2018 HPVC Design Scoring Criteria			
	Design Report Evaluation	**100**	
	General	**5**	**Evaluated based on report**
1	**Form 6**	1	Form 6 completed and attached to front of report (V.F.1)
2	**Title Page**	1	Title page information correct and complete (V.F.2)
3	**3-View Drawing**	1.5	3-View drawing, in accordance with ASME Y14.5 and related standards such as ASME Y14.24 and ASME Y14.3
4	**Abstract**	1.5	Abstract included, correct length, clear, concise, and informative. This should be page 1
	Design	**15**	**Evaluated based on report**
1	**New Design**	2	2 - Teams must demonstrate that the entry is a new design (not just a new frame or fairing) completed during the current academic year, or not HPVC entry for last 2 years 1 -Some new elements (frame, fairing, etc.) or no HPVC entry for last year 0 - Similar to previous year's entry
2	**Design Methodology**		
	Design Objective	1	Provide clear design objectives and goals for project. (Hint: "To Win" or "To do better than last year" are not acceptable objectives)
	Background research	1	Include supporting research and review of prior art. Provide background information to justify your objectives, mission, design approaches, and design concepts. Background research should include specific information found/used to aid in design and development of the HPVC, but should not include your teams general competition history. Appropriate background research can include information found on HPV development, aerodynamics, HPV standards (such as ISO or Federal), competitive vehicles, etc. Cite references as appropriate.
	Prior Work	1	Clearly document any design, fabrication, or testing that was not completed in the current academic year. If teams reuse work from previous years and it is not listed here teams will be assessed a penalty for reusing content.
	Organizational Timeline	1	Include an organizational timeline or Gantt chart showing project scheduling and completion
	Design Criteria/PDS	1	Provide well established design criteria and product design specifications
	Alternatives and Evaluation	1	Present alternative designs that were considered using concept improvement and selection techniques
	Structured Design Methods	2	Document use of established design methodologies, including, but not limited to QFD, Decision Matrices, etc. How did you choose features of your design with respect to your specifications and requirements?
	Description	1	Describe the final vehicle design, making generous use of drawings and figures. Describe how the vehicle can be practically used, what environmental conditions were addressed and components and systems were selected or designed to meet the objectives.
3	**Discretionary Points**	4	Discretionary points based on overall thoroughness, quality, accuracy, and approach
	Analysis	**25**	**Evaluated based on report**
1	**Rollover/Side Protection System**		Per RPS requirements
	Top Load Modeling	1	Clearly and accurately describe constraints, idealizations, load path from rider to ground, etc.
	Top Load Results	2	Clearly describe and interpret results, score depends on results and perceived validity of results. Target load is to be applied and deflection value is to be clearly documented as result. 0: Maximum total elastic deflection equal to or greater than 7.6 cm (3.0 in); 1: 6.4 cm (2.5 in); 2: 5.1 cm (2.0 in) or less
	Side Load Modeling	1	Clearly and accurately describe constraints, idealizations, load path from rider to ground, etc.
	Side Load Results	2	Clearly describe and interpret results, score depends on results and perceived validity of results. Target load is to be applied and deflection value is to be clearly documented as result. 0: Maximum total elastic deflection equal to or greater than 6.4 cm (2.5 in); 1: 5.1 cm (2.0 in); 2: 3.8 cm (1.5 in) or less
2	**Structural Analytical Calculations**		Demonstrated appropriate and correct use of numerical computational tools such as FEA, CFD, etc.
	Objectives	1	Clear objective for the analysis
	Analysis Case Definitions	1	Clearly identify and describe analysis cases, include rationale for each
	Modeling	1	Clearly and accurately describe constraints, idealizations, use of symmetry, etc.
	Results	2	Clearly describe and interpret results
	Design Modifications	1	Demonstrate how results were used to modify and improve the design
3	**Aerodynamics**		
	Aero Device Incorporated	1	All entries are required to have an aerodynamic device incorporated into their design (make-shift items, false claims, and claims such as reclined rider position contributes to aero will not be granted credit)
	Alternatives Evaluated	1	Must evaluate several alternatives in a trade study
	Chosen Design Substantiated	1	Must substantiate chosen aero device through analysis
4	**Cost Analysis**		
		2	Tabulated cost summary of prototype included. Include all actual expenditures and capital costs, but do not include student labor.
5	**Other Analyses**		Vehicle handling, stability, steering, suspension kinematics & dynamics, optimizations, and other analyses
	Objectives	1	Clear objective for the analysis
	Analysis Case Definitions	1	Clearly identify and describe analysis cases, include rationale for each
	Results	1	Clearly describe and interpret results
	Design Modifications	1	Demonstrate how results were used to modify and improve the design
6	**Discretionary Points**	4	Discretionary points based on overall thoroughness, quality, accuracy, and approach
	Testing	**25**	**Evaluated based on report and presentation**
1	**Rollover/Side Protection System**		Per RPS requirements
	Top Load Testing Setup	1	Test method clearly described, appropriate, and scientific
	Top Load Testing Results	2	Clearly describe and interpret results, score depends on results and perceived validity of results. Increasing load is to be added to RPS until maximum deflection is reached and then load achieved is to be clearly stated as the result. 0: Less than 1780N (400 lbf); 1: 1780-2670N (400-599 lbf); 2: ≥2670N (600 lbf)
	Side Load Testing Setup	1	Test method clearly described, appropriate, and scientific
	Side Load Testing Results	2	Clearly describe and interpret results, score depends on results and perceived validity of results. Increasing load is to be added to RPS until maximum deflection is reached and then load achieved is to be clearly stated as the result. 0: Less than 890N (200 lbf); 1: 890-1330N (200-299 lbf); 2: >1330N (300 lbf)
2	**Developmental Testing**		Physical testing to develop or verify design, usually conducted prior to final vehicle construction
	Objective & Methodology	1	Clear objective for the experiment. Methodology clearly described, appropriate, and scientific
	Results and Discussion	1	Data is reported and presented clearly, with appropriate discussion (interpretation, error sources, uncertainty, etc.)
	Statistical Analysis	1	Data is analyzed and presented clearly, with appropriate statistical analyses (t-test, ANOVA, regression, etc.) and measures (mean and standard deviation, confidence intervals, p-value, etc.)
	Conclusions	1	Conclusions and recommendations stated clearly. Results should be quantitative where possible and include applicable statistical analyses (mean, standard deviation, student T test, etc.)
	Design Modifications	1	Demonstrate how testing results used to modify or improve the design
	Comparison with PDS and Analysis	1	Test results clearly compared with analysis results and product design specifications
	Comprehensiveness	1	Extent of developmental testing: 0: few experiments/little significance on design, 1: many experiments/significant effect on design
3	**Performance Testing**		Physical testing (often conducted on final vehicle) to evaluate and optimize performance
	Objective & Methodology	1	Clear objective for the experiment. Methodology clearly described, appropriate, and scientific.
	Results and Discussion	1	Data is reported and presented clearly, with appropriate discussion (interpretation, error sources, uncertainty, etc.)
	Statistical Analysis	1	Data is analyzed and presented clearly, with appropriate statistical analyses (t-test, ANOVA, regression, etc.) and measures (mean and standard deviation, confidence intervals, p-value, etc.)
	Conclusions	1	Conclusions and recommendations stated clearly. Results should be quantitative where possible and include applicable statistical analyses (mean, standard deviation, student T test, etc.)
	Design Modifications	1	Demonstrate how testing results used to modify or improve the design
	Comparison with PDS and Analysis	1	Test results clearly compared with analysis results and product design specifications
	Comprehensiveness	1	Extent of developmental testing: 0: few experiments/little significance on design, 1: many experiments/significant effect on design
4	**Discretionary Points**	5	Discretionary points based on overall thoroughness, quality, accuracy, and approach
	Safety	**20**	**Evaluated based on report, safety inspection, and safety video**
1	**Rollover/Side Protection System**		
	Installation & Design	1.5	Rollover/Side protection system installed and functional
	Consistent with RPS rule	1.5	RPS design and fabrication appears consistent with rules
	Prevents bodily contact with ground	1	RPS must prevent the riders appendages and head from contacting the ground in the event of a crash where the HPVC falls over or inverts
2	**Safety Harness**	2	Seat belt installed correctly and appears to meet rules
3	**Steering System**	1.5	No excessive play or looseness, correct installation, apparent stability, etc.
4	**Braking System**	1.5	Inspection shows brake levers & calipers/brake assemblies are ridgidly mounted, cables are tight, pads have ample thickness and pads make full contact with rim/disk. HPV must pass braking performance test within one or two attempts for full points
5	**Sharp Edges, Protrusions, Pinch Points**	2	No sharp edges or protrusions on fairing, frame or components. No hazardous pinch points, especially near spoked wheels, chains, sprockets, etc. (Subtract points for serious hazards)
6	**Other Hazards**	1	No other obvious hazards
7	**Rider's Field of View**	1	Rider should have more than 180 degrees of visibility
8	**Safety Accessories**		
	Bell/Horn	1	Audible signal device installed and operational
	Taillight	1	Red Taillight visible 150 meters to the rear, installed and operational
	Headlight	0.5	White headlight installed and operational, visible 150 meters to the front, installed and operational
	Side reflectors	0.5	Red, amber, or similar colored reflectors on each side of vehicle properly installed
	Rear view mirrors	0.5	Mirror(s) installed providing the driver with views to the rear of the vehicle
9	**Additional Safety Features**	1.5	An additional safety feature(s) are incorporated specific to their design (beyond required safety features)
10	**Discretionary Points**	2	Discretionary points based on the quality and thoroughness of design to maximize HPVC safety (based on report and safety inspection)
	Aesthetics	**10**	**Evaluated based on state of vehicle at safety inspection**
	Overall impression of vehicle	3	Overall impression
	Quality of craftsmanship	3	Craftsmanship (welds, joints, assembly, etc.) is professional and attractive
	Quality of custom parts	2	Team-fabricated and custom parts look professional and of high quality
	Quality of Frame/Fairing Finish	2	Exterior finish and decoration quality is neat, attractive, and professional (frame and/or fairing)

2018 HPVC Innovation Scoring Criteria

	Item	Question	Points	Discussion	Notes	Evaluation based on
Innovation Multiplier	1	Is the proposed innovation a new idea?	1x to 2x multiplier	Students must provide clear evidence that they have developed a truly innovative and new idea. This can be bolstered by a high level of difficulty/depth of the innovation, and conversely trivial/banal innovations will not earn a high multiplier.	List/discussion of similar patents, summary of literature review, and/or patent applications by teams are sufficient. Reused innovations are **not acceptable** and points are only awarded in the first year a team submits a specific design. Ignorance of an existing design does not warrant allocation of points if the judging team does not feel the innovation is not a new idea.	Report
Design	2	What is the need for the proposed innovation?	2	Students must document the target market and need of their specific innovation	All innovations solve problems for specific needs. Please list the embodiment of the need and how this innovation solves the problem.	Report
	3	Does the proposed innovation benefit or advance the state of the art of human-powered vehicles?	2	Students must clearly show that the innovation has benefits, which can be performance, ergonomics, cost, environmental, social, etc.	This can be applicable in the HPVC or to mainstream human powered vehicles.	Report
	4	Is the innovation possible with existing or proposed technology and is this specific proposed execution feasible?	3	Students must clearly demonstrate that the innovation is does not require a violation of the laws of physics or the use of an unavailable process or material. Students must also show that the proposed embodiment of the design is feasible. In other words, the concept will work?		Report
Concept Evaluation	5	Is the prototype functional?	3	Does the prototype do what was intended? This is not an evaluation of how well it performs, but a validation of the design concept.	Early prototypes will often show more learning opportunities while subsequent prototypes (or iterative improvements to one prototype) will often better confirm functionality.	Report and Innovation Video
	6	Are the proposed benefits of the concept realized?	3	Students must provide data to show how effectively the prototype achieved the anticipated benefits in question 3.	This can be executed by testing a mock up, prototype, or even a full scale version.	Report and Innovation Video
	7	Are there any unanticipated benefits?	2	Students must provide data to show how effectively the prototype achieved unanticipated benefits. Often the proposed benefits are not as important as unanticipated benefits.	Often times during the innovation process unanticipated benefits outweigh the original goals of the design and advance the state of the art significantly.	Report and Innovation Video
Learnings	8	What failures were experienced?	2	Students should document what did not work -- concepts that turned out to be infeasible (why?), prototypes that did not work (why), and unanticipated difficulties.	Read Henry Petroski to get an idea of how important failures are in innovation.	Report and Innovation Video
	9	What was learned from the failures?	3	Students should document how failures were used as stepping stones to subsequent successes.	Most innovations are built on what is learned by failures. In fact, more is learned from failures than from successes.	Report and Innovation Video
	10	What are the unanticipated negative aspects of the design?	2	Students should clearly identify and if possible quantify unanticipated negative aspects -- increased cost, regulatory restrictions, negative environmental aspects, etc.	Even though benefits are realized, the innovation may not have full value because of some unanticipated negatives.	Report and Innovation Video
Execution	11	How well does the concept function based on the quality of the design?	3	Students should demonstrate how well the concept performs based on the quality of the design and the quality of physical execution	Well executed designs that function as intended shall receive maximum points, whereas poorly executed concepts with low craftsmanship that do not function shall receive low points.	Innovation Video
	12	Does the quality of execution reinforce the benefit(s) of the innovation?	3	Students must show that the physical execution of the design allows for or exceeds the intended benefits of the innovation	If the execution of the concept performs up to or beyond the intended level described in the benefits, full points should be awarded. If explicit metrics for measuring the quality of execution are not available the judges will assess points at their discretion.	Innovation Video