COMPETITION RULES

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UAV CONTEST 2026

The 3rd International Competition on Research and Design of Unmanned Aerial Vehicles

May 27-30, 2026

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I. PURPOSE AND CONTEXT

Wildfires and fire-related incidents represent some of the most devastating disasters globally. According to **CTIF** (The International Association of Fire and Rescue Services) statistics, approximately 4 million fires occur annually, resulting in over 20,700 fatalities and 70,000 injuries. Additionally, hundreds of thousands of deaths are attributed to respiratory issues caused by wildfire smoke and haze.

The **Firefighting & Rescue UAV Competition** simulates a high-stakes scenario involving five spreading fire zones and trapped victims. Participating UAVs are required to execute precision firefighting and search-and-rescue (SAR) missions.

II. COMPETITION OBJECTIVES

- **Practical Application:** To develop and optimize the deployment of UAVs in emergency response, search and rescue, and firefighting scenarios.
- **Innovation and Creativity:** To foster a spirit of innovation in mechanical design, systems integration, and advanced flight control programming.
- **Performance Evaluation:** To comprehensively assess both manual piloting skills and autonomous operations (leveraging Artificial Intelligence and Computer Vision) within a simulated real-world environment.

III. UAV TECHNICAL SPECIFICATIONS

1. Configuration

- **Maximum Dimensions:** 1.0 × 1.0 × 1.0 meters (inclusive of propellers and propeller guards).
- **Maximum Takeoff Weight (MTOW):** ≤ 5.0 kg (including batteries and all onboard mission equipment).
- **Power System:**
    - **Battery Type:** LiPo/Li-ion, maximum **6S** configuration.
    - **Quantity:** ≤ 3 battery packs.
    - **Total Energy Capacity:** ≤ 300 Wh.
- **Payload Capacity:** The UAV is permitted to carry a maximum of **five (05) tennis balls** at takeoff. (For the autonomous phase, teams must pre-load the balls into the UAV before the match begins).
- **System Integrity:** All electrical and mechanical systems must ensure high safety standards, with no risk of electrical leakage, short circuits, or fire/explosion hazards.

2. Safety Requirements

All participating UAVs must be equipped with the following mandatory safety features:

- **Propeller Guards:** Mandatory installation of protective cages or shrouds for all rotors.
- **Manual Override:** An emergency manual control mode that can be activated immediately.
- **Fail-safe Features:** Automatic **Return-to-Home (RTH)** or emergency landing protocols in the event of signal loss, control failure, or low battery status.
- **Status Indicators:** Visual LED status lights (highly recommended).
- **Personnel Safety:** The physical design of the UAV must be non-hazardous and pose no risk of injury to operators or referees.
- **Non-ionizing Radiation (Laser Safety):** All laser systems must comply with **IEC 60825-1** standards, up to a maximum of **Class 2 (2M)**. Any UAV utilizing lasers must be clearly labeled according to IEC 60825-1 and its corresponding laser class.
- **Ionizing Radiation:** The use of any system that emits ionizing radiation is **strictly prohibited**.

3. Control Systems

- **Phase 1 (Rescue):** Manual or semi-autonomous control is permitted.
- **Phase 2 (Firefighting):** Fully autonomous flight via **waypoints**. Manual intervention is strictly prohibited except in emergency situations.

RADIO COMMUNICATION AND SIMILAR EQUIPMENT

- **Regulatory Compliance:** All radio transmission, radionavigation, and radar equipment utilized in the competition must strictly comply with the Radio Frequency Law and all current legal regulations of Vietnam.
- **Prohibited Placement:** It is strictly forbidden to place any radionavigation equipment (e.g., positioning anchors, signal beacons) directly on the competition surface (Playfield).
- **Installation Responsibility:** Teams are solely responsible for the installation of their equipment within the Perimeter (the area surrounding the playfield). Such installations must ensure absolute safety and must not obstruct other teams or referees.
- **Standalone Radar Prohibition:** The use of ground-based radar systems functioning as standalone sensors—including devices capable of autonomous transmission, reception, and on-site data processing for environmental scanning—is not permitted. ***Note:*** *This regulation is intended to prevent electromagnetic*

interference and ensure competitive fairness. Positioning systems utilizing external anchors (such as UWB RTLS) located outside the playfield remain permitted for use.

- **Signal Disclaimer:** The Organizing Committee (BOC) assumes no responsibility and provides no guarantee regarding the signal coverage quality or the reliability of communication systems within the competition venue. Teams are strongly advised to have contingency plans in place for potential signal interference.

4. Gripping and Delivery Mechanisms

- **Rescue (Gripping) Mechanism:**
  - Must not cause structural damage to the victim models.
  - **Minimum Lift Capacity:** ≥ 300g (equivalent to the weight of the victim model).
  - **Security:** Must feature a safety locking mechanism to prevent accidental drops during transit.
- **Ball Drop (Dispensing) System:**
  - **Precision Release:** Capable of releasing balls individually and accurately, preventing unintended free-falls.
  - **Storage:** Capacity to hold 05 balls upon takeoff.
  - **Operational Altitude:** During the drop, the lowest point of the UAV must maintain a minimum height of **≥ 3.0 meters** above the arena floor.

5. Competition Materials

- **Fire Suppression Simulants (Tennis Balls):** Representing fire extinguishing spheres to be delivered into targets **F1–F5**.
- **Victim Models:** 0.3-meter cubes made of rigid foam; Weight: **300 grams**; Features: Integrated handles or hooks for retrieval.

IV. ARENA SPECIFICATIONS

- **Overall Dimensions:** 12.0 × 24.0 meters.
- **Safe Zone Area:** 12.0 × 3.5 meters.
- **Target Zones (TZ1–TZ4):**
  - **Inner Diameter:** 1.6 meters.
  - **Center Height:** 1.7 meters above the arena floor.
  - **Total Structure Height:** 2.6 meters.
- **Fire Zones (F1–F5):**
  - **Placement:** Positioned 0.1 meters above the arena floor.

- **Scoring System:** Equipped with integrated sensors to automatically record scores upon successful ball delivery (fire suppression).

- **Victim Rescue Area:** 12.0 × 4.5 meters.
- **Victim Platforms:**
  - **Dimensions:** 1.0 × 1.0 meters.
  - **Height:** 1.0 meter above the arena floor.
- **Operational Altitude Limits:**
  - **Manual Flight:** ≤ 5.0 meters.
  - **Autonomous Flight:** 3.0 – 5.0 meters.

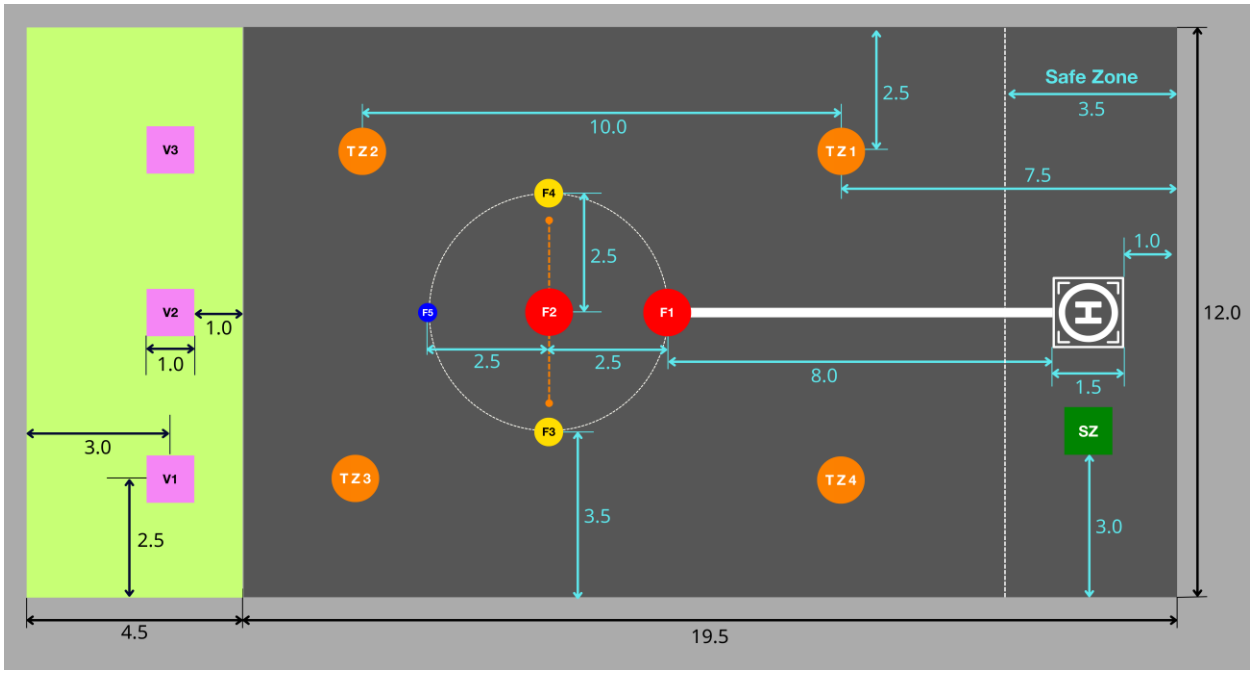


Figure 1: Competition Field Layout and Dimensions

V. MISSION REQUIREMENTS

A. PRELIMINARY ROUND (QUALIFYING PHASE)

PHASE 1: RESCUE (Manual or Semi-autonomous Control)

This phase evaluates the team's precision piloting skills and the operational efficiency of their mission mechanisms (actuators).

1. Takeoff and Approach:

- **Starting Position:** The UAV begins at the designated parking spot within the **Safe Zone**.
- **Procedure:** Upon the referee's signal, the UAV takes off and must fly through the center of transition gates **TZ1** and **TZ2**.
- **Note:** The entire airframe of the UAV must pass completely through the plane of the gate frame to be credited with a successful obstacle clearance.

2. Rescue Execution:

- **Operation:** The UAV approaches the danger zone and utilizes its mission mechanism (gripper, electromagnet, vacuum suction, etc.) to retrieve victim models from three designated positions: **V1, V2, and V3**.
- **Restriction:** The UAV is permitted to rescue only **one (01) victim per sortie** (flight turn).

3. Transport and Return:

- **Procedure:** The UAV must transport the victim back to the **Safe Zone**.
- **Requirement:** During the return flight, the UAV **must** fly through the center of gates **TZ3** and **TZ4** while maintaining a secure grip on the victim model.
- **Delivery:** The victim must be placed within the **Safe Zone (SZ)**. Only after a successful delivery may the UAV return to retrieve subsequent victims.

4. Landing:

- The UAV concludes the phase by performing a controlled landing at the designated landing pad.

PHASE 2: FIREFIGHTING (Autonomous Flight)

Mission 1: Autonomous Takeoff

- **Position:** The UAV is placed at the center of the Takeoff Area.
- **Procedure:** Upon the referee's signal, the team triggers the autonomous flight mode.
- **Requirement:** The UAV must lift off and reach the mandatory safety altitude (above **3.0 meters**) without any manual intervention from the remote controller.

Mission 2: Fire Suppression (Payload Delivery)

- **Procedure:** The UAV must navigate to designated coordinates and drop fire suppression balls into the target circles.
- **Target Designations:**
    - **F1, F2:** Red Circles.
    - **F3, F4:** Yellow Circles.
    - **F5:** Blue Circle.
- **Scoring Rules:**
    - Each fire point (F1–F5) is eligible for scoring only **once (01)** when a ball successfully lands within the circle.
    - Teams may decide the order of engagement for the fire points.
    - In the Preliminary Round, the coordinates for points F1–F5 remain **fixed** as per the provided arena layout.

Mission 3: Autonomous Return and Precision Landing

- **Procedure:** Upon neutralizing all targets, depleting the payload, or at any point of mission completion, the UAV must autonomously calculate its flight path back to the **Safe Zone**.
- **Requirement:** The UAV must perform a precision landing at its original takeoff position.
- **Mission End:** The official time stops once the UAV has safely touched down and the motors have been completely disarmed.

B. SEMI-FINAL ROUND

In this round, the requirement for **algorithmic flexibility** is significantly increased. UAVs can no longer rely on pre-programmed coordinates; instead, they must "perceive" and navigate the environment using **Computer Vision (CV)**.

Key Differences from the Preliminary Round:

- **Phase 1 – Rescue:**
  - **Content:** The procedure remains identical to the Preliminary Round (clearing TZ gates, rescuing victims V1–V3, and returning to the Safe Zone).
- **Phase 2 – Firefighting:**
  - **Dynamic Targets:** The positions of fire targets **F1 through F5** are no longer fixed.
  - **Matrix Mechanism:** Prior to each match, the Organizing Committee (BOC) will conduct a random draw to determine the coordinates for the F-points from a provided matrix of potential locations.

C. FINAL ROUND

The Final Round represents the ultimate challenge in flight control programming and **Real-time Computer Vision**.

Key Differences from Previous Rounds:

- **Phase 1 – Rescue:**
  - **Content:** The procedure remains consistent with the Preliminary Round (clearing TZ gates, rescuing victims, and returning to the Safe Zone).
- **Phase 2 – Firefighting:**
  - **Target Selection:** Coordinates for all fire points (**F1–F5**) will be randomly drawn from the matrix immediately before the match starts.
  - **The Dynamic Challenge:** Among the five targets, **Target F2** will be mounted on a **mobile platform**.

- **Movement Protocol:** The dynamic target will move at a constant velocity of **10 cm/s**. The movement follows a **linear translational path** (back and forth) along a designated **orange guide line** on the arena floor.

VI. SCORING CRITERIA

A. PRELIMINARY AND SEMI-FINAL ROUNDS

Category	Mission Details	Scoring Criteria	Maximum Score
Phase 1: Rescue	Passing through Transition Gates (TZ)	5 points per gate (TZ1, TZ2, TZ3, TZ4)	60
	Successful Victim Recovery (Delivery to Safe Zone)	20 points per victim (V1, V2, V3)	60
	Successful Precision Landing	10 points	10
TOTAL SCORE			**130**
Phase 2: Firefighting	Autonomous Takeoff (Altitude ≥ 3.0m)	20 points	20
	Successful delivery to F1, F2 (Red, D=1.0m)	20 points × 2 locations	40
	Successful delivery to F3, F4 (Yellow, D=0.6m)	30 points × 2 locations	60
	Successful delivery to F5 (Blue, D=0.4m)	50 points × 1 location	50
	Successful Autonomous Precision Landing (Fully within landing zone)	30 points	30
TOTAL SCORE			**200**

B. FINAL ROUND

Category	Mission Details	Scoring Criteria	Maximum Score
Phase 1: Rescue	Passing through Transition Gates (TZ)	5 points per gate (TZ1, TZ2, TZ3, TZ4)	60
	Successful Victim Recovery (Delivery to Safe Zone)	20 points per victim (V1, V2, V3)	60
	Successful Precision Landing	10 points	10
TOTAL SCORE			**130**

Phase 2: Firefighting	Autonomous Takeoff (Altitude ≥ 3.0m)	10 points	10
	Successful delivery to Stationary F1 (Red, D=1.0m)	10 points × 1 location	10
	Successful delivery to Dynamic F2 (Red, D=1.0m)	50 points × 1 location	50
	Successful delivery to F3, F4 (Yellow, D=0.6m)	30 points × 2 locations	60
	Successful delivery to F5 (Blue, D=0.4m)	50 points × 1 location	50
	Successful Autonomous Precision Landing (Fully within landing zone)	20 points	20
TOTAL SCORE			**200**

VII. PENALTIES AND VIOLATIONS

1. Point Deductions (Penalties)

- **Obstacle Collision:** Any contact between the UAV and the **Transition Gate (TZ)** frame: **-5 points per occurrence**.
- **Boundary Violation:** UAV flying outside the designated arena limits (exceeding boundary lines) for more than 5 seconds: **-5 points per occurrence**.
- **Altitude Violation (Phase 2 Only):** During autonomous missions, flying below the mandatory altitude (**< 3.0m**) for more than 5 seconds: **-5 points per occurrence**.

2. Invalid Mission Attempts (Non-Scoring)

- **Rescue Mission Failure:** If the victim model falls from its starting position or is dropped during transport before successfully touching the **Safe Zone (SZ)** ground: **0 points** awarded for that victim.
- **Firefighting Mission Failure:** Balls landing outside the target circles or dropping a second ball into an already completed target: **0 points** awarded for that specific ball/attempt.

3. Retry Protocol and Early Termination

In the event of technical malfunctions (signal loss, software errors, severe collisions) or manual intervention, the Team Captain may elect to initiate a **Retry** under the following conditions:

- **Retry Limit:** A maximum of **one (01) retry** is permitted per competition round.
- **Timer Status:** The match clock **will not stop** during a retry. The team is responsible for manually returning the UAV to the starting position.

- **Scoring Reset:** All mission points earned prior to the retry will be **voided**. Scoring for all tasks will restart from zero once the retry begins.

VIII. SAFETY REGULATIONS

Safety is the paramount priority of this competition. Any team violating the following provisions may be subject to immediate suspension from the competition at the discretion of the Organizing Committee (BOC).

1. Pre-flight Technical Inspection

- **Timing**: All UAVs must be presented at the technical area for referee inspection 15 minutes prior to the start of their scheduled match.
- **Inspection Criteria**:
    - Structural integrity of the airframe, propellers, and mission mechanisms (gripping/dispensing systems).
    - Battery condition (batteries showing signs of bulging or deformation are strictly prohibited).
- **Mandatory Requirement**: A UAV is permitted to take off only after receiving "Safety Clearance" confirmation from the BOC technical staff.

2. Flight Space Limitations (Geofencing)

- **Arena Boundaries**: UAVs must strictly remain within the designated arena boundaries, including the vertical airspace above the technical areas.
- **Violation Protocol**:
    - If a UAV touches or exceeds the boundary lines for more than 5 seconds, penalties will be applied according to Section VII.
    - Should a UAV show signs of loss of control or fly toward the spectator area, the BOC will immediately initiate emergency protocols.

3. Autonomous Safety Mechanisms (Fail-safe & RTH)

- **Return-to-Home (RTH) Activation**: Teams are required to configure mandatory Fail-safe settings. In the event of a signal loss between the remote controller and the UAV exceeding 3 seconds, the aircraft must automatically trigger RTH to the Safe Zone or perform an immediate emergency landing.
- **Emergency Stop**: All autonomous flight control software (Ground Control Station - GCS) must feature a prominent emergency stop button to instantly cut motor power in dangerous situations.

4. Personal Protective Equipment (PPE)

To ensure the safety of all participants within the Paddock/Pilot Zone:

- **Mandatory Gear**: The primary pilot and supporting technicians must wear safety goggles and helmets (standard sports or industrial grade) when entering the arena.
- **Attire**: Team uniforms and closed-toe shoes are strongly encouraged to ensure professionalism and mobility (open-toed sandals are prohibited).

5. Authorities of the Organizing Committee

- **Right to Terminate**: Referees and Flight Safety Officers hold full authority to issue an immediate "Stop Mission" command if hazardous factors are detected (e.g., battery fire, loss of UAV control, or unauthorized personnel entering the arena).
- **Disqualification**: The BOC reserves the right to disqualify any team that intentionally commits multiple safety violations or fails to comply with referee instructions.

IX. APPEALS AND DISPUTE RESOLUTION

To maintain fairness and ensure the focused operation of the Referee Panel, all appeals must adhere to the following protocols:

- **Appeal Window:** Any dispute regarding results, scoring, or in-match incidents must be formally submitted within **05 minutes** immediately following the conclusion of the match. The Organizing Committee (BOC) will not accept any appeals filed after this deadline.
- **Authorized Representative:** Only the **Team Captain** (as registered in the official BOC roster) is authorized to represent the team in filing an appeal with the Referee Panel.
- **Submission Protocol:** Appeals must be presented in a professional, respectful manner and supported by clear evidence. The BOC will review official surveillance footage (CCTV) and referee logs to cross-reference the claim.
- **Final Verdict:** The decision rendered by the **Board of Judges (BOJ)** after reviewing all evidence is final and legally binding with immediate effect. Teams are strictly prohibited from further dispute once the BOJ has issued its conclusion.

X. TEAM RESPONSIBILITIES

The professionalism of participating teams is vital to the success of the competition:

- **Punctuality:** Teams must arrive at the designated technical area at least **15 minutes** before their scheduled match time for the mandatory technical inspection. Failure to arrive on time without a valid justification will result in the cancellation of the team's match turn.
- **Equipment Preparedness:** Teams are solely responsible for providing all necessary equipment, including UAVs, spare batteries, chargers, remote controllers, and

Computer Vision (CV) processing hardware. The BOC is under no obligation to provide or lend any equipment.

- **Operational Compliance:** All team members must strictly comply with the instructions provided by the BOC, the Referee Panel, and on-site security personnel.
- **Professionalism and Etiquette:** Teams must maintain cleanliness within the technical area (Paddock). A spirit of fair play, mutual respect for opponents, and professional conduct toward all participants is mandatory.
- **Teams must strictly adhere to the membership quotas as specified in the competition regulations:**

  PhD Students: Maximum of **01** member.

  Graduate (Master's) Students: Maximum of **02** members.

  Undergraduate Students: Maximum of **06** members.

  Total Team Capacity: The total number of members shall not exceed **06 individuals per team**.

XI. MATCH DURATION AND TIMING

To ensure the competition remains on schedule, timing will be strictly enforced:

- **Total Match Time:** Each team is allocated a maximum of **05 minutes** to complete all missions within a single round. All participating teams will compete in **Phase 1 sequentially** before the competition proceeds to **Phase 2**.
- **Timing Protocol:** The match clock begins upon the referee’s signal and stops only when the UAV has safely landed and the motors are completely **disarmed** at the designated position.
- **Time Expiration:** Upon reaching the 05-minute limit, the team must immediately command the UAV to land. Any mission tasks completed after the 05-minute mark will be considered invalid and will not be scored.
- **Field Setup Time:** Each team is granted **60 seconds** to set up their ground station and load mission code prior to the official start of the match timer.

XII. DETAILED ARENA TECHNICAL SPECIFICATIONS

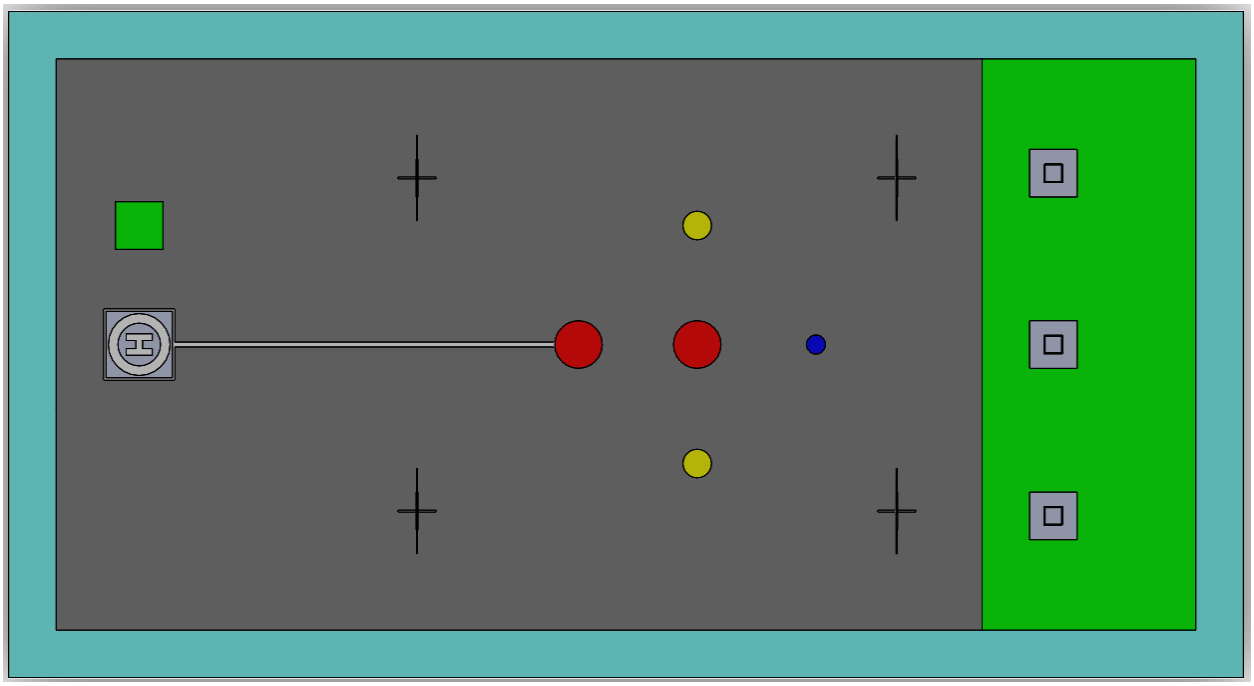
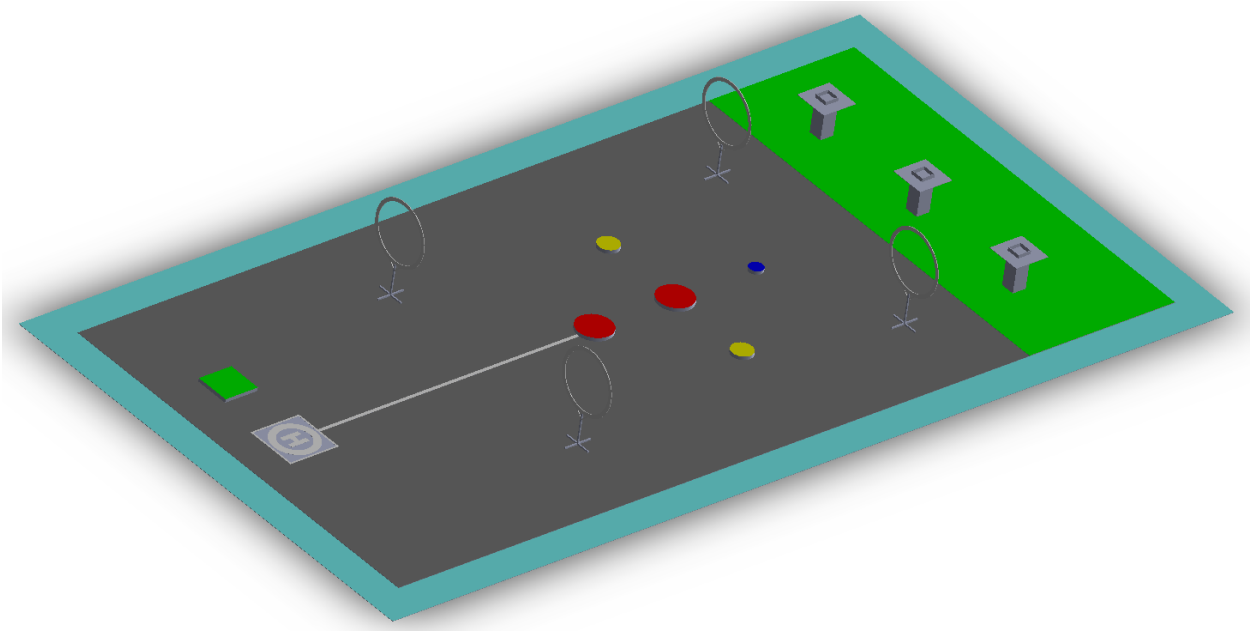


Figure 2: Front Elevation of the Aren



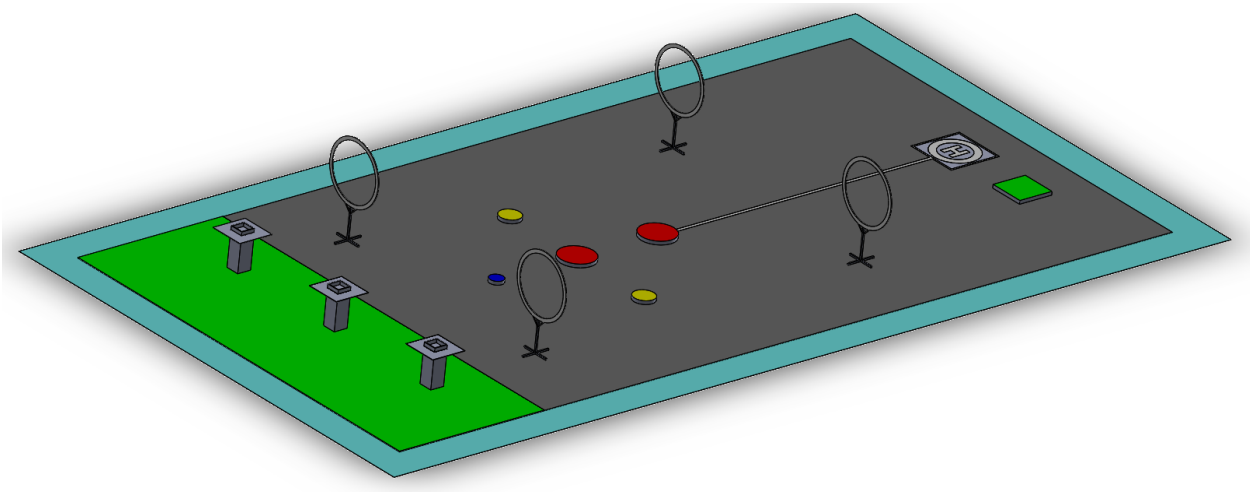


Figure 3: Arena Layout

Figure 4: Transition Gate (TZ) Obstacle Structure

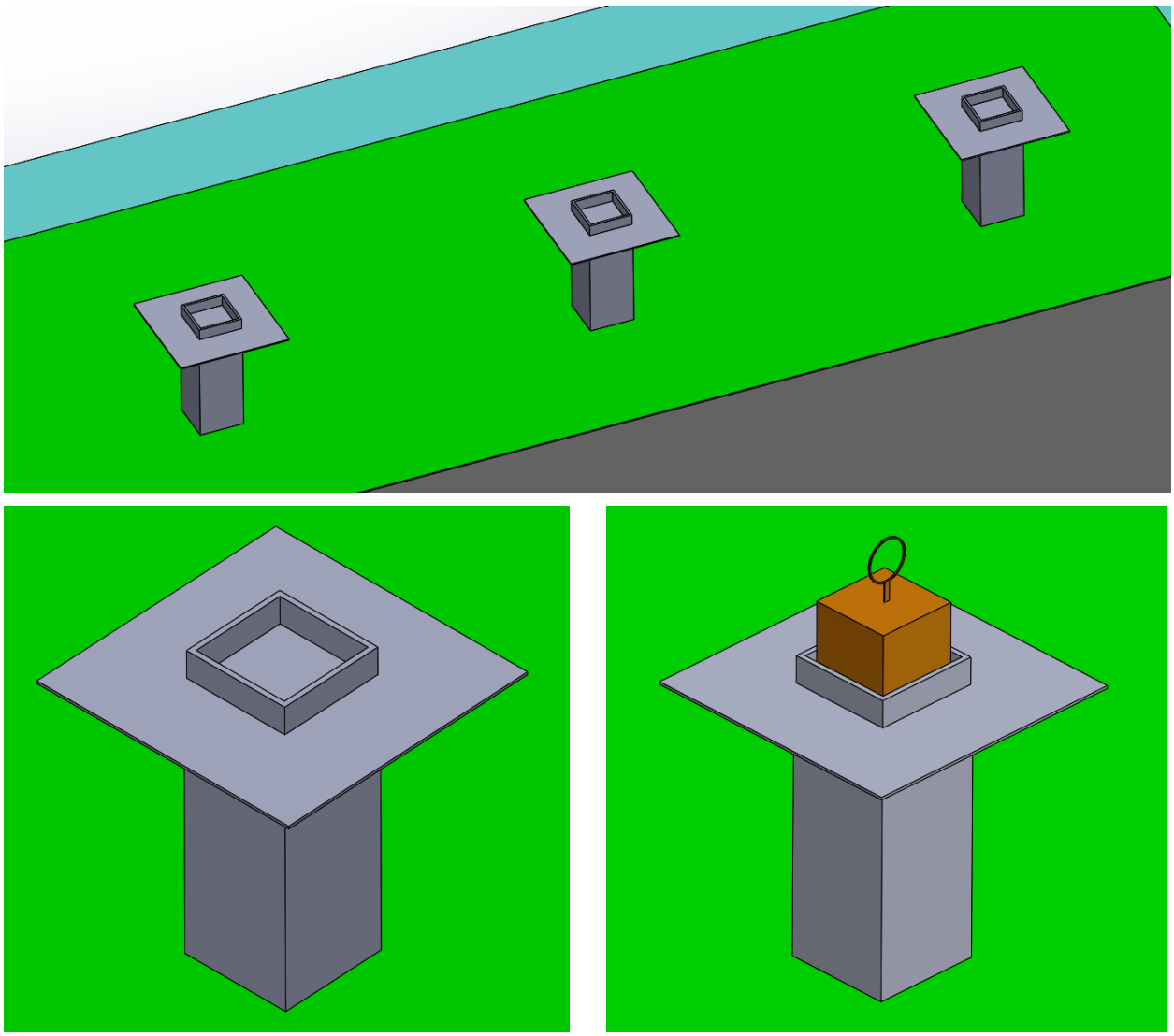


Figure 5: Victim Rescue Area Layout

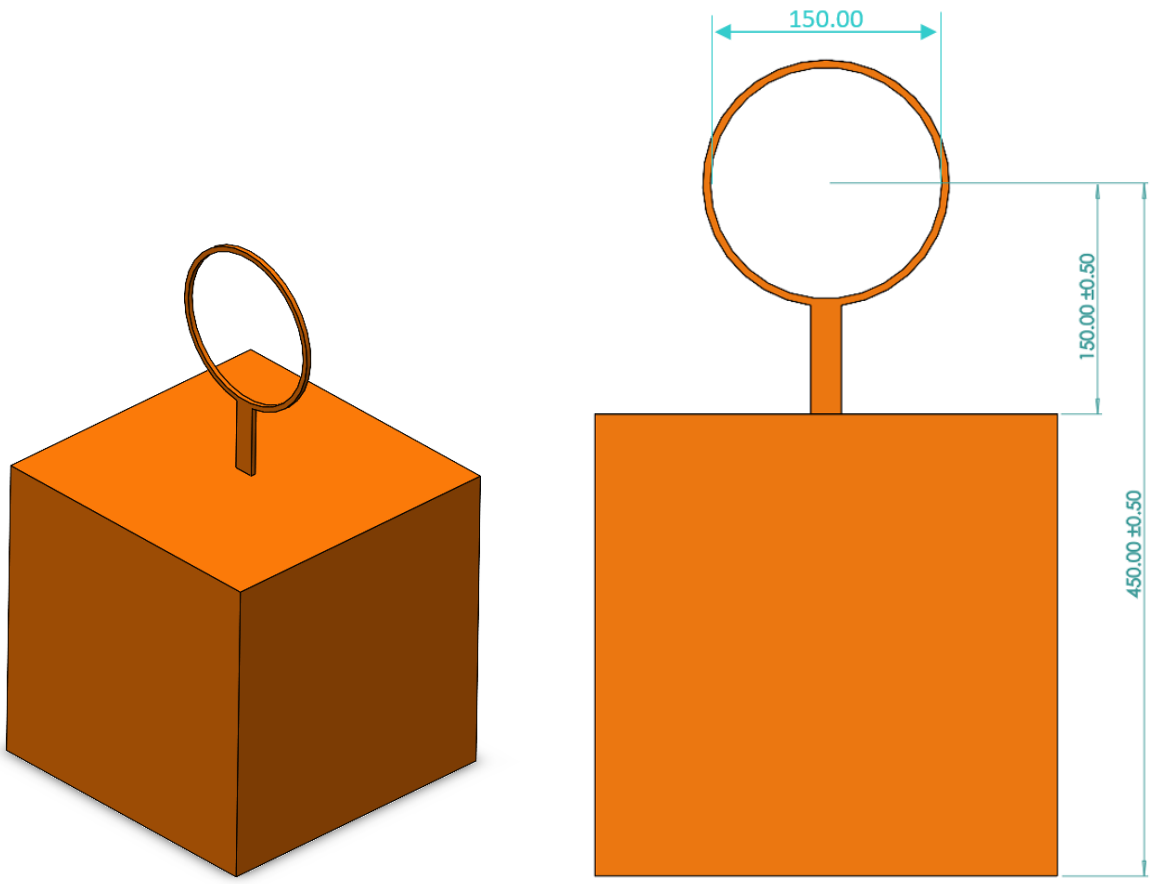


Figure 6: Victim Model Specifications

To ensure consistent target recognition for Computer Vision (CV) algorithms, the fire zones are standardized as follows:

- **F1, F2 (Red):**
  - **Diameter:** 1000 mm
  - **Color:** Red
  - **HEX Color Code:** #FC2A1B
- **F3, F4 (Yellow):**
  - **Diameter:** 600 mm
  - **Color:** Yellow
  - **HEX Color Code:** #FAFF37
- **F5 (Blue):**
  - **Diameter:** 400 mm
  - **Color:** Blue
  - **HEX Color Code:** #3C00FB

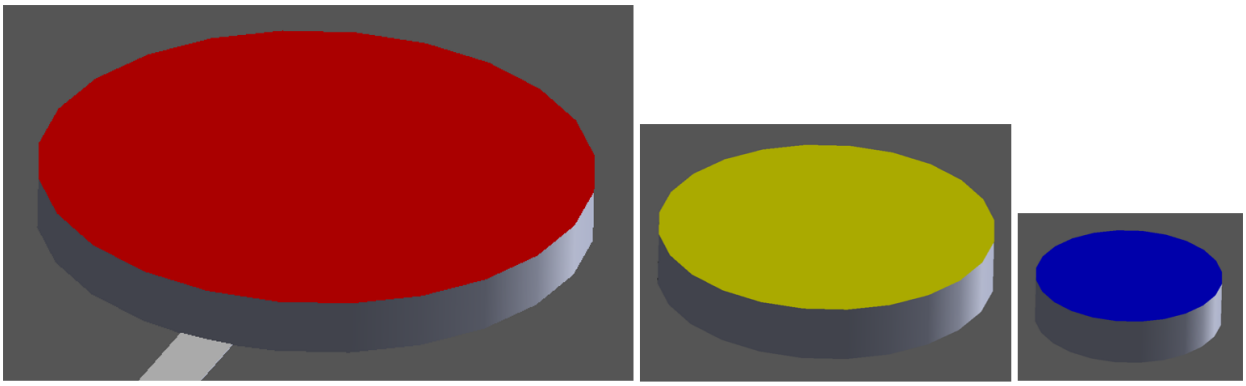


Figure 7: Fire Zones F1–F5

Figure 8: Takeoff and Landing Zones

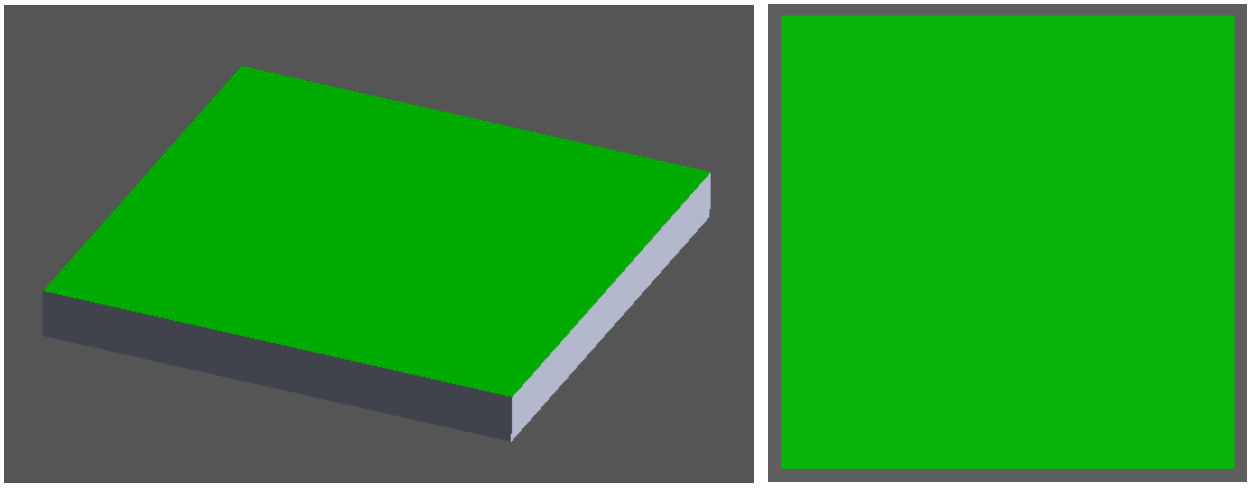


Figure 9: Victim Assembly Area (Safe Zone)

Type: Standard pressurized tennis ball (used as a fire suppression simulant).

Physical Dimensions:

- **Diameter:** 65.41 – 68.58 mm (Standard: ~67 mm).
- **Mass (Weight):** 56.0 – 59.4 grams (Standard: ~58 g).

Figure 10: Fire Suppression Simulant (Tennis Ball)

Note: During the organization process, the Organizing Committee (BOC) reserves the right to amend the competition regulations to ensure professional standards. All official updates and changes will be formally communicated to the participating teams.