



Official Rules and Mission



AUVSI & ONR's 11th Annual International Autonomous Underwater Vehicle Competition



"Underseas 11"

July 29 – August 3, 2008
Space and Naval Warfare Systems Center
SSC SD TRANSDEC Facility
San Diego, CA



Goals

The goals of the AUVSI student competitions are to provide opportunities for students to experience the challenges of system engineering, to develop skill in accomplishing realistic missions with autonomous vehicles and to foster relationships between young engineers and the organizations developing and producing autonomous vehicle technologies.

The primary emphases of the AUVSI student competitions are learning and outreach. These events are not grand challenges designed explicitly to progress the state-of-the-art. The objective is to produce the people who will push the envelope in the future. Major innovations may be spawned in these events, but this is a by-product, not an objective. Most important are gaining an appreciation for the trade offs inherent in any system design and the lessons learned in transitioning from a working bench prototype to operating reliably in the real world.

When competitiveness and collegiality are in balance, learning is maximized. The AUVSI competitions strive to maintain this balance. The nominal winners are those teams that have scored the most points. The real winners are all those participants who have learned something lasting about working together to create an autonomous system that accomplishes a challenging mission in a complex environment.

The legacy of the student competitions can be found today throughout government and industry. Employers and venture capitalists seek out prospects with the kind of resourcefulness and team management experience that former competitors offer.

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SCHEDULE*:

Event		Due Date
Intent to Compete Form and Payment Due	Friday	April 18
Journal Paper, Resume and Website Due	Monday	July 14
Team Check-in & Orientation	Tuesday	July 29, 2pm
In-water Practice Time	Wednesday	July 30
Safety Inspections and In-water Practice Time	Thursday	July 31
Static Judging / Qualifying Runs	Friday	August 1
Qualifying Runs	Saturday	August 2
Finals	Sunday	August 3
Awards Party (evening)	Sunday	August 3

*subject to change

SCHEDULE

Teams will register on the afternoon at the mandatory Team Check-in & Orientation meeting. Practice time will be all day on both practice days (and both sides of the pool will be set-up for practice runs). Safety inspections will be conducted when a vehicle is brought up to the staging area to be lowered into the water. **Depending on the number of competitors, a vehicle may need to autonomously pass through the gate once during the practice days in order to advance to the qualifying rounds. (see figure 7).** Three to five teams will be selected to compete for the Finals round. As usual, the Awards Party will take place Sunday evening after the finals.

1 MISSION & ARENA

The end of July and beginning of August is high-roller season at Casino TRANSDEC. Our inside-man says they will have a lot of cash on hand for high payouts. We recommend you blend in first, playing the slot machines or heading over to the black jack table. Then, when the coast is clear, make your way to the air duct. The duct can be tricky, so our inside-man has painted a stripe for you to follow. Try to be as quiet as possible (don't hit any of the sides), so that the guards aren't alerted to your presence. The owner of the casino, being the paranoid sort, has placed the cash in one of two safes. Luckily our inside-man has marked the correct room with an acoustic pinger. Follow the pinger, retrieve the safe, and make your way to the rooftop to be picked up.

1.1 Splitting the Arena

As in the past, we will operate vehicles in both halves of the arena at once. The layout in the two halves will be quite similar, as shown in Figure 5 (however, there will be only one safe in the practice side). To increase the number of teams at any given time, we will operate vehicles in both halves of the arena at once. During the practice days, both sides will be arranged in the practice configuration.

For the qualifying round, the competition side of the arena will be changed to the competition configuration, as shown in the right half of Figure 5. If our staffing permits, teams that are not making their qualifying run will be allowed to practice during the qualifying runs. Practice side pingers will be left **on** during the qualifying rounds. For the finals round, only the competition side will be in use (and, consequently only the competition side pingers will be on).

1.2 Starting Point

Each vehicle will be launched from the launch platform, whose approximate location is indicated on the arena plan.

1.3 Weight and Size Constraints

1.3.1 Vehicle

For the International AUV Competition, each entry must fit within a six-foot long, by three-foot wide, by three-foot high “box” (1.83 m x 0.91 m x 0.91 m). Table 1 shows the bonuses and penalties associated with a vehicle’s weight in air. **Reminder: The weight limits are lowered!**

Table 1. Size and weight constraints on AUVs entered into the 2004 competition		
	Bonus	Penalty
AUV Weight > 110 lbs (AUV Weight > 50 kg)	N/A	Disqualified!!!
110 lbs ≥ AUV Weight > 84 (50 kg ≥ AUV Weight > 38 kg)	N/A	Loss of 250 + 5 (lb – 110) 250 + 11(kg – 50)
84 lbs ≥ AUV Weight > 48.5 (38 kg ≥ AUV Weight > 22 kg)	Bonus of 2(84 – lb) 4.4(38 – kg)	N/A
AUV Weight ≤ 48.5 lbs (AUV Weight ≤ 22 kg)	Bonus of 80 + (48.5 – lb) 80 + 2.2(22 – kg)	N/A

1.3.2 Markers

A vehicle may carry up to two markers. Each marker must fit within a box 1.5" square and 6" long (3.81 x 3.81 x 15.24 cm). Each must weight no more than 1.5 lbs (0.68 kg) in air. Any marker that exceeds these limits by less than 10% will result in 500 point penalty. Any marker that exceeds these limits by more than 10% will disqualify that entry. Each marker must bear the team name or an emblem. Markers will be cleared from the arena after each run. A reasonable amount of time will be spent looking for lost markers, however consider them expendable and have back ups.

2 Description of Tasks

The Launch point, Gate (shown in Figure 6), Slot Machine (Figure 8), Black Jack table (Figure 9), Air condition duct (Figure 10), and Safe (Figure 11) will be placed in such a way as to not have any three elements along a single line.

2.1 “Path”

This task consists of line segments constructed of four sections of flat PVC sheet snaking their way from the Gate to in between the two Safe areas (see Figure 5 and Figure 11). The “path” will be constructed of 6 inch (0.15 m) wide by 4 foot (1.2 m) long sections of flat PVC sheet. It will be painted **ORANGE**. The “path” is raised off the floor of the pool 1-2 feet (0.3-0.6 m) and each segment will not have a relative angle between two pieces of more than 90°. The segments are situated in such a way that if you follow a heading along the line segment you will (eventually) meet with the next task (Path to slot machine, path to black jack table, path to air duct, path to safe area). Distances between segments will vary depending on the positing of the Safe areas and the meanderings of the line. The order of the tasks will always be: Slot machine, Black Jack table, Air duct and Safe. You may complete the tasks in any order (with the Gate required to be first before starting anything else).

2.2 Slot Machine

This task consist of a moored 9” (22.9 cm) diameter **RED** buoy. The buoy will stayed moored to the floor of TRANSDEC. The goal is to strike the buoy (Pull the slot machine's lever).

The buoys will be constructed so that they can take a decent blow. The mooring “line” will be nylon rope covered with rigid PVC pipe to minimize chances of the vehicle becoming entangled. You may hit the buoy from any direction.

2.3 Black Jack Table (Target Bins)

This task consists of 24” x 12” x 6” (0.6 x 0.3 x 0.15 m) **BLACK** bins surrounded by a 6” white border (0.15 m) (see Figure 9). The bins will be 1-2 feet (0.3-0.6 m) off the bottom. The four bins will be positioned side-by-side (along their longest side). In each bin, there will be one **RED** card suit (diamond ♦, club ♣, heart ♥, spade ♠). Since there are four bins, each bin will contain one of the four suits, there where be no duplicates. Each symbol will fit within a 8” (20.23 cm) square, and will be approximately centered within the bin. There will be a card value associated with each of the suits, and the values will change between the qualifying rounds and the finals.

2.4 Air Duct

This task consists of an 5ft x 5ft x 5ft (1.52m x 1.52m x 1.52m) “duct” made from **BLACK** PVC sheet. The entrance and exit will be painted with a 6” (0.15m) wide **yellow** stripe (inside and outside). A 6” (0.15m) **yellow** stripe will also be painted along the bottom from the entrance to the exit. The vehicle must find the entrance, enter the duct, follow the line and exit without hitting any of the sides.

2.5 Safe & Rooftop

This task consists of an acoustic pinger located 2 feet (0.6 m) off the floor of the pool. Floating above the pinger on the surface will be a single octagon representing the roof of the casino (see Figure 11). The octagon will be constructed from ½” PVC pipe and have a “diameter” of 9 feet (2.74 m). On the competition side, there will be two octagons placed in different locations. At the start of a run, one of the two pingers will be turned on.

Positioned directly above each pinger will be a fixture which holds a PVC “Safe” (see Figure 12). This fixture will constrain the “Safe” from movement and rotation in such a way that you have to lift it up from the fixture to remove it. The “Safe” portion of the treasure will be painted **ORANGE** similar to the “path”

In order to obtain full points for the rooftop escape, your vehicle must surface fully inside the octagon (no portion of the sub touching the structure). In order to obtain full points for recovering the money, the “Safe” must be captured by the vehicle when it surfaces. A capture consists of constraining the treasure in at least 3 degrees of freedom (grabbing the Safe with a dangling lines does not count).

The competition and practice side will ping at a rate of 0.5 Hz (2 seconds), and separated by 0.9 seconds. The pingers will be synchronized. The schedule will be:

Unit 1 (Competition)	pings t=0 s
Unit 2 (Practice)	pings t=0.9 s
Unit 1 (Competition)	pings t=2 s
Unit 2 (Practice)	pings t=2.9 s
Etc.	

This gives the reverbs from each pinger (near) maximal time to die out. Note that for the final runs, only the competition side will be pinging, and will therefore have a 2s delay between pings to further reduce any reverberations in the pool. The ping duration is 1.3ms with a sound level of 187 dB.

2.6 Interference

Vehicles that interfere with competition elements may be disqualified at the judges’ discretion. “Interference” does not include cases where, in the opinion of the judges, a vehicle is attempting to complete one of the tasks. If a vehicle becomes entangled in an objective, the run will be declared completed. Teams may keep the points earned on that run, or may have the AUV returned to the

launching platform and start another new run. If a new run is begun, all points from the previous run are lost. See Section 5 Official Rules, Submissions and Fees for more information on interference.

2.7 Acoustics

We are leasing ORE model 4330B transponder/responder units (<http://www.ore.com>). They will be operated in responder mode, and each unit will be preset to one of the following frequencies: 22, 23, 24, 25, 26, 27, 28, 29, or 30 kHz. Since we cannot specify the frequency settings of the units we will receive, we will not be able to report them to the teams until the start of the practice runs.

3 OFFICIAL RULES, SUBMISSIONS AND FEES

1. The official source for all information concerning rules, interpretations, and information updates for the International Autonomous Underwater Vehicle Competition is the World Wide Web home page at: <http://www.auvsi.org/competitions/water.cfm>
2. An *Intent to Compete* form, available on the website, and the entry fee must be completed. The submission must be in English and is not considered official until the entry fee has been received by AUVSI. As the competition format cannot handle an unlimited number of entries, the organizers reserve the right to limit the total number of entries that are allowed to compete by declaring the competition closed to new entries before the due date above. As with all official information, this announcement (should it be necessary) will appear on the official website.
3. During the competition, the vehicle must operate autonomously, with no control, guidance, or communication from a person or any off-board computer. The vehicle and any parts connected to the vehicle must submerge and remain submerged. No item may break the surface or be left floating while the vehicle is underway.
4. Teams must submit a journal paper and a website for evaluation by the judges.
5. There will be a qualifying round that most/all teams will compete in. After the qualifying round, the judges will convene and tally their scores. The judges have the discretion to select the number of teams entering the finals that they deem appropriate. Teams will be accepted into the finals round in rank order from the qualifying round. We anticipate that three to five teams will be accepted into the finals.
6. Depending on the number of contestants, in order to be considered for selection in the qualifying round, a vehicle must show that it can submerge and pass through the gate during the two practice days. A vehicle that passes through the gate is guaranteed a position in the qualifying round (see Figure 6). If this requirement is necessary, it will be announced on the official website.
7. After the competition, the judges will issue overall standings. Any team that is accepted in the finals round will be ranked ahead of all teams that are not accepted into the finals round.
8. Each team will have 20 minutes on the dock. The first 5 minutes constitute the preparation period. During this time, the vehicle may not be deployed in the water. The 15-minute-long performance period immediately follows. **These times are subject to change depending on the number of contestants.**

Preparation period: The vehicle may remain on the crane, or be placed on the dock. A team may waive any portion of the 5-minute-long preparation period and start the 15-minute-long performance period. Once the performance period starts, the team loses any unused time in the preparation period.

Performance period: When the officials signal the start of the performance period, the team may ask to have the vehicle deployed into the water and released to perform the mission. Only tournament officials may deploy and recover the vehicle. The time required to deploy and/or recover does not

count against the 15-minute limit. This is to prevent unsafe actions in an attempt to speed the deployment and recovery processes.

9. Multiple runs: A team may attempt multiple runs during the performance period. Once a team has the officials re-deploy their vehicle, all points earned in previous runs are lost.
10. Ending a run and retrieving a vehicle: At any time while a vehicle is running, the team captain can signal the end of the run and request the retrieval of the vehicle. Only officials may retrieve a vehicle and return it to the dock. The countdown clock for the performance period stops when the official touches the vehicle to recover it. The clock continues its countdown once the team establishes communication with the vehicle, or the vehicle is safely back at the dock, whichever is first (i.e. if a team has wireless communication with the sub, the countdown clock continues while the diver is returning the sub to the start).
11. Depending on the time, a team may use any of their 15-minute-long performance period time to survey the arena. The survey, however, must be completed autonomously. Unlike performing a competition run, the clock will continue to run while retrieving a vehicle. **This is subject to change depending on the number of contestants.**
12. If a vehicle experiences a significant interference from a piece of equipment, line, cable, or diver deployed in support of the competition, the team captain may ask, at that time, to have the clock stopped, the vehicle returned to the dock, and for the judges to add back to the clock their best estimate of the time used in that run up to the point of interference. If the team captain does not make this request in a timely manner (as determined by the technical director or his designee) then the option is lost. Interference with a gate, light, or target object does not qualify for this option, and a vehicle interfering with those items may be disqualified at the judges' discretion.
13. The mission ends when any of the following occur:
 - The 15-minute (or the time limit set by the number of contestants) performance period ends.
 - The judges order the end of the mission.
 - The team captain requests the end of the mission.
 - The vehicle breaches the surface (as determined by the judges, see Section 10.6 for more detail).

4 VEHICLES

1. Each team may enter only one vehicle into the competition. Each vehicle will be physically-inspected by the competition judges. The judges may disqualify any vehicle that they deem to pose an unreasonable safety hazard.

The judges will confer with representatives of the host facility, and any vehicles that, in the opinions of the judges or the representatives of the host facility, pose an unreasonable risk to the integrity of the host facility will be disqualified. The AUVSI and the host organization, their employees and agents, as well as the organizing committee, are in no way liable for any injury or damage caused by any vehicle, nor for any damage or injury caused directly or indirectly by the disqualification of a vehicle.

Each vehicle must operate autonomously during its dive. While carrying out the mission, no communication is permitted between the vehicle and any person or off-board computer. Vehicles must operate solely on their ability to sense and maneuver in the arena using on-board resources.

2. The weight of each vehicle must be less the maximum allowed. Note that bonus points are awarded to vehicles that are below a certain value, and penalties assessed for those that exceed it (Table 1). The entire vehicle must fit within a box that is 6 feet long, 3 feet wide, and 3 feet deep (1.83 m x 0.91 m x 0.91 m).
3. All vehicles must be battery powered. All batteries must be sealed to reduce the hazard from acidic or caustic electrolytes. Batteries may not be charged inside of sealed vessels at any time while on the

site of the competition and/or while engaged in the competition. The open circuit voltage of any battery in a vehicle may not exceed 60 VDC. If a team has any questions or concerns, they are encouraged to contact the organizing committee.

4. No materials (except for the markers and compressed air used to blow ballast) may be released by the vehicle into the waters of the arena.
5. For the safety of your vehicle, we require it to be slung on a harness or sling of some type. Even if the vehicle is light enough to hand carry, we wouldn't want anyone to slip and destroy their vehicle. Also, we need to weigh the vehicle, and require that the vehicle be slung somehow for the measurement. Please see the document ***Harnessing the Submarine*** for hints and ideas on how to accomplish this.
6. All vehicles must bear a clearly marked kill switch that a diver can readily activate. This switch must disconnect the batteries from all propulsion components and devices in the AUV. All props must have shrouds. The shrouds must surround the prop and have at least a 2" (5.08 cm) distance between the spinning disk of the prop and the edges of the shroud (front and back). If you have a guard across the opening, this distance can be minimal. Commercial thrusters qualify as is, as long as they are shrouded. A vehicle will not be allowed in the water without a properly working kill switch and prop shrouds.
7. All vehicles must be buoyant by at least one half of one percent (0.5%) of their mass when they have been shut off through the kill switch.
8. Teams may comprise a combination of students, faculty, industrial partners, or government partners. Students may be high school, undergraduate and/or graduate students. Interdisciplinary teams are encouraged. Members from industry, government agencies, or universities (in the case of faculty) may participate; however, full-time students must compose at least 75 percent of each team. Participants must be enrolled at their schools as a full time student per quarter/semester during winter and spring to be considered "students." The student members of a joint team must make significant contributions to the development of their vehicle. One student member of the team must be designated as the "team captain." The team captain, and only the team captain, will speak for the team during the competition run. Only the student component of each team is eligible for the cash awards.
9. No team member is allowed to enter the arena at any time (this includes wading, swimming, and diving as well as floats, boats, etc.). Competition officials will be responsible for recovering lost vehicles. Officials will make all reasonable efforts to recover a lost vehicle but cannot guarantee that they will be able to do so. All teams recognize that by entering the competition, they risk damage to or the loss of their vehicle. The judges, officials, hosts, and sponsors can take no responsibility for such damage or loss.
10. The officials will suspend the operation of a vehicle at any time they deem that it is required by safety or security considerations. Teams may be required to submit technical descriptions of their vehicles to the officials in advance of the competition, with the goal of identifying potential safety concerns well in advance. When requested, such technical information submitted to the judges will be held in confidence until the end of the competition.
11. The officials will suspend the competition at any time they deem that it is required by safety or security considerations.

5 JOURNAL PAPER

Each team is required to submit a journal paper that describes the design of their vehicle and the rationale behind their design choices. This paper may be no more than 10 pages long (including all figures, references, and appendices). Additionally, each journal paper must include an abstract of no

more than 250 words. The journal paper and abstract must be printed on standard 8.5 × 11-inch paper, with margins of at least 1 inch on all sides, and all text must be in 12-point or larger font. Each page must bear a footer with the page number and the team name. The journal paper will be evaluated as described below in the section on scoring.

The journal paper must be received in electronic format (pdf is preferred) via email. Teams that do not meet the deadline may be disqualified from the competition.

6 STATIC JUDGING

Each vehicle will be subject to static judging before being allowed to compete. During the static display time, each team will be visited by the judges, and by the public, the press, and representatives of other organizations. The judges will evaluate each vehicle for technical merit, safety, and craftsmanship as described below in the section on scoring. Each team is required to have at least one member attending their vehicle throughout the static display period (not just during the judges' scheduled visit). Teams are also strongly encouraged to make a poster describing the vehicle. The posters can be set up next to the vehicle during the static display period. Representatives of the press and of other organizations will be encouraged to visit each team during this period.

7 ONSITE EXPECTATIONS

The organizers have made every attempt to provide the competitors with maximum resources at the Competition site, including electrical power, test pools, Internet access, and practice time in the main pool. This event is not only opened to the public, but there is a very high possibility that a potential future employer or sponsor may also be observing the event.

It is expected that **ALL** teams will be present during **ALL** days of the competition. If your team does not make it into the finals, it is expected that your team will display your vehicle and be present in the team tent during this time (**All** teams, **All** days!).

8 RESUMES

One goal of the competition is to foster links between young engineers and the companies, universities, and government agencies involved in AUV development. To advance that goal, we request that each team provide resumes of each team member, along with class year and expected graduation date. These resumes (when submitted) will be circulated to our sponsors and employers who will be considering opportunities for full-time employment, internships and co-op programs. Your participation in this new program is strongly encouraged. Electronic versions of team member resumes should be appended to the journal paper.

Students are also encouraged to use AUVSI's Online Career Center at <http://careers.auvsi.org>

9 SCORING

Each of the tasks has a point value associated with it. A team may decide to complete an individual task, two or all in any order. In order for the Safe to be considered recovered, the vehicle must be in control of it. It must be semi-rigidly attached (constrained by at least 3 degrees of freedom) to the vehicle (no lines attached to the Safe that you are just dragging along) at the end of the run. If you decide to grab the Safe first, you must maintain control of it until the end of the run. Remember, the vehicle dimensions (include any device used to retrieve the item, but not including the recovered item) must be within the limits set above.

9.1 Breaching

When completing the sequence of tasks, a team may choose to complete the "Rooftop exit" first. In this cases (and only this case) a vehicle may breach the surface (hopefully within the octagon) and then submerge again to complete the remaining tasks without risking disqualification.

9.2 Final Round

After the qualifying round, the Judges will rank-order the teams based on their scores from the qualifying round, and select the top teams (as deemed by the judges) to compete in the final round. The point totals and rankings for the teams not selected are then frozen. For the final round, all point totals are set to zero. The final standing of teams selected for the finals will be determined by the points their vehicles score in the final round based on the Performance Measures alone. Any team that is selected to be in the finals will finish ahead of the remaining teams which were not selected.

9.3 Point Breakdown

Subjective Measures	Max. Points
Utility of team website	50
Technical merit (from journal paper)	50
Written style (from journal paper)	50
Technical accomplishment (from static judging)	75
Craftsmanship (from static judging)	75
Team uniform (from static judging)	10
Discretionary static points (awarded after static judging)	40
Total	350
Performance Measures	Max. Points
Weight	See Table 1
Each marker exceeding a weight or dimensional specification by no more than 10%	-500 per specification exceeded per marker
Pass through the validation gate	100
Maintain a fixed heading through gate	150
Play the Slot Machine	600
Black Jack Table	50 or Card total*20
Black Jack: Beat the Dealer	2:1
Black Jack: "21"	2:1
Pass through the Air Duct	1000
Follow the "Path"	200
Surface within an Octagon	500
Surface within the correct Octagon	2000
Surface with the Safe	1000
Finish with mission with T minutes (whole + fractional)	T x 100

9.3.1 "Subjective Measures" description

Technical accomplishment and Craftsmanship: These considerations will exclude any components of the design that are or could be (in the opinion of the judges) commercially available or do not include a significant contribution by team members. In other words, if you use a well-built, well-designed, off-the-shelf computer, your team does not get points for the computer's good technical design. You will get points for selecting a computer that is, in the opinion of the judges, well suited to the engineering needs of the vehicle.

9.3.2 "Performance Measures" description

Passing through the validation gate: The judges discretion will determine whether or not the vehicle satisfactorily passes through the validation gate.

Maintain a fixed heading through the gate: Did the sub travel in a straight line through the validation gate?

Slot Machine: You bump into the buoy. Partial points are awarded if you track the buoy but you brushed by the buoy instead of a head on bump.

Black Jack Table: You get 50 points if you drop a marker on the border. The total for your two markers is added together and multiplied by 20. For the qualifying round, the dealer holds an "18". For the finals, the dealer holds a "20". If you beat the dealer, your score is multiplied by 2. If you get a "21", your score is again multiplied by 2. So, if you get "21", you will get: $21 \times 20 \times 2 \times 2 = 1680$ points.

Pass through the Air Duct: How well did you find/follow the air duct?

Follow the "Path": How well did you follow the segments?

Surface within the Octagon: The sub must fully surface within the octagon to obtain full point value. Partial points may be awarded with judges' discretion.

Time bonus: At a minimum, a sub must tip over the docking station, drop at least one marker on the lip of the pipeline inspection bin and fully surface within one of the octagons to obtain the time bonus. These can be completed in any order.

The time bonus is a calculation of whole minutes remaining plus fractional seconds. For example, with a remaining time of 7:13, a team will receive $(7 + 13/60) \times 100 = 721.667$ points

10 SEQUENCE OF EVENTS DURING THE COMPETITION

10.1 *Static display period*

Each team will receive a visit from the judges during this period for the static judging. Additionally, members of the public, the press, and representatives of other organizations will be encouraged to view the vehicles and talk with team members.

Each team will have a series of visits from the judges during scheduled time periods. The judges may work together in small groups.

10.2 *Practice runs*

Practice time slots will be scheduled on an ad hoc basis by the technical director or the designee during the two practice days. It is our intent to provide as much practice time in the arena as is practical and to ensure minimal idle time for the arena. Each vehicle must be approved by the technical director or the designee before it will be allowed into the arena.

10.3 *Time slots announced for competition runs*

Competition time slots will be awarded based on standings after the static judging. The team that is in first place will have first choice, etc. Ties will be broken by a coin toss or random draw.

10.4 *Qualifying round of the competition*

Each qualifying team will be assigned a time slot to perform the mission. Twenty minutes before the beginning of their time slot, the team may enter the staging area near the launch site. At the beginning of their time slot, the team may move to the launching site on the dock. The first 5 minutes are for preparation. During this period, the vehicle may not be deployed in the water. When the 5-minute limit has expired (or the team has waived the balance of the preparation time), the judges will begin the **competition time** clock. These competition minutes are for the vehicle to perform the mission. Once this period has begun, the team may ask to have their vehicle placed in the water to begin its mission.

Vehicles will be put into and taken out of the water by tournament officials. The time required to do so will

not count against the **competition time** limit. If a vehicle is in the water, the team may request that it be lifted onto the dock. Tournament officials will move the vehicle onto the dock and (when requested) re-deploy the AUV into the water. Again, the time required to move the vehicle into and out of the water will not count against the **competition time** limit. However, time spent by the team on the dock does count against the **competition time** limit. The exception is when the vehicle is performing an autonomous survey and the clock will continue to run while retrieving and moving the vehicle.

The mission will continue until the **competition time** limit has expired, or the team captain requests the end of the mission, or the judges order the termination of the mission, or the vehicle breaches the surface. The judges may order termination of the mission at their discretion. Once the judges order the end of the mission, no further points may be scored. The judges' decisions on the termination of the run are final.

10.5 Final round of the competition

After the preliminary round, the judges will tally their scores. Teams will be accepted into the finals in rank order from the preliminary round. The judges have the discretion to select the number of teams entering the finals that they deem appropriate. We anticipate three to five teams competing in the finals. The finals round will be conducted in the same manner as the preliminary round.

11 AWARDS

Case prizes (and serious bragging rights) of up to \$20,000 will be awarded at the discretion of the judges.

12 DIAGRAMS

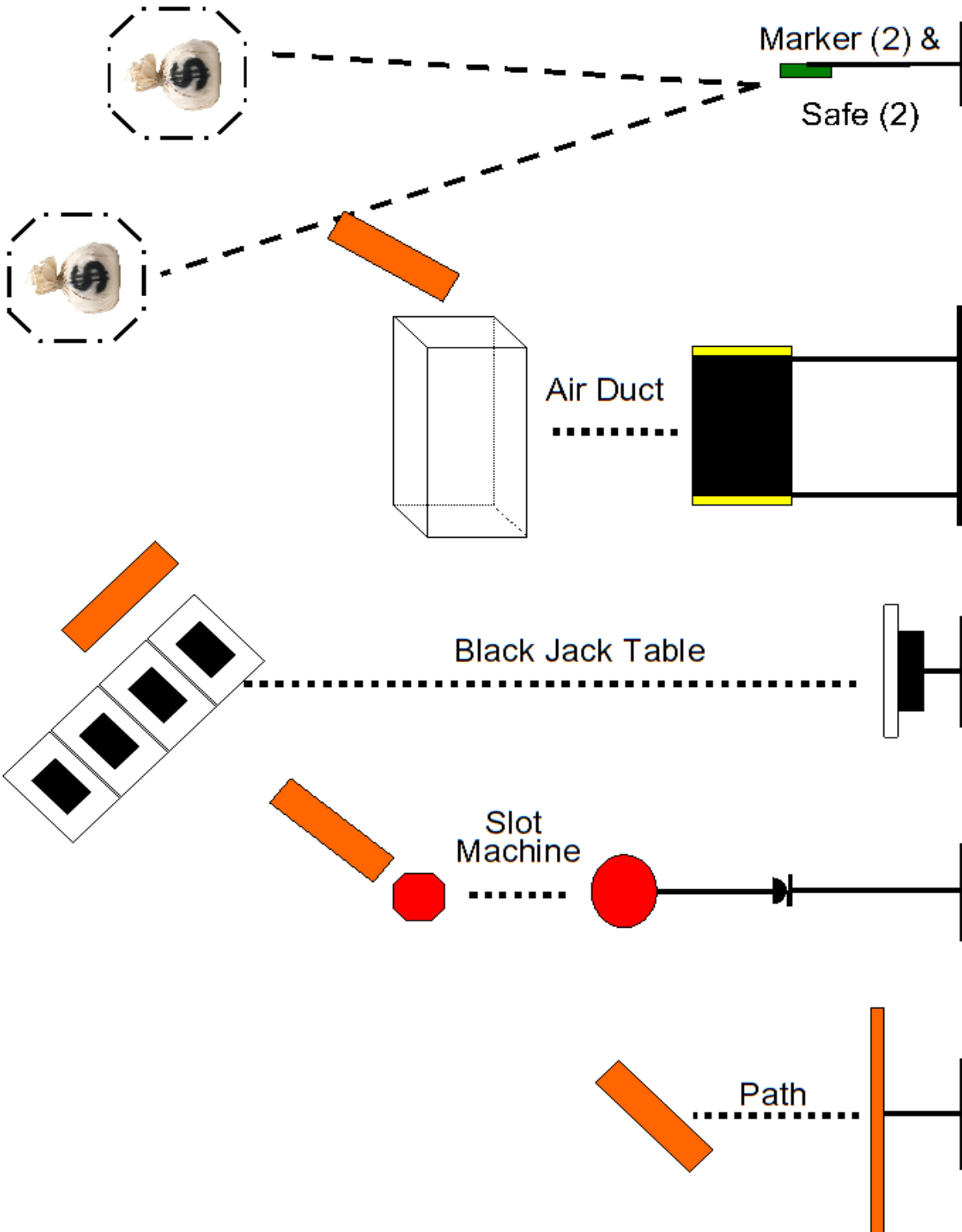


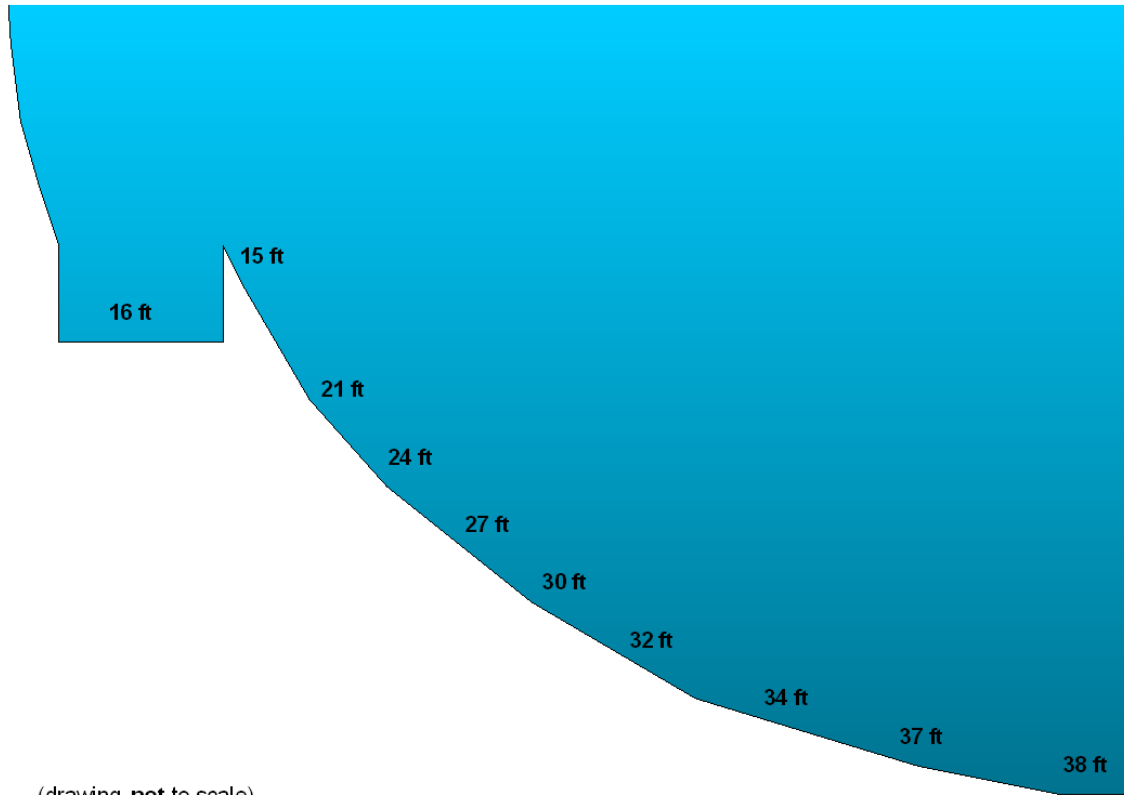
Figure 1: Casino TRANSDEC floor plan



Figure 2: Aerial photo of facility. The water clarity shown is typical. The bridge structure has no piers or supports in the pond.



Figure 3: Artsy photo of bridge across the water.



(drawing not to scale)

Figure 4: Cross section of arena showing the depth profile in feet. Note that the acoustic trap (the 16 ft deep section around the perimeter) varies in width around the pond.

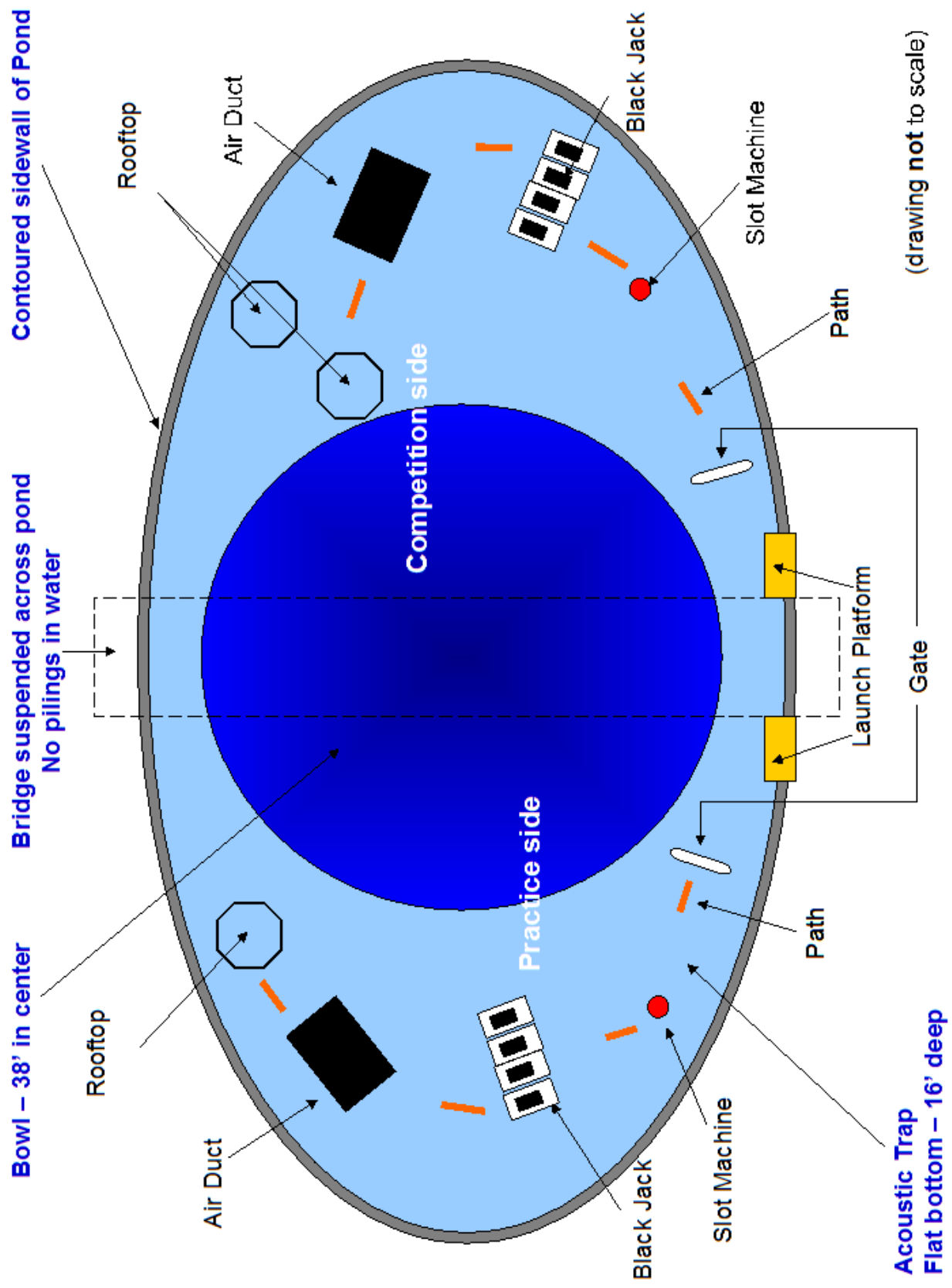


Figure 5: General layout of the arena. The arena is split into a competition side (right half of this view) and a practice side (left half).

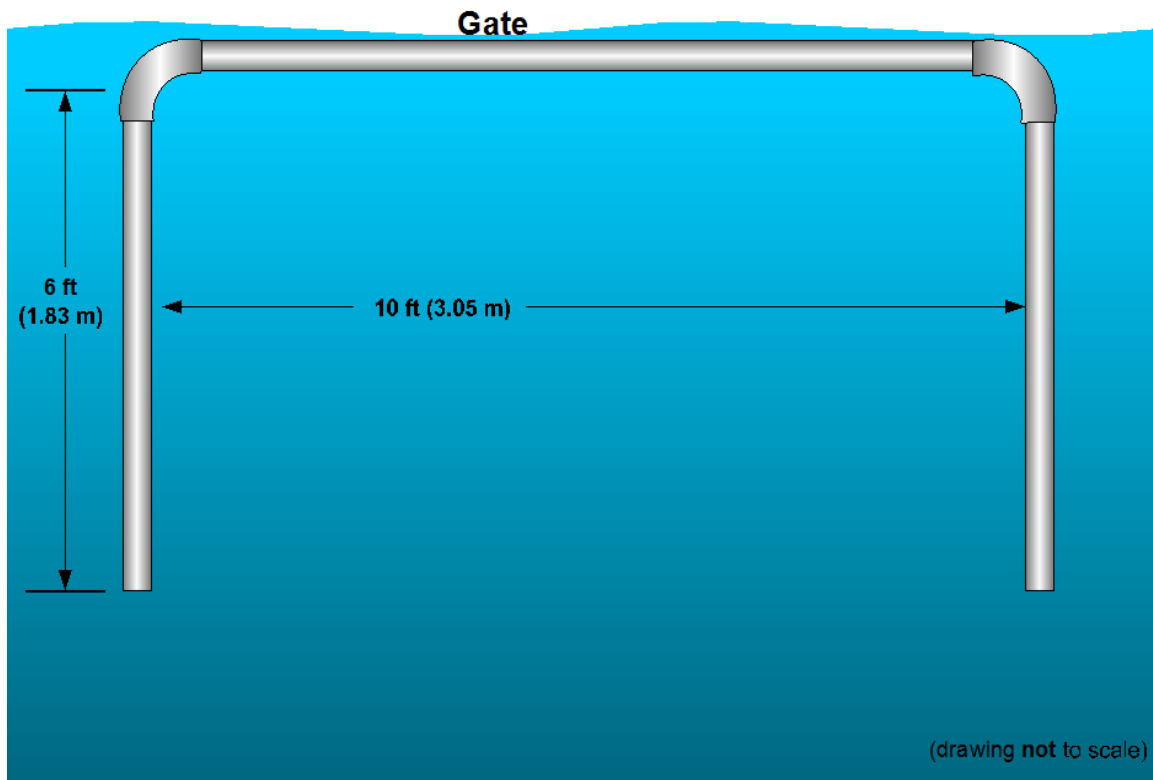


Figure 6: Validation gate. The gate is constructed of 4 inch inner diameter PVC pipe. It will be buoyant, and will be anchored to the bottom by lines.

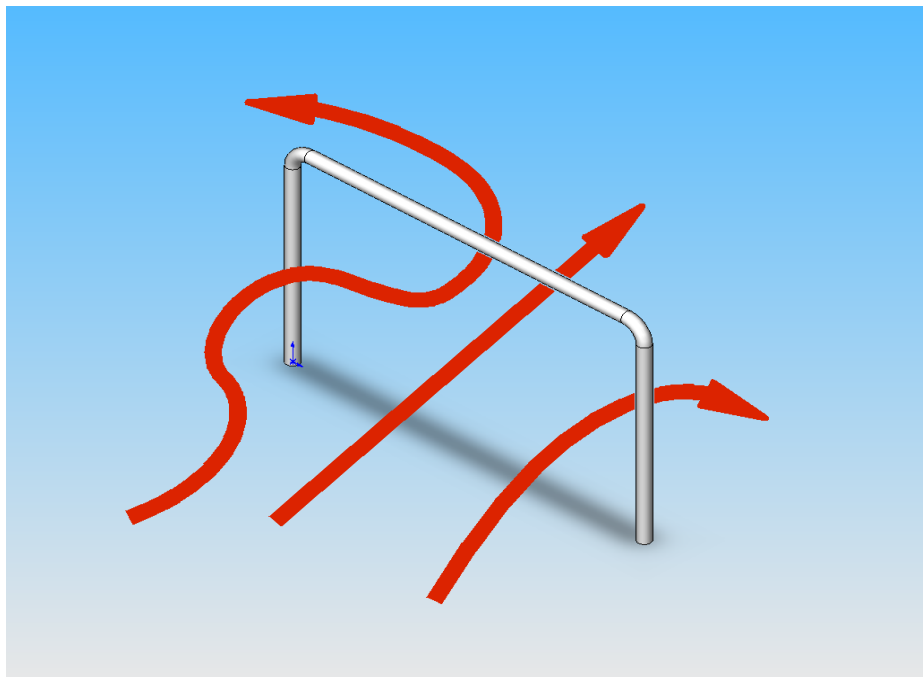


Figure 7: Valid ways to pass through the validation gate during the practice days.

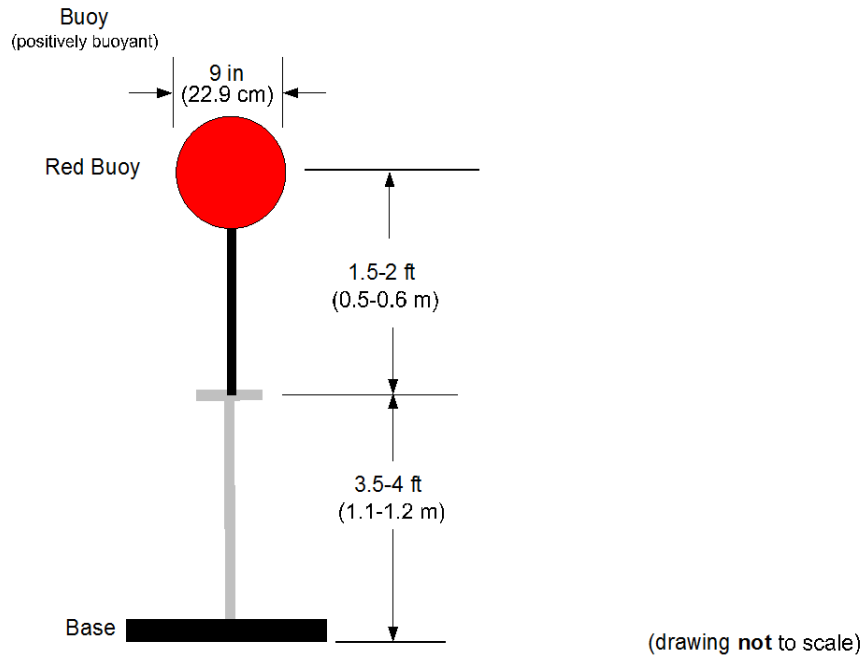


Figure 8: Slot machine (buoy), mooring line and base.

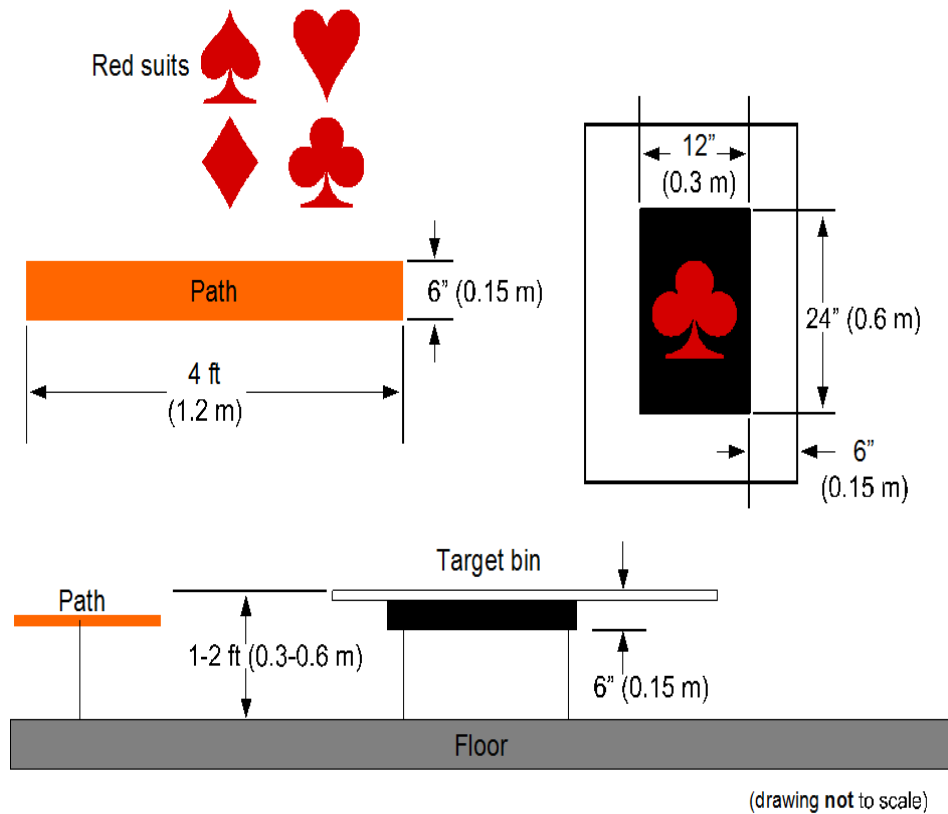
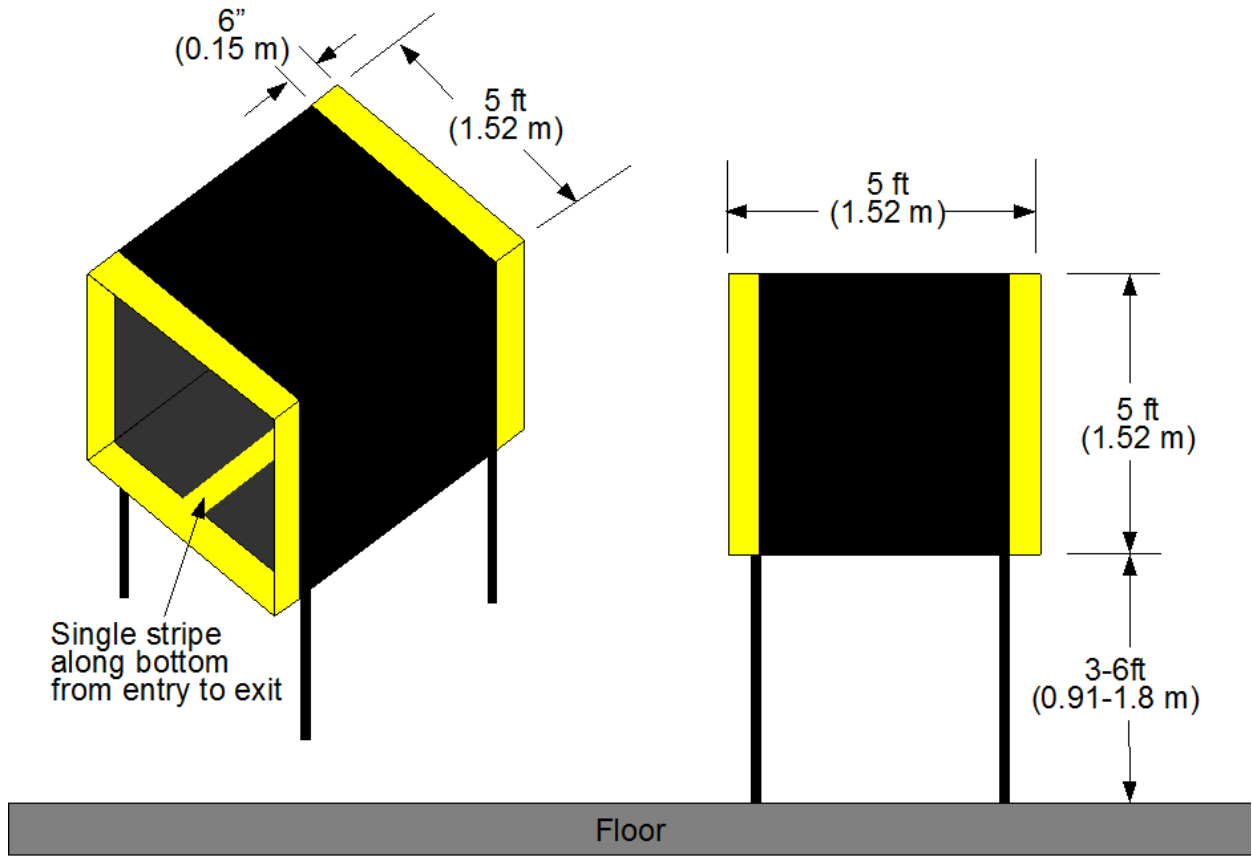


Figure 9: "Path" and Black Jack table (target bins). Distance between the path segments will vary.



(drawing not to scale)

Figure 10: Air duct. Entry/exit marked with a yellow stripe (inside and out). Yellow stripe along bottom from entry to exit.

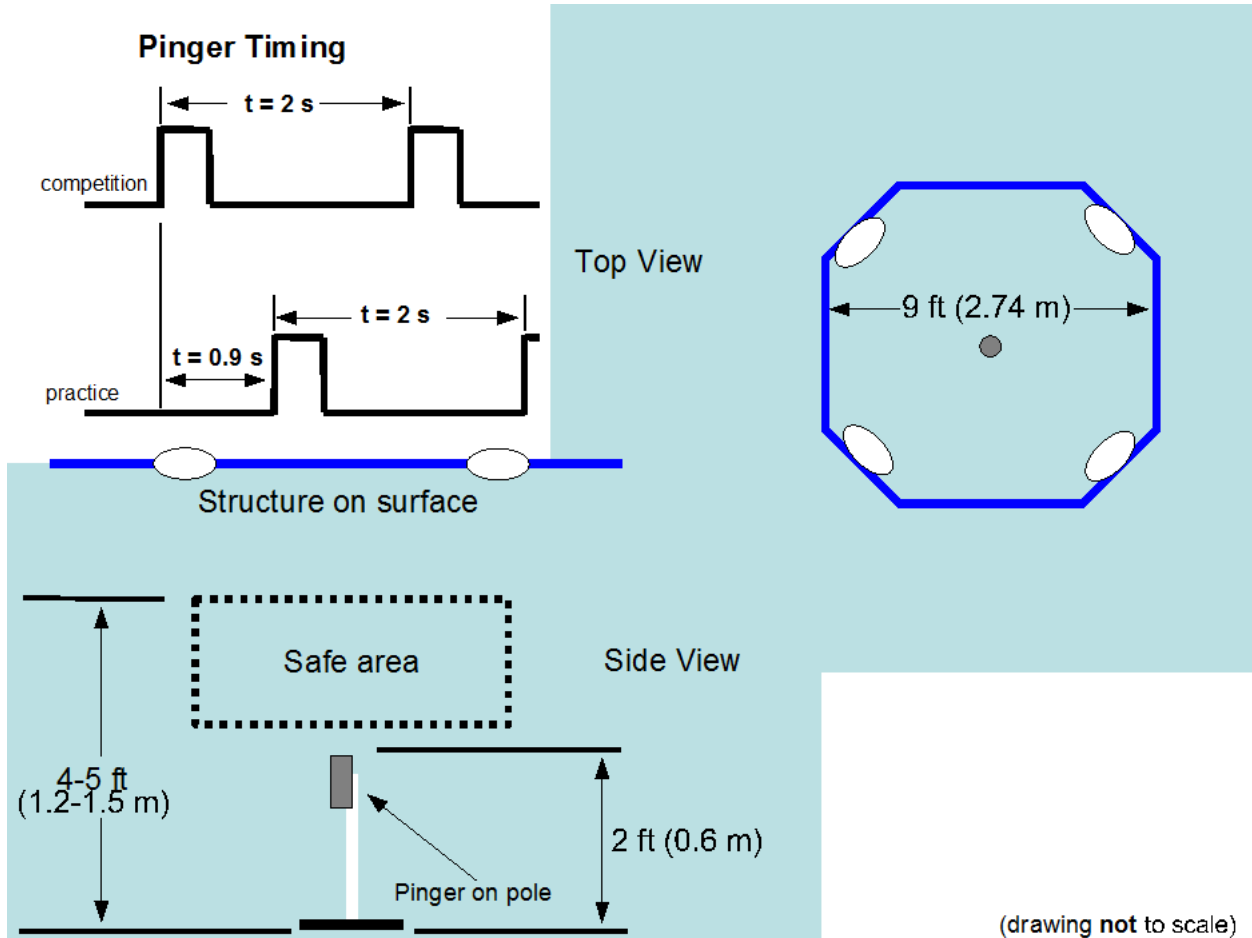


Figure 11: Safe & Rooftop. The "rooftop" is marked on the surface with floating 1/2" PVC pipe. The acoustic pinger is mounted on a pole in the center of this area. The Safe to be recovered is positioned directly above the pinger and held in place in such a way that you have to lift it to remove it from it's base.

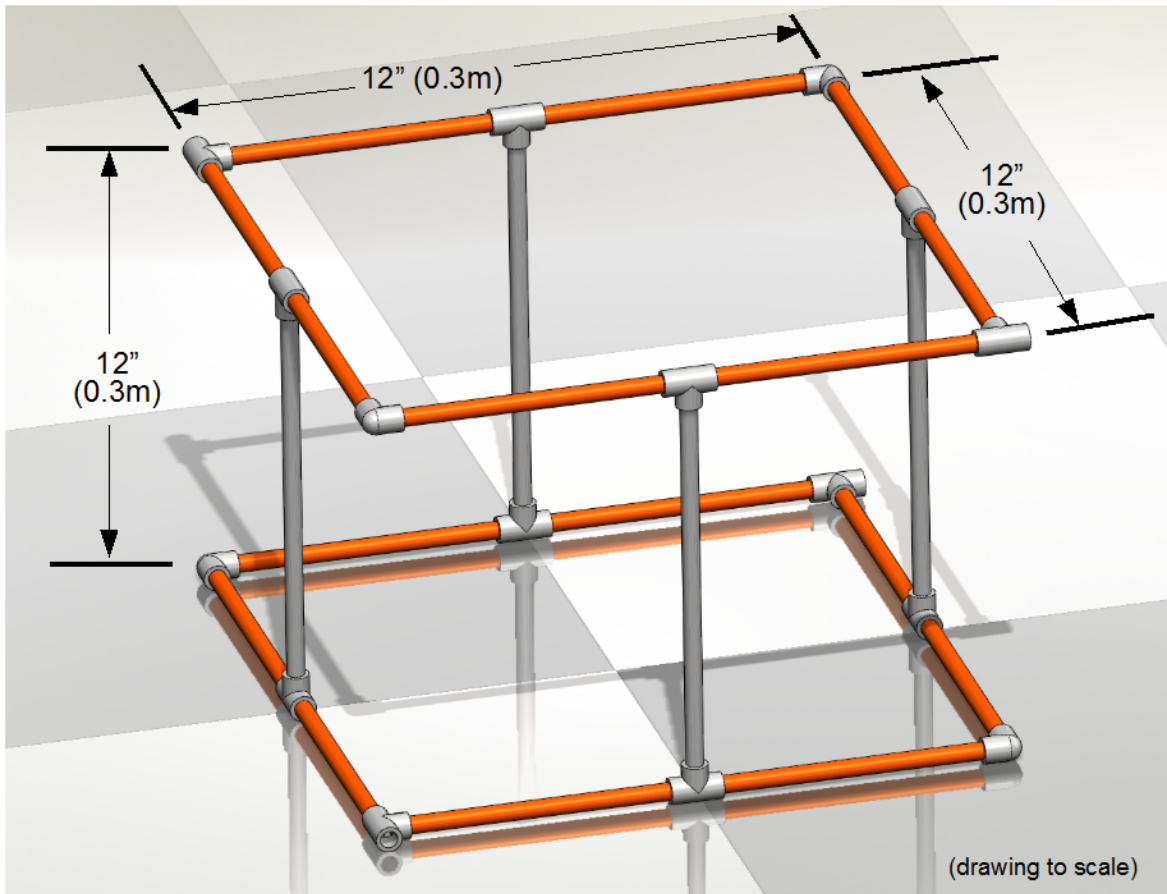


Figure 12: The Safe to recover.