

HPS2006

Human Powered Submarine Contest

Contest Date: July 19- 23, 2006

Contest Rules and Regulations

Rev 1.0

1. HPS2006 Structure

1.0 Dates and locale: the HPS2006 will be held on the 19th through the 23rd of July, 2006 at

Offshore Model Basin
578 Enterprise St.
Escondido, CA 92029

1.1 Application of regulations: These Regulations apply to all aspects of the HPS2006. The HPS2006 includes registration of the teams and contestants, oral design presentations, inspection of the submarines, and speed trials.

1.2 Purpose: The Purpose of HPS2006 is to enhance the engineering education of university level students by their participation in the design and construction of a submarine.

1.3 Acceptance of regulations: Teams and persons participating in the HPS2006 are assumed to know the Regulations. Participation in the HPS2006 by the teams or persons will constitute acceptance of the regulations.

1.4 HPS2006 headquarters: All mailed correspondence should be forwarded to:

HPS2006
7824 Mission Bonita Drive
San Diego, Ca
92120

1.5 Officials: A team of Officials to conduct Registration, Judging, and Timing will be selected by ASME Organizers. Officials having specific duties will be announced to the teams through a newsletter and at the HPS2006.

1.6 Jury: The organizers may form a jury made up of three to five members. The Jury will judge protests on the conformity with these Regulations, team disputes, and penalties, except safety decisions which are solely controlled by the dive master of the day. In addition, during the HPS2006 the Jury is empowered to decide cases not specifically covered by the Regulations, and cases filed after the HPS2006.

1.7 Advertisement, promotion and publicity: All advertising, sales promotion and publicity material produced by the entrants or their sponsors concerning or referring to the HPS2006 will refer prominently to the HPS2006 as the HPS2006. By entering the HPS2006, all teams and team members agree to the use of their names and photographs in any publicity materials that may be issued by the HPS2006's sponsors.

2. Entries: Teams must submit required registration materials on time to obtain or maintain registered status. HPS2006 must receive registration materials by the dates specified or the team's participation may be cancelled.

2.0 Team Entries: The HPS2006 is open to colleges, universities, trade schools and other post-secondary and secondary educational institutions. Each Institution /Team wishing to participate in the HPS2006 must submit an entry consisting of a team entry form and the applicable fee per 2.2.1. The form is due April 30, 2006 along with the fee. Submit forms/payments to headquarters per section 1.4.

An entry from multiple Institutions is permitted. An Institution may support more than one teams' entry. The entries are used to officially register all teams for the HPS2006.

Demonstration of underwater operation of the submarine prior to the HPS2006 is mandatory for entry. A VHS videotape or photographs of the safety and marking features of the submarines shall be submitted by June 30, 2006. The submarine must be substantially complete in the video/photographs, any incomplete features must be listed with completion plans and dates and provided with the tapes/photos. The video/photos shall demonstrate the following:

- Timing stripes and identification numbers on both sides of the submarine.
- Underwater operation of the canopy release mechanism both inside and outside the submarine.
- Underwater Operation of the operator constraint release mechanism.
- Safety markings for releases and constraints
- Underwater normal operating position of the operator(s).
- Underwater Safety Diver's view of occupant heads and faces and air gages per 3.6.2 and 3.7.1.
- Underwater egress of the operator(s) including operation of any necessary devices.
- Underwater occupant escape without assistance and occupant unconscious rescue.

2.1 Team Member Entry: Team members shall be ASME student members and full time credit earning students having good academic standing at the sponsoring institution during 2006. Participants who will not enter the water during the HPS2006 need not register as team members.

To assure the safety of divers and the purpose of the HPS2006, and to meet insurance requirements, each member of the team who enters the water must meet certain additional requirements, including:

- ASME membership.
- Photocopy of Dive certification
- File appropriate releases and forms.
- Full time student during 2006.

The forms for registering individual team members will be posted on the HPS2006 web site and must be filed by April 30, 2006. Additional dive certifications, first aid cards, etc. should be photocopied and sent in with individual registrations for judging of the safety prize. Evidence of enrollment must also be submitted. Submit forms/payments to headquarters per section 1.4.

2.1.1 Exception to ASME membership can be applied for before April 15th. The applicant must submit documentation of membership in 2006 in a professional organization appropriate to the applicant's participation in the design of the submarine. The applicant must also submit a letter explaining the applicant's contribution to the design and why membership in the professional organization is more appropriate than membership in ASME. Submit the application to headquarters per section 1.4.

2.1.2 Exception to an engineering major can be applied for before April 15th. The applicant must submit documentation of full time university enrollment in 2006 in a major appropriate to the applicant's participation in the design of the submarine. The applicant must also submit a letter explaining the applicant's contribution to the design and how their major subject is useful to the design team. Submit the application to headquarters per section 1.4.

2.2 HPS2006 registration: Anyone entering the water at the HPS2006 must be registered in advance. Onsite registration is not available. This includes:

- Team members.
- Safety Divers.
- Any other Divers

- 2.2.1** A non-refundable five hundred dollar (\$500) entry fee will be assessed from each submarine racing team. The entry fee must be submitted by April 30, 2006. Checks must be in US funds drawn on a US bank. Due to US banking practices, non US checks cannot be accepted. The committee will attempt to arrange a credit card payment method for non US teams. Checks may be payable to:

“ASME - San Diego Section”

The form and payment should be forwarded to HPS2006 headquarters per section 1.4.

- 2.3 Awards:** Awards for speed will be given for the four categories of section 2.5.

Additionally, an overall award and several lesser awards will be given for the design portion of the competition.

Oral Design Presentation

An oral design presentation shall be given by each team. The presentation will be judged on:

- Content: The presentation clearly explains the design and manufacturing tradeoffs and decisions made by the team.
- Knowledge: Each team member demonstrates in depth knowledge of their portion of the design.
- Delivery: The oral presentation and the visual aids are excellent.

Safety

A minimum level of safety is required for participation in the HPS2006 per these Regulations. The Safety Award is for safety features, practices, and training which exceed the requirements of these Regulations. Teams who violate any safety regulation are not eligible for the safety award, even after correction of the violation.

Innovation

Awards beneficial innovations in design.

Design

Awards well designed, efficient, and easily functioning submarines.

Construction

Awards excellent craftsmanship in submarine manufacturing.

Operation

Awards coordinated and practiced team operations. Discourages excessive delays caused by unprepared teams.

Overall Engineering

Due to differences between design categories per section 3.1 and differences in athletic ability, speed will not be considered in the Engineering Award. The Safety, Innovation, Design, Construction, and Operation categories above will each be considered equally, and the Oral Presentation Award will be considered at 200% the score of the other categories in assigning the Overall Engineering Award.

- 2.4 Guinness Book of Records:** The Guinness book of Records recognize as World Speed Records, the fastest propeller driven and non propeller driven human powered submarine. The HPS2006 committee will document and submit to the Guinness Publishing Company any record claim exceeding current speed records, consistent with the established methodology.

2.5 IHPVA International Records: The IHPVA recognizes as International Records the fastest:

- 1-person propeller driven human powered submarine.
- 2-person propeller driven human powered submarine.
- 1-person non propeller driven human powered submarine.
- 2-person non propeller driven human powered submarine.

The HPS2006 committee will document and submit to the IHPVA any record claim exceeding current speed records, consistent with the established methodology.

3. Design Technical Regulations

3.0 Technical Summary:

3.1 Definitions: For the purposes of the HPS2006, a submarine is defined as a free flooding (water filled; the transient presence of air bubbles before venting is acceptable) marine vehicle that fully encapsulates the occupant(s) and operates entirely beneath the surface of the water. Air filled devices such as air purged transmission components and ballast and attitude control systems are allowed provided that appropriate pressure relief devices are incorporated. Gasses other than breathable air are prohibited.

Racing is defined as the period of time starting when any one sub has departed the starting area and until it comes to a stop and a crewmember has notified a Safety Diver that it has completed its run.

Pool Operations is defined as the period of time starting any time the DM has declared that pool operations are in affect which usually requires a minimum number of Safety Divers in the pool; paramedics on site and in position; and radio communications with key personnel are established.

3.2 Propulsion Type

3.2.1 A propeller is defined as a thrust generating impeller which rotates 360 degrees or more.

3.2.2 A non-propeller system is defined as any propulsion system other than that described in 3.2.1.

3.3 Stored Propulsion Energy: All submarine propulsive power must be supplied by the human(s) aboard the submarine at the time it is used. Use of stored energy for propulsion is prohibited. Stored energy may be used for control, breathing, and other non-propulsion purposes provided that this energy will not incidentally propel the submarine.

3.4 Submarine Braking: Submarine braking devices are not required. However, a cargo net will be suspended across the basin after the exit of the timing gate. Its purpose, if necessary, is to “catch” the sub and bring it to a stop. The catch net will have a web spacing of not more than 1 foot. Any damage to a sub caused by the catch net is the sole responsibility of the sub team. The following types of braking are not allowed: Drogue chutes and sea anchors or similar devices; “Catcher” divers; and braking by rapid ascent or breaching. Refer to the facility Description, Section 4.0 for a description of the available deceleration space.

3.5 Drag reduction and lubricants: The use of drag reduction materials is permitted provided that the material(s) is non-hazardous, non-dissolving and will not slough off into the model basin. If drag reduction material(s) are used, teams must submit documentation to support the qualities of materials used. Given the closed water basin, tank conditions must be maintained throughout the HPS2006. The judges reserve the right to deny the use of any drag reducing material(s). Lubricants must follow the same rules and should be biodegradable vegetable types. Any other materials which would pollute the basin are prohibited. Documentation of any such chemicals shall be submitted to headquarters by April 30, 2006.

- 3.6 Life support systems:** All submarines must have on board for each occupant a totally independent primary air supply. Submarines shall not operate with less than 1000-psi air pressure in any primary life support bottle. These air supplies may only be used only for life support. All air pressure tanks must have a current visual inspection and hydrostatic test, a current United States Department of Transportation (DOT) approval, and must be filled within the limits of the DOT approval.
- 3.6.1** The primary air supplies shall be carried onboard the submarine and have the capacity to provide adequate air supply for each crewmember to propel the submarine through the course at depths to 5 meters.
- 3.6.2** Breathing air pressure gages shall be readily accessible and continuously visible to the occupant breathing from the air system. Occupants, when requested, shall show pressure gages to support or safety divers.
- 3.6.3** All breathing air used by the contestants shall be compressed normal atmospheric air. Special air mixtures such as Nitrox or oxygen-enriched air are prohibited.
- 3.6.4** All breathing air must be delivered via an open circuit SCUBA regulator. The use of other air systems, such as re-breathers or closed-circuit systems is prohibited.
- 3.6.5** Support dive air supply: All support divers shall be equipped with octopus regulators so as to support all submarine crew activities. All support divers are required to monitor their own air supply, and shall not allow their air supply to fall below 500psi.
- 3.6.6** The organizers reserve the right to inspect and declare the fitness for use of all life support equipment used by the submarine crew and team support divers.
- 3.7 Safety requirements:** Submarines shall be constructed and marked such that rescue of injured or unconscious occupants by safety divers totally unfamiliar with the submarine is simple and quick. Unassisted escape of occupants must also be simple and quick. Fluorescent orange or pink coloring is required for all devices the rescuer or occupant will need to operate for egress, including hatch releases, restraints, etc. The use of pink or orange or red markings on submarines is restricted to the specific safety requirements of these regulations and to other safety devices designated by the teams.
- 3.7.1** All head and face areas of all occupants must be visible to one safety diver at one location at all times to ensure the safety of the crew. Viewports, windows, canopies, etc. are required and shall be located on the submarine such that the crew has as unrestricted view as possible, especially forward, in the case of the pilot, and such that the safety diver has the view required above.
- 3.7.2** If in use, crew restraint devices must be easily visible, easily accessible and easily releasable by safety divers and the restrained occupants. Personal restraint devices must incorporate a single point release mechanism. All restraint devices, including foot restraints, must be marked with fluorescent orange or pink paint or tape. If attached to the hull, the location of restraint attach points on the hull shall be brightly marked with minimum 200 square centimeters of fluorescent orange or pink paint per hull attach point. A Hull Attach Point is the point(s) at which the harness attaches to the hull of the submarine. The mark shall be a square centered over the point or an arrow pointing to the point. The use of simple instructions such as "PULL" or "TURN" in black letters approximately 3 cm high with 5 mm line width over the pink or orange field is allowed. Handles and cords incorporated in the restraint shall also be marked in pink or orange. Cords restraining occupants shall be cuttable with a standard dive knife.
- 3.7.3** Towed surface floats, flashing beacons, transponders, deadman emergency buoy systems, and any other systems not specifically required by the regulations are NOT required. However, safety

features which exceed the requirements of these rules are encouraged and will be considered in the election of the safety prize winner. Releasable masses or any other devices which could cause rapid ascents are prohibited.

- 3.7.4** The crew compartment(s) of the submarine must be readily accessible with a hatch or canopy release mechanism. Each submarine occupant shall be able to exit the submarine without moving equipment (other than the canopy or hatch) or other occupants. Each occupant shall be able to open their applicable hatch. The handle or release mechanism(s) shall be operable from by either the occupant or external rescuer(s). The location of inside and outside release mechanisms on the hull shall be brightly marked with minimum 200 square centimeters of fluorescent orange or pink paint per release. The mark shall be a square centered over the release or an arrow pointing to the release. The use of simple instructions such as "PULL" or "TURN" in black letters approximately 3 cm high with 5 mm line width over the pink or orange field is allowed. Release handles and cords shall also be marked in pink or orange.
- 3.7.5** Propeller tips, control surface tips, and other protruding devices which may entangle in nets or hit nearby divers shall be painted or marked in fluorescent orange or pink for the outermost 8-12 centimeters for easy diver recognition.
- 3.7.6** Communications: Any devices which cause interference with race equipment or operations are prohibited.
- 3.8** **Diver certification:** All divers, including submarine occupants and team support divers, must show current minimum "Open Water" level scuba certification by a nationally recognized diver certification organization (NAUI, PADI, YMCA, SSI, etc.). A copy of that certification must be included with the individual's entry form. Failure to show adequate proof of certification will disqualify that individual from the HPS2006.
- 3.9** **Safety precautions:** Each team is responsible for the operating worthiness of their submarine. Passing judging or implementing changes suggested by judges does not relieve the team of any liability. All submarines, life support systems, including support diver equipment must be maintained in a safe and functional condition and be operated safely at all times. A team may be disqualified and withdrawn from the HPS2006 at any time if it is judged to be operating in an unsafe manner, which includes but is not limited to: sudden surface breaching, lack of safe directional control of the sub, crewmembers who are not in a safe medical condition to be a crewmember at any time during the HPS2006, and lack of adequate communications and/or coordination with the sub's support divers.
- 3.9.1** The dive master has final authority over boats and divers in the water. Teams who endanger other submarines and divers will be advised. Recurring dangerous activity will result in the team disqualification and removal from the basin. **Safety is a prime concern in this HPS2006. Any safety decisions by any safety diver or the HPS2006 chairman or his designee shall be heeded under penalty of disqualification and removal from the facility. The dive master has final authority in review of all HPS2006 safety decisions**
- 3.10** **Submarine identification:** The name of a submarine and paint scheme is left to the discretion to the team. Any graphics related to the submarine name, team's Institution(s) and or sponsors are permitted, provided they are neither offensive nor disruptive. It is advised that each submarine be painted with high-visibility coloration for the purposes of easy visual location. The use of certain colors is restricted by section 3.7.
- 3.10.1** Each team registered for the *HPS2006* will be assigned a unique hull identification number. If a submarine team prefers a specific number, they may request it be assigned to their hull by email or on the Team Entry Form.

- Requested numbers must be positive integers, 2 digits maximum. In the event of conflict, hull numbers will be assigned on a first-come-first-served basis.
- Hull identification numbers must be clearly displayed on both sides (port and starboard) of the hull.
- Each number shall be placed in a solid color field extending 2.5cm beyond the numbers.
- The digits shall be at least 25cm in height and 10 cm in width and shall have a line width of at least 2.5 cm.
- The color of the hull number and the background color must be in high contrast.
- Numbers having more than a single digit must have a minimum of 2.5 cm spacing between digits.

3.10.2 To provide a clear target for the timing cameras, a high contrast vertical color transition shall be affixed to both sides of the submarine. The transition shall consist of

- Two minimum 5cm wide stripes of contrasting color immediately adjacent to each others, and the stripes shall be minimum 60 cm in height.
- The transition shall be placed anywhere along the hull where it will be clearly visible.

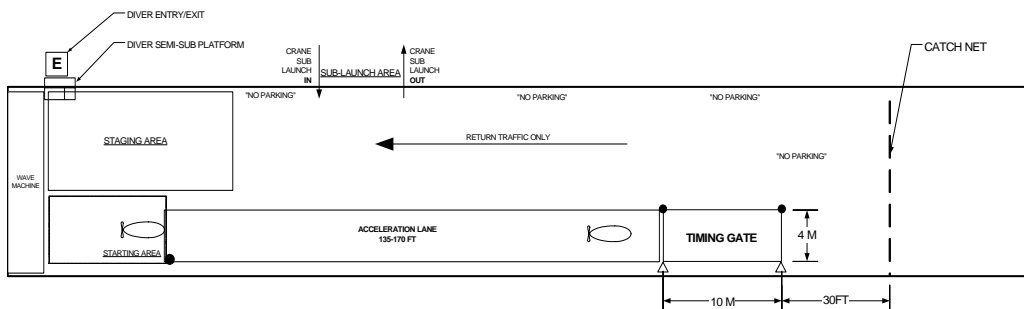
3.10.3 For the numbers and stripes discussed in this section contrasting colors means black and white or a similar very dark and very light color combination.

3.11 Judging: Each team registering for the HPS2006 must submit their submarine for inspection to verify vehicle safety and compliance with the Regulations. In addition, spot checks for regulation compliance may take place during and immediately after the HPS2006. Teams failing to pass the inspections will be allowed to correct deficiencies to participate in the speed trials, however, safety deficiencies disqualify teams from the safety prize even if corrected. Modifications made to an entry after safety judging may require re-inspection. A complete submarine is required for judging. Teams failing to pass safety inspection will be denied access to the basin. Judges will also inspect the submarines and interview the team members to determine the engineering prizes.

4. Race Proceedings

4.0 Facility description: The HPS2006 is staged in an indoor fresh water model tow basin

- 48 feet wide
 - 15 feet deep.
 - Cameras are 6' above the tank floor
 - A stripe on the floor defines the center of the lane.



- 4.1 Protests:** Any team that desires to file a protest must do so in writing by submitting an official protest letter to HPS2006 Headquarters. The dive master of the day has final authority on all safety decisions. The jury will hear all other protests.
- 4.1.1 Protest Judgements:** Final safety decisions are made by the dive master of the day. The decision of the jury on any other matter is final and no further appeals are allowed. The jury will notify HPS2006 Headquarters of their decision, and HPS2006 Headquarters will then inform the affected teams.
- 4.1.2 Opportunity to Be Heard:** Protests will be heard by the jury at the earliest possible jury sitting. However, it may be necessary in some instances for the jury to postpone the hearing on a protest.