Team.
 - a. An exception is allowed if one (1) pilot and/or one (1) programmer on the team cannot attend the event. The team can make a single substitution of a pilot or programmer for the Championship event with another student, even if that student has competed on a different team. This student will now be on this new team and may not substitute back to the original team. Violations of this rule will be evaluated on a case by-case basis, in tandem with the REC Foundation Student-Centered Policy as noted in <G2>, and the REC Foundation Code of Conduct as noted in <G1>.



Note: Event partners should keep <G3> in mind and use common sense when enforcing this rule. It is not the intent to punish a team who may change team members over the course of a season due to illness, changing schools, conflicts within a team, etc. Event partners and referees are not expected to keep a roster of any student who has ever piloted for a day. This rule is intended to block any instance of loaning or sharing team members for the sole purpose of gaining a competitive advantage.

*General Game Rules continued***<G6> Be prepared to play.**

Teams must be prepared to play when they bring their drones to the field. For example, teams must ensure that their batteries are charged and their drone controller is paired with their drone before placing the drone on the field.

<G7> Keep your drone together.

Drones may not intentionally detach parts during the match.

<G8> Drones cannot physically interact with the opposing alliance.

A drone may not physically interfere with the opposing alliance by any means. Violations of this rule will result in disqualification.

<G9> Drones cannot directly interfere with humans.

Drones and attachments are not allowed to directly interfere with the opposing alliance's team members. This includes but is not limited to interfering with the vision of the opposing alliance's team members.

<G10> Stay off the floor.

Drones and attachments are not allowed to drag on the floor, make prolonged contact with the floor, or employ strategies that utilize repeated contact with the floor.

<G11> Flight team members are the only team members allowed at the field.

During a match, each team may have

1. One (1) pilot and one (1) co-pilot in the pilot station
2. One (1) visual observer in the visual observer station

<G12> Stay out of the field during the match.

Once a drone is placed in the prematch set up per <SG1>, team members must stay out of the field until the Head Referee gives the all clear signal.

<G13> Offensive drones get the "benefit of the doubt."

In the case where referees are forced to make a judgment call regarding a destructive interaction between a defensive and offensive drone, or an interaction that results in a questionable rules violation, the referees will err on the side of the offensive drone. Note that in the context of an Aerial Drone Competition match, an offensive drone will be actively attempting to score points and a defensive drone will generally be attempting to de-score points or block the movement of an opponent.

<G14> You can't force an opponent into a penalty.

Intentional strategies that cause an opponent to violate a rule are not permitted, and will not result in an infraction on the opposing alliance.

*General Game Rules continued***<G15> Be prepared for minor field variance.**

Field element positions and tolerances may vary by $\pm 3''$ unless otherwise specified. Game element tolerances may vary by $\pm 0.1''$ and 10 grams.

<G16> Match replays are allowed, but rare.

Match replays (i.e., playing a match over again from its start) are at the discretion of the event partner and Head Referee, and will only be issued in the most extreme circumstances. An example of an extreme circumstance would be the event venue losing power during a match.

<G17> It's not over until it's over.

Scores will be calculated for a match immediately after the match once all balls and drones have come to a rest.

<G18> The Q&A system is an extension of this game manual.

All teams must adhere to all Aerial Drone Competition rules as they are written and must abide by the stated intent of the rules. Every team has the opportunity to ask for official rules interpretations in the Aerial Drone Competition Question & Answer system.

All responses in this Q&A system should be treated as official rulings from the Aerial Drone Competition Game Design Committee, and they represent the correct and official interpretation of the Aerial Drone Competition rules. The Q&A system is the only source for official rulings and clarifications. The Aerial Drone Competition Challenge Question & Answer system can be found at

<https://www.robotevents.com/ADC/2022-2023/QA>.



SECTION 8: THE TOURNAMENT

<T1> The Head Referee has ultimate authority on ruling decisions during the competition.

- a. Scorekeeper Referees score the match, and may serve as observers or advisers for the Head Referees, but may not determine any rules or infractions directly.
- b. When issuing a major violation or minor violation to a team, The Head Referee must provide the rule number of the specific rule that has been violated.
- c. Violations of the REC Foundation Code of Conduct may involve additional escalation beyond the Head Referee's initial ruling, including (but not limited to) investigation by an REC Foundation representative. <G1>, <G2>, and <G5> and are the only rules for which this escalation is likely to be required.
- d. Event partners may not overrule a Head Referee's decision.



Note from the Aerial Drone Competition GDC

The rules contained in this game manual are written to be enforced by human Head Referees. Many rules have “black-and-white” criteria that can be easily checked. However, some rulings will rely on a judgment call from this human Head Referee. In these cases, Head Referees will make their calls based on what they and the Scorekeeper Referees saw, what guidance is provided by their official support materials (the game manual and the Q&A), and most crucially, the context of the match in question.

The Aerial Drone Competition does not have video replay, our fields do not have absolute sensors to count scores, and most events do not have the resources for an extensive review conference between each match.

When an ambiguous rule results in a controversial call, there is a natural instinct to wonder what the “right” ruling “should have been,” or what the GDC “would have ruled.” This is ultimately an irrelevant question; our answer is that when a rule specifies “Head Referee’s discretion” (or similar), then the “right” call is the one made by the Head Referee in the moment. The Aerial Drone Competition GDC designs games, and writes rules, with this expectation (constraint) in mind.

<T2> Head Referees must be qualified

Head Referees must have the following qualifications.

1. Be at least 20 years of age
2. Be approved by the event partner
3. Possess the following attributes:

Thorough knowledge of the current game and rules of play

- Effective decision making
- Attention to detail
- Ability to work effectively as a member of a team
- Ability to be confident and assertive when necessary
- Strong communication and diplomacy skills

Head Referees

- May not review any photo or video match recordings to determine a score or ruling
- Are the only people permitted to explain a rule, disqualification, or warning to a team
- Must give the rule number of the rule violated when issuing a disqualification or warning to a team

<T3> The flight team members are permitted to immediately appeal the Head Referee's ruling

If the flight team members wish to dispute a score or ruling, the pilot and co-pilot must stay in the pilot station until the Head Referee talks with them; the Visual Observer may move to the pilot station.

The Head Referee may choose to meet with the flight team members at another location and/or at a later time so that the Head Referee has time to reference materials or resources to help with the decision. Once the Head Referee announces that their decision has been made final, the issue is over and no more appeals may be made. The event partner may not overrule the Head Referee's decision.

Violations of this rule may result in the team being disqualified from the match in question and/or the event and is up to the discretion of the Head Referee.

<T4> Students must be accompanied by an adult

No student may attend an Aerial Drone Competition event without a responsible adult supervising them. The adult is subject to all rules of the Aerial Drone Competition and must be present in case of an emergency.

SECTION 9: SAFETY RULES

<S1> No flying of drones except in designated areas.

Teams may not fly their drones in any area that is not designated as a flight zone and must adhere to the specific rules of that flight zone (e.g., where to stand when piloting the drone and when it is okay to retrieve the drone).

All other areas, including but not limited to parking lots, fields, hallways, etc. are no-fly zones before, during, and after the event. Violations will result in a team being disqualified from the event and the team will be required to remove the drone from the venue.

<S2> Stay in the pilot station or visual observer stations.

Once a drone is placed in a legal starting position at the beginning of a match, pilots and visual observers must return to and stay in their pilot station or visual observer stations until the referee gives the all clear.

<S3> Control your drone.

Teams are responsible for maintaining control of their drone at all times.

<S4> Virtual ceiling.

If possible, teams should use software to set a virtual ceiling to ten (10) feet or lower.

<S5> Fly within the flight zone.

Drones must not pass outside of the flight zone. Violations of more than five (5) seconds will result in a team receiving an immediate grounding. If a referee determines that there is an immediate safety issue, grounding will be commanded without a five (5) second countdown.

<S6> Batteries must be charged before launch.

Teams will not be permitted to launch if the drone lights are red, indicating a low battery level. Teams are required to check the battery levels prior to a match to ensure that the drone is ready for flight before their match.

<S7> Wear safety glasses.

Team members are required to wear safety glasses in and around the flight zone.



SECTION 10: THE DRONE

<D1> Teams must use the Parrot Mambo or CoDrone EDU as their stock drone.

All teams must use the Parrot Mambo or CoDrone EDU as their starting point. While modifications and attachments are permitted, teams must ensure that replacement motors and batteries are functionally identical to the equipment on the stock drone.

Teams are allowed to bring as many drones to a competition as they would like, but only one (1) may be brought from the pit to the playing field for each Match.

<D2> Drones and attachments must pass inspection.

Every drone is required to pass inspection before being allowed to compete.

<D3> Drones must be safe.

Drones and attachments must not:

- Damage the field or game elements
- Damage other drones
- Pose an unnecessary risk of entanglement

<D4> Drones must utilize four (4) motors with propellers attached.

Drones must use four (4) motors with all propellers installed correctly. Drones may not use more or fewer than four (4) motors.

<D5> Drones must utilize stock drone electronics.

Drones may not remove or otherwise modify any stock drone electronics.

<D6> Protect your props.

Teams must have adequate physical guards for their propellers. The stock drones include examples of adequate prop guards.

<D7> Teams must clearly identify their alliance during a match.

Teams must identify their alliance color for each match following the guidelines given by the event partner.

Possible methods include:

- Light on the Co-Drone EDU
- Snap-on building blocks on Parrot Mambo
- Colored prop guards on Parrot Mambo



Note: Because the CoDrone EDU comes standard with 2 red propellers, using propellers as an alliance indicator is not a valid option. Teams must find another way to identify alliance color.



Drone modifications and attachments should be colored in a way that does not interfere with a referee's ability to identify the team's alliance.

<D8> Drone customization is allowed.

Teams are permitted to customize their drones as long as all rules in this game manual are followed. This rule is intentionally open-ended. Put simply, most plastic components of the stock drone can be customized by most means, including gluing the hulls onto the Parrot Mambo drone. Customizations that present a safety hazard or prohibit sustained flights are not allowed.

<D9> Attachments are allowed.

Custom attachments are allowed as long as all rules in this game manual are followed. This rule is intentionally open-ended. Attachments that present a safety hazard or prohibit sustained flight are not allowed.

<D10> Only registered teams may compete in Aerial Drone Competition Mission 2023: Blackout.

To participate in an official Aerial Drone Competition event, a team must first register at www.robotevents.com.

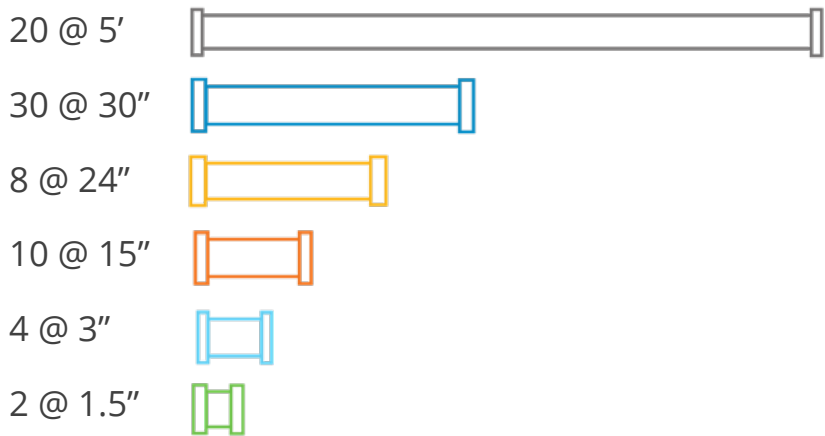


SECTION 11: FIELD ASSEMBLY

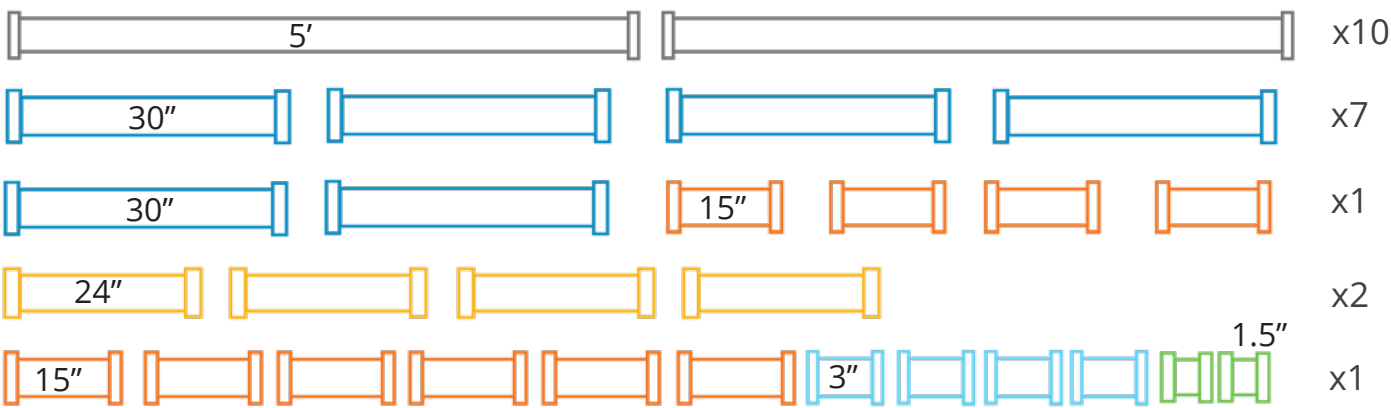
INSTRUCTIONS

To create the Field Perimeter, you will need twenty one (21) 10 ft long, 1 inch diameter, PVC pipes cut to the following lengths.

1" PVC Lengths (21 Total 10')



Cut Length



In addition, the following 1 inch PVC connectors are also required.



10 - 1" Couplings



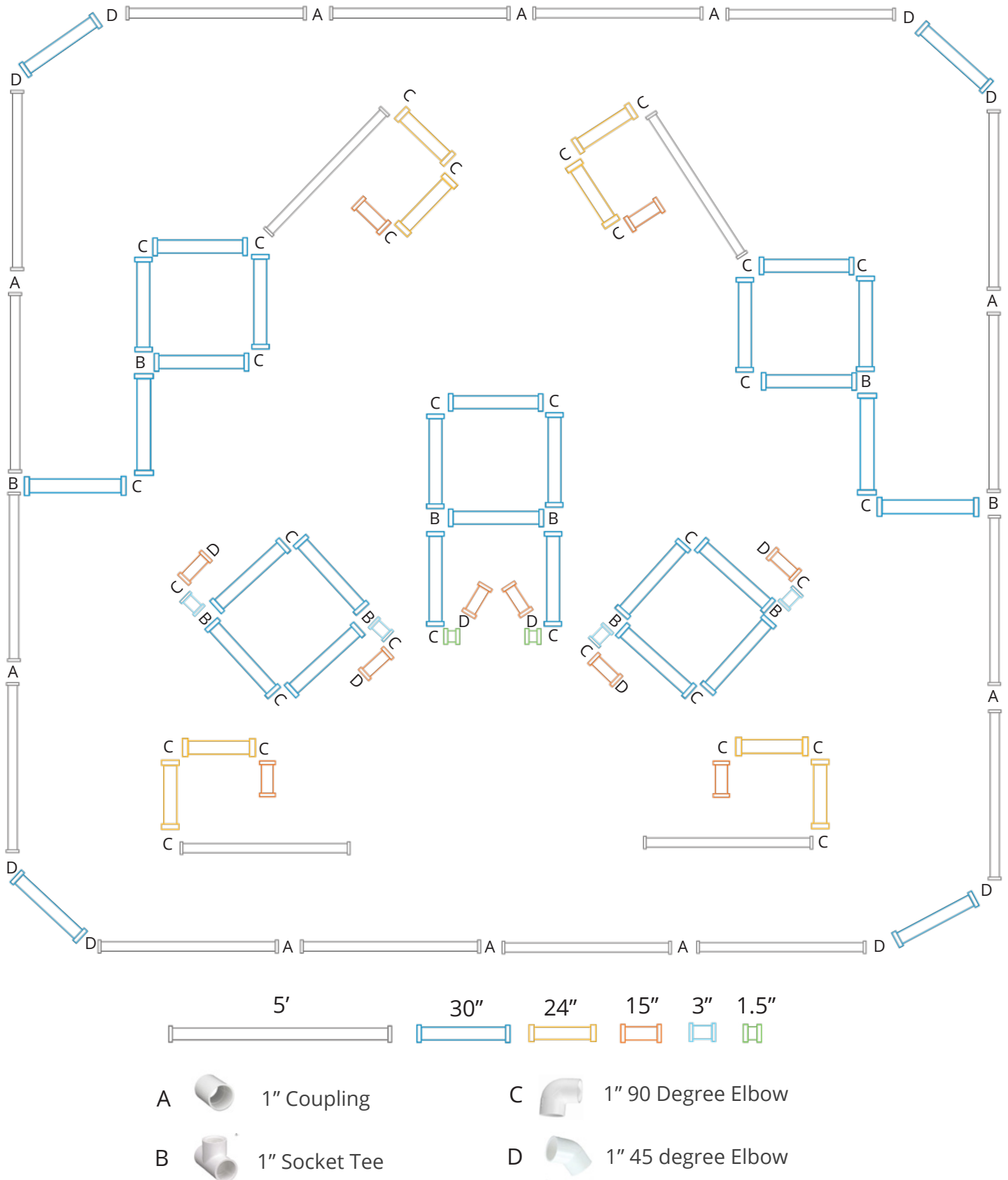
10 - 1" Socket Tees



32 - 1" 90 Degree Elbow



14 - 1" 45 degree Elbow



Note: The above is for reference only and not to scale.

SECTION 11: FIELD ASSEMBLY

INSTRUCTIONS

The following images will help with where to place elements on the field. Reminder: <G15> Be prepared for minor field variance. Your field and elements should match these images as closely as possible, but due to potential differences in cutting and assembly teams should be prepared for some level of variance between events. Field element positions and tolerances may vary by $\pm 3''$ unless otherwise specified. Game element tolerances may vary by $\pm 0.1''$ and 10 grams.

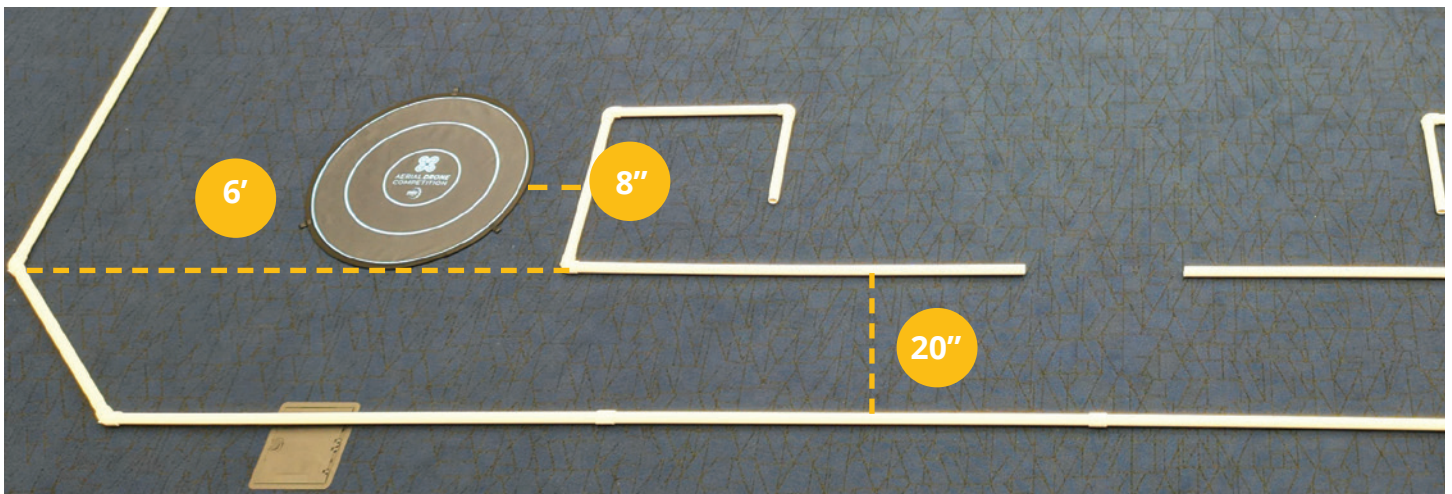


Figure 1.3 - Keyhole Gates and Landing Zones Placements

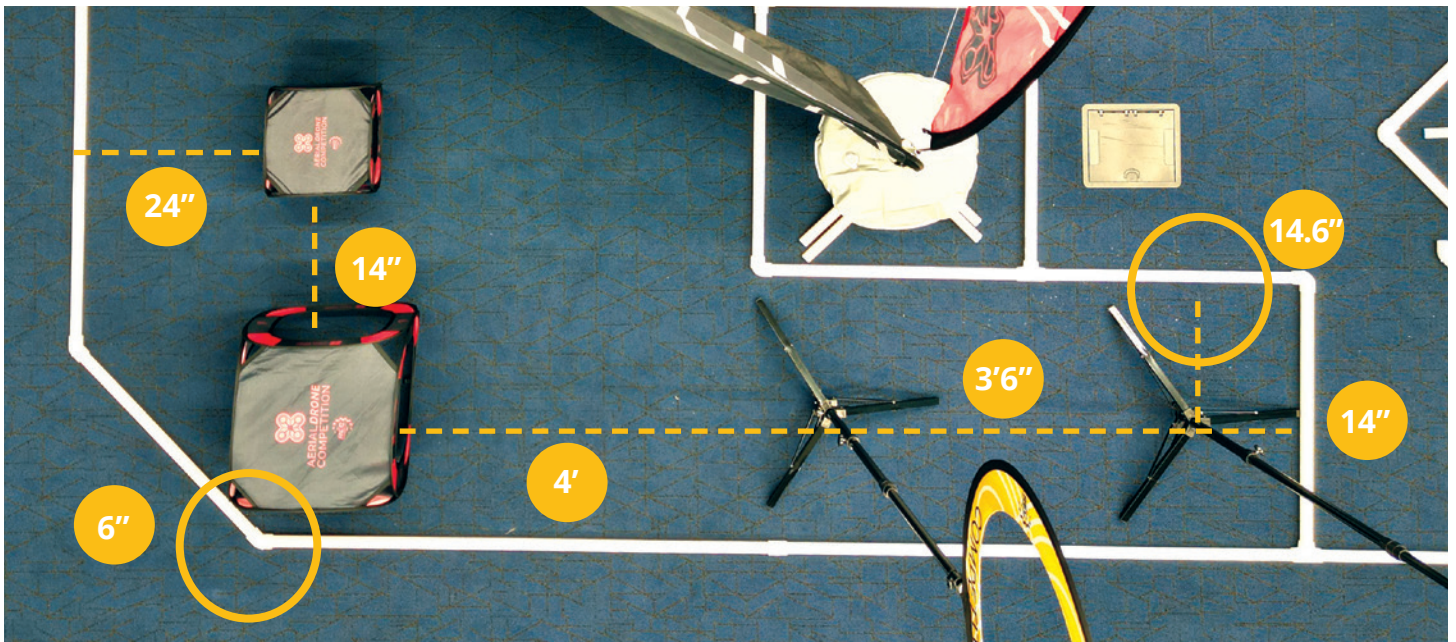


Figure 1.4 - Front Goals and Landing Pad Placement. Above: 6" from the inside of the PVC to the outer edge of the box

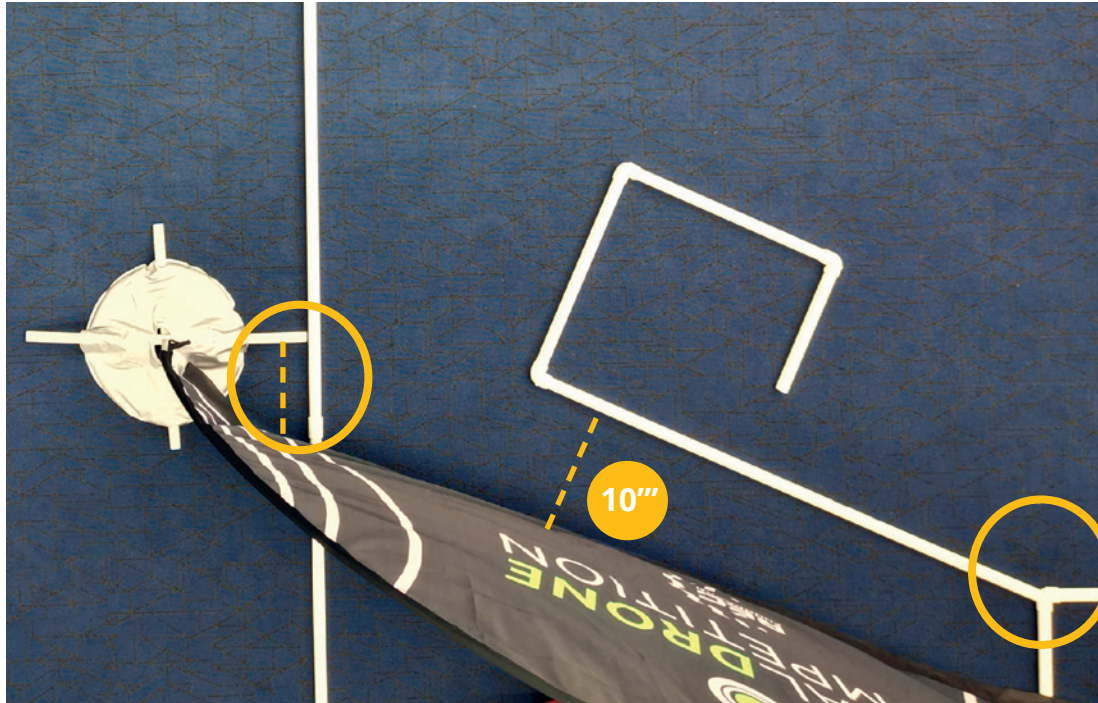


Figure 1.5
Left: Inside the circle show 8" from the edge of the stand to the inside of the PVC Coupler

Right: Inside the circle this goal is not "connected" at this point, but rather touches the 90 degree corner

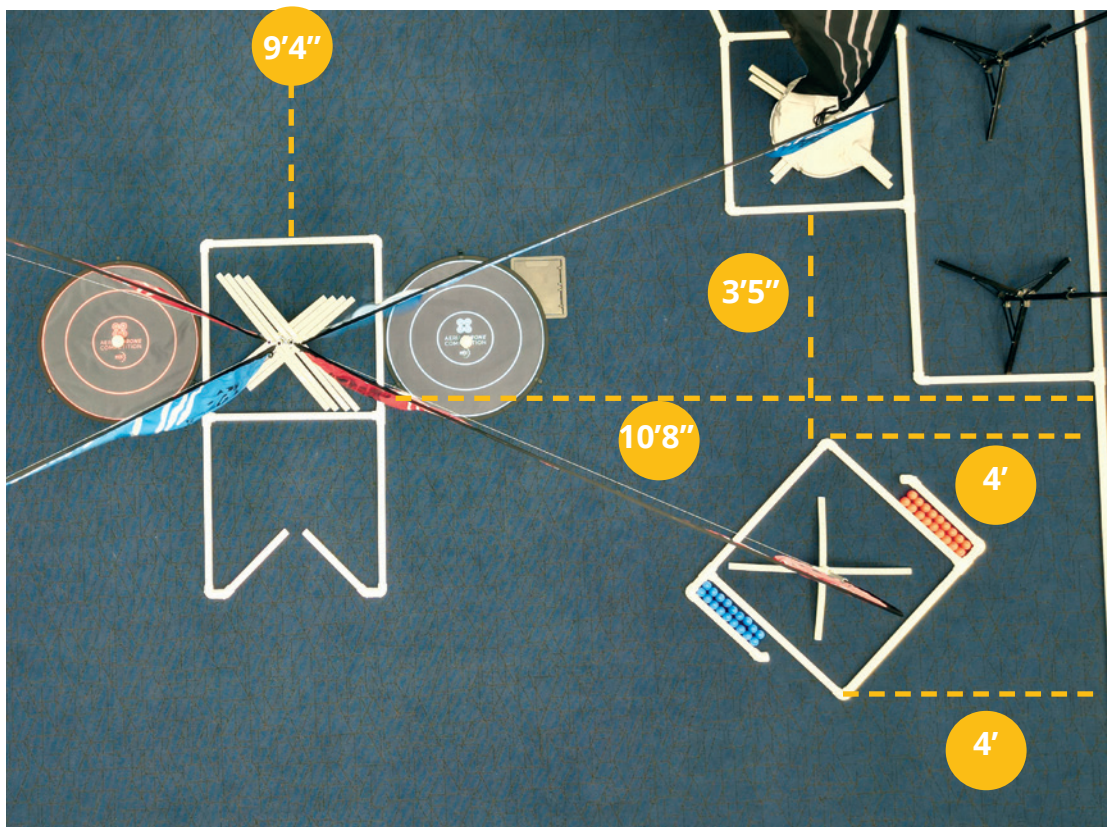


Figure 1.6 - Center Goal, Landing Pads and Starting Lane Placements.
Note: 9'4" to the inside of the PVC edge



Figure 1.7 - Keyhole Gate Heights. From the floor to the bottom of the keyhole gate - Green 6' and Yellow 5'

SECTION 12: CHANGE LOG

Version 1.1 - September 20, 2022

Version 1.2 - September 28, 2022

- Minor Typos

Version 1.3 - October 25, 2022

- Update <AFS1> “landing pad” to “floor” - teams are expected to use the same Starting Position <SG1> in all matches (including Autonomous Flight Skills)
- Updated Scoring description in Autonomous Flight Skills to remove reference to the landing pad
- Updated Figure 1.4 to correct measurement between landing Pads to 14”
- Updated Figure 1.7 to correct placement of yellow line to the bottom of Keyhole gate

Version 1.4 - November 4, 2022

Updated image on Page 31 (Skills Field Layout) to correctly show the placement of red balls in the starting lane.





AERIAL *DRONE* COMPETITION



MISSION 2023

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Tel: + 1 903 401 8088

Email: support@roboticseducation.org

Website: www.roboticseducation.org

Address: 1519 Interstate 30 West

Greenville, Texas 75402

#OMGDRONES