Playbook Module
B-5: Intermediate Level Drone Race

Level: Intermediate
Topic: Racing!
Objective: Setup and run an intermediate level drone race
Pre-requisites: A-5, B-1
Learning Objectives: not applicable - skills and proficiency demonstration
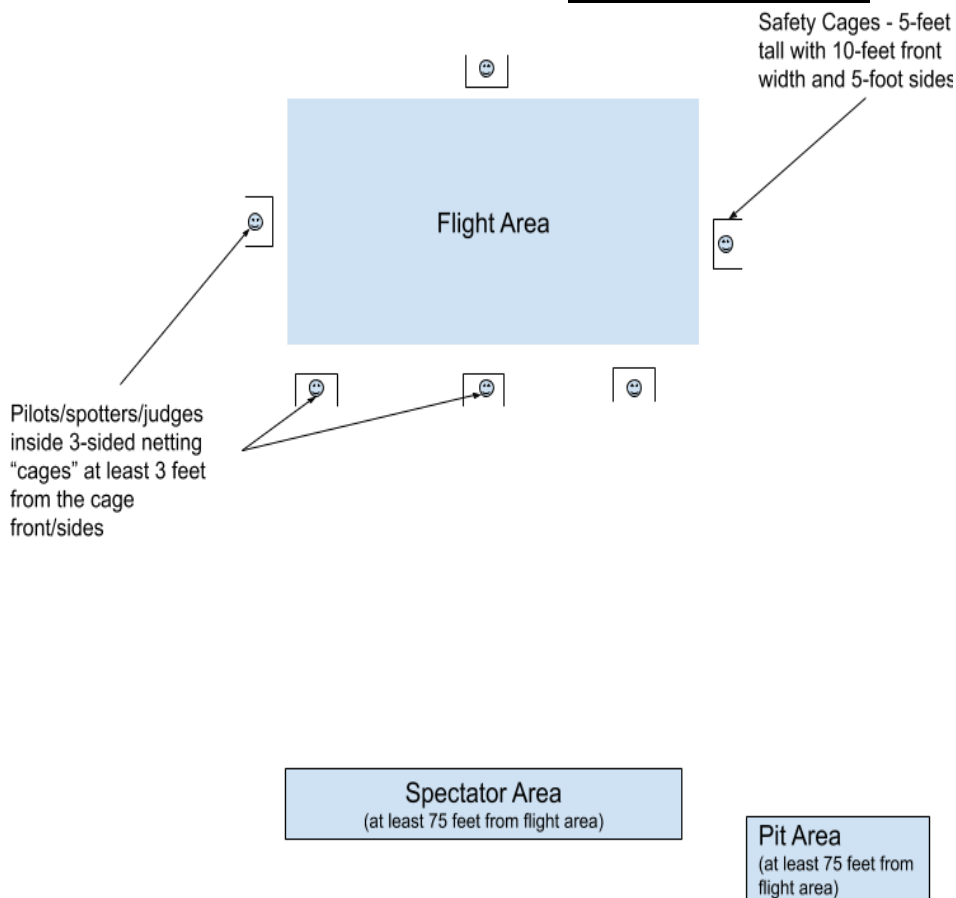- Pre-defined racing courses - bill of materials, layout, setup and use guides.
  - Events & Competitions Handbook

Materials Needed: racing course materials, rules/guidelines, scoring templates, drones, prizes/trophies
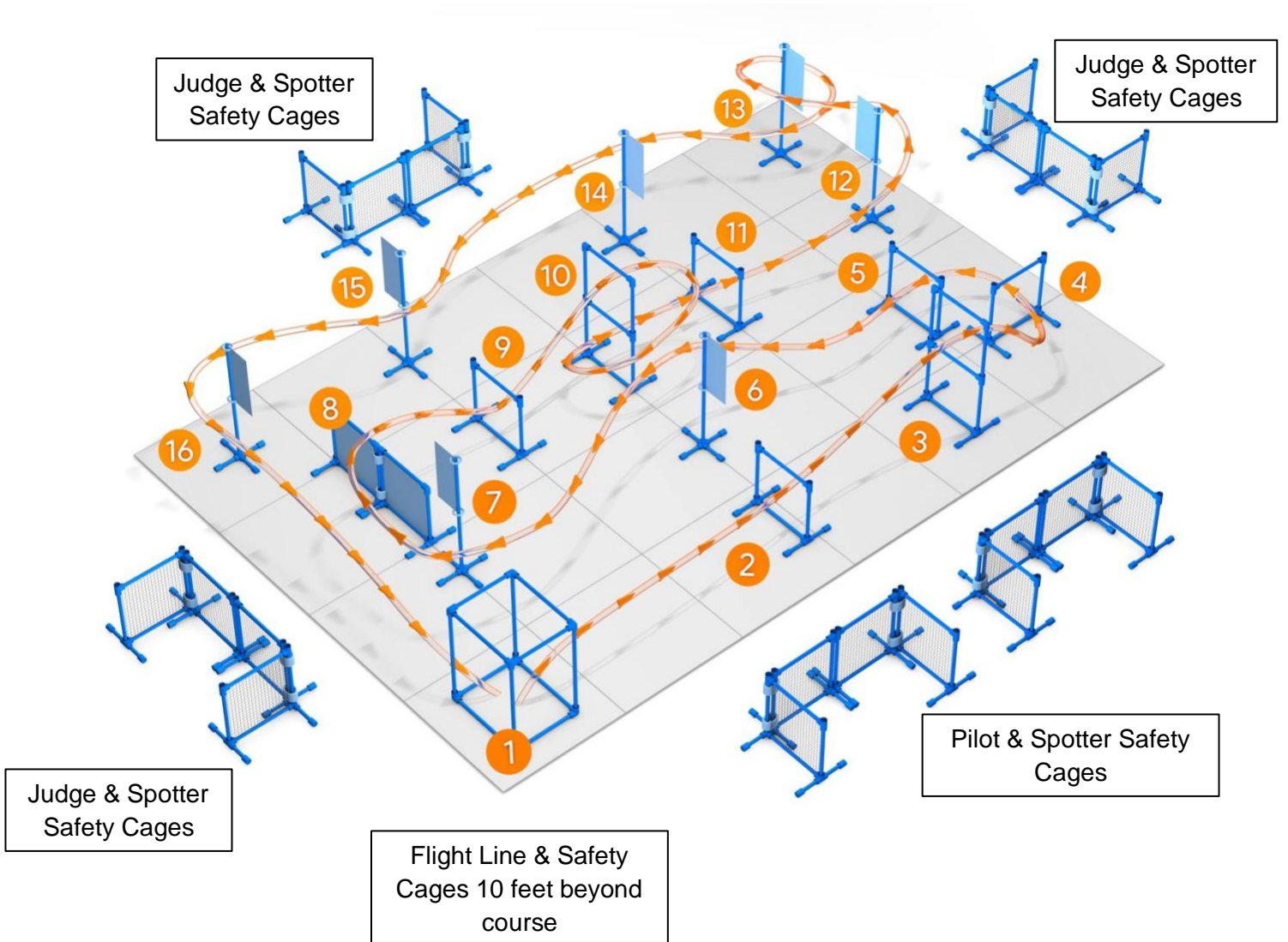**Space Needed:** 60 x 80 foot space at least 30 feet high
Note: The race course layout shown is without safety netting around the course. It shows individual safety cages. Please refer to the Events & Competitions Handbook for more information about options on setting up race courses and safety netting.

General Event Layout

Safety Cages - 5-feet tall with 10-feet front width and 5-foot sides

Flight Area

Pilots/spotters/judges inside 3-sided netting "cages" at least 3 feet from the cage front/sides

Spectator Area
(at least 75 feet from flight area)

Pit Area
(at least 75 feet from flight area)

Recommended Course Layout

Judge & Spotter Safety Cages

Judge & Spotter Safety Cages

Judge & Spotter Safety Cages

Pilot & Spotter Safety Cages

Flight Line & Safety Cages 10 feet beyond course

Safety Considerations: GSS for Drones section
Module Content Outline:

- Race rules/guidelines, including check-in requirements
  - Race Objectives
    i. Have FUN!
    ii. The objective of the Intermediate level race is to build Scout's drone flying proficiency. These courses should be more challenging and require more precise flying skills. A recommended intermediate course is provided below, and leaders are encouraged to develop their own courses utilizing the spaces available to them. This course is much larger than the Beginner's course, allowing for more complex flying with 3-D altitude changes.
  - Race options
    i. Decide if you are running separate races for the different age classes or combining all pilots together.
    ii. Races can be run in separate or mixed drone configurations. Leaders may run the race with Drones only using the standard introductory kit, or allow performance modifications. Leaders may hold more than one race, one with just the standard kits to demonstrate flight proficiency and a second allowing modifications to the drones - effectively combining flight proficiency and drone construction proficiency.
    iii. It is recommended that this race be flown in First Person Viewer (FPV) mode using the camera display on the BSA Raptor App. This requires at least one spotter to work with the pilot.
    iv. Define the number of heats and heat structure. For this race, 3 laps per heat are recommended.
    v. At this level, the race should be run as a time trial style race, where only one drone is flying in the race course at a time.
  - Pre-Flight Check-in/Rules - there should be a checkin/inspection table. See the Drone Events & Competition Handbook for check-in and inspection standard procedures, and augment them if necessary based on the race options implemented.
    i. Drones that do not pass inspection are not allowed to race.

- Race scoring system
  - See the Drone Events & Competitions Handbook for standard scoring guidelines.
  - Optional score points additions and subtractions for this race are identified in the scoring rubric section.
- Race Steps
  - Check in & Inspection
  - Stage drones in the Paddock/Pit area
  - The Race Leader should introduce the race to the pilots, spotters, and audience.
    i. Describe the race format - numbers of laps, numbers of heacatcleacatts, scoring, penalties, etc.
    ii. Review the participant guidelines from the Events & Competitions Handbook.
  - The referee should call the first heat - each pilot/team should move to the pilot area as they are called.
  - Preflight your drone using the [Preflght Checklis](Preflght Checklist)t

- Stage your drone under the launch gate, roughly in the center of the gate, and when the race leader instructs the team to powerup their drone - turn on power to the drone and initialize it with zero throttle power.
- Verify everything is synched up properly to the pilots app/phone.
- The referee will ask if you are ready.
- Referee simultaneously issues a "Launch" command (use an air horn or similar device), and starts the lap timer.
- Each Lap goes through the entire course as follows (If you have modified the course, modify this sequence). The numbers refer to the race course map in this module. Directions (left, right) refer to the orientation from the drone's camera.

Sequence	Obstacle type	Notes
1	Launch Gate	Pilots stage their drones right under the safety netting on this position. Upon Launch command, Ascend vertically out of the launch gate, then fly forward and go to the next gate.
2	Standard Gate	Fly through this low gate.
3	Double Tower Gate	Fly up and through the top (high) gate.
4	Standard Gate	Dive and turn left to go through low gate.
5	Standard Gate	Make a hard left turn and go through this next low gate.
6	Flag	Fly around this flag, keeping it on your left.
7	Flag	Fly around this flag, keeping it on your right.
8	Full hurdle	Make a hard right turn and fly over this hurdle.
9	Standard Gate	Immediately dive down and fly through the low gate.
10	Double Tower Gate	Fly up and straight to go through the top gate at 10, then circle around the gate to the right and fly through the low gate at 10 again.
11	Standard Gate	Fly through this low gate.
12	Flag	Fly around this flag, keeping it on your left.
13	Flag	Fly a 270-degree circle around this flag, keeping it on your right the entire time.
14	Flag	Fly around this flag, keeping it on your right.
15	Flag	Fly around this flag, keeping it on your left.
16	Flag	Fly around this flag, keeping it on your right and turn 90-degrees to head to the launch gate.
1	Launch Gate	Race to this gate. Enter the launch gate from the side facing flag 16. This ends the lap and starts the next lap.
		When you enter the Launch gate the second time, you have completed your 3 laps. Slow down, get close to the safety netting and land and shut down your drone.

Always go through your postflight checklist after the race.

Event Scoring Rubric:

1) Inspection of Drone (Pass/Fail)
2) Race: 1st place: 100 points, 2nd place: 50 points, 3rd Place: 25 points
   a) Average of the 3 laps (or as many laps that are not disqualified for missing a gate) in a heat is the drone's flight time for that heat. Best average lap time of the different heats determines 1st, 2nd, and 3rd place.
   b) Hitting obstacles: -1 point each occurrence
   c) The drone must go all the way through a gate from the front. If a drone misses a gate the pilot must go back and fly through the missed gate or flag. Flags extend infinitely into space but pilots should navigate near the flag so that judges can accurately assess the turn. If a pilot does not go back and fly though the missed gate/flag, then that lap is disqualified.
   d) A drone may not enter from the rear of the gate, unless specifically instructed to as a part of the race course directions. Entering a gate from the rear disqualifies that lap.
   e) If a drone flies out outside of the flight area and crosses the flight perimeter, that lap is disqualified. If a drone flies outside the flight area 3 or more times in the course of a race, that pilot is disqualified from the entire race and must immediately stop flying.

3) Disqualifications and crashes
   a) If a drone flies outside of the flight line area 3 times, that pilot is disqualified from that heat.
   b) If a drone crashes during a heat, the pilot gets a second heat. This should be at the end of the first heat for all pilots to allow time for the pilot with a crashed drone to make repairs. If the competition has multiple heats planned, no pilot may fly more than the defined number of heats, including any heats where they crashed.
   c) Any deliberate breach to safety guidelines that endangers the safety of participants, non-participants, or could result in damage to property is merit for disqualification and subject for review.
   d) Any device malfunction that results in the loss of vehicle control is subject to temporary grounding until a cause determination and remedy has been made, and tested off-course in a designated area for rectification. Should the failure not be resolved, the participant is subject to temporary disqualification on the grounds of vehicle readiness.