MINI-INDY RULES

1979

Mini-Indy 1979 Rules*

The typical mechanical engineer leaves the university with a respectable background in the basic engineering-science-type disciplines of thermodynamics, heat transfer, fluid mechanics, mechanics of solids and control theory. But upon entering industry he often finds difficulty in applying his theoretical background. This is, in part, due to a lack of practice in the specialized communication techniques industry so often requires: instructing secretaries, draftsmen, and shop personnel, sketching and using symbolic language, report writing and talking with clients, contemporaries and managers. The problem may further be compounded by a deficiency in knowledge of the state of the art and in methods for gathering information. Primarily, however, the difficulties lie in the open-ended nature of the design process.

The open-ended nature of design can be presented to the student most effectively in the form of a competitive design project, such as Mini-Indy '79.

During the last three years, over twenty universities have designed and built one-man vehicles for competitions in Columbia, S.C., Lafayette, La., Milwaukee, Wis., Tempe, Az., and Orlando, Fla. The response to these competitions has been excellent and Mini-Indy '79 continues this tradition.

The estimated cost of producing a 5 hp Mini-Indy car is about $600. The purpose of Mini-Indy '79 is to introduce engineering students to practical industrial design by engaging in a design competition. The object of the competition will be to design and fabricate a small, one-man Indy-type car that will be completely competitive and safe. In other words: design the <u>most</u> competitive vehicle for the <u>least</u> cost.

DESIGN CONSTRAINTS

A. General Design Considerations

1. Visually appealing to buying public
2. Closely resemble Indy cars in appearance
3. Enjoyable to operate because of performance
4. Reliable
5. Manufactureable with standard machine tools and materials using predominantly semi-skilled employees
6. Most competitive vehicle for the least cost
7. Fuel efficient

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*Rules are based on and extracted from MINI-BAJA 1977, Dr. John F. Stephens, University of Southwestern Louisiana.

B. Specific Design Constraints

1. Each entrant will use an identical 5 hp, 4-cycle horizontal shaft, air-cooled engine, supplied at no charge by Briggs and Stratton. The engine must remain completely stock. No oil or gasoline additives will be permitted. The fuel tanks may be relocated. A Briggs and Stratton representative will tune the engines on the day of the race.

2. Each vehicle will represent approximately 300 man-hours of manufacturing time. This does not include design time.

3. The vehicle must be capable of carrying a 6'3" adult weighing 250 pounds.

4. The vehicle must be capable of operating on an asphalt or concrete type race surface.

5. The vehicle must have a top speed of approximately 40 mph.

6. The weight of the vehicle should be less than 400 pounds.

7. The total vehicle must have a manufactured cost of $600 or less (see the next section for costing techniques). Each entrant will prepare a cost analysis endorsed by a P.E. not on the faculty of the entering school. These analyses must be submitted two weeks prior to the competition; they will be carefully reviewed by the judges.

DISCUSSION OF THE DESIGN, FABRICATION AND COSTING PROCEDURE

Each entrant will receive a 5 hp, air-cooled engine (Briggs & Stratton Model No. 130232, Type 0112-01). The cost of this engine will be deducted from the allotted $600. With the remaining funds, the vehicle must be constructed in its entirety. During the design and fabrication process, each student should be exposed to standard parts catalogs, simple fabrication using basic machine tools, and the world of design economics. It is important, then, that all students participate equally. The manufacture of the vehicle should be the product of approximately 300 man-hours, and the students should fabricate most of the vehicle components. The manufactured cost of these vehicles, based upon 4000 units per year, will be determined as the sum of the following items:

a) All purchased parts at wholesale prices. To determine this price, obtain the suggested retail price from the distributor and deduct 60%. The remaining cost is the manufacturers cost to you based upon 4000 vehicles per year. Deduct only 40% for the engine.

b) A labor cost equal to the time to produce any part (as estimated by a qualified individual such as a shop foreman) times the hourly rate of $5.00 per hour. In this way, students with little machine experience are not at a disadvantage. Base all labor cost on a production run of 4000 units per year.

c) An overhead cost equal to the time determined in part (b) times a burden rate of $5.00 per hour.

d) The wholesale cost of all material used.

e) The cost does not include design time.

f) A complete costing guide will be sent to each entrant.

It is obvious that complete fabrication of all parts is impossible in the given time frame. As part (a) indicates, students may purchase any parts they wish.

The engine cannot be altered in any fashion that will affect its performance (except for the relocation of the fuel tank). It may be tuned to the manufacturer's specifications and parts may be replaced should they fail or wear out.

THE COMPETITION

During the Mini-Indy 1979 competition, to be held in mid-May, each vehicle will be judged in the following manner:

1. General appearance -- asthetic beauty, attention to detail, neatness, appearance of an Indy-type car.

2. Safety -- safety is an extremely important facet of this competition. A designer is liable for negligence in design if it affects passenger safety. We will, then, require safety standards. Required prior to the judging:

   a) The driver must wear an approved motorcycle type helmet and protective eyewear (these items do not contribute to the vehicle cost).

   b) The vehicle must be equipped with at least an automotive type seat belt as a driver restraint system.

   c) The vehicle must have driver roll cage constructed of at least 1" O.D. (0.083" thick) mild steel tube. This cage must be anchored in at least four locations.

   d) The vehicle must carry a class B & C fire extinguisher with an Underwriters Lab decal and at least a 2 lb. capacity.

   e) The vehicle must have an engine kill switch within convenient reach of the driver.

   f) There should be no sharp edges or protrusions on the vehicle.

   g) The driver, the fuel tank, and the fuel lines must be protected from flying debris that would result from the failure of any drive component (chains, torque converter, sprockets, etc.). The shield for these parts must be mild steel plate at least 1/8" thick.

No vehicle deemed unsafe by the judges will be allowed to compete until the safety defect is corrected.

3. Design and Creativity -- new design concepts, design improvements, unusual manufacturing techniques, etc.

4. Performance -- we encourage each entrant to have a different driver for as many events as possible primarily to spread out the fun.

   a) 100-yard acceleration (drag) race -- elapsed time to traverse a level, paved 100-yard track. Minimum driver weight for this event is 150 pounds.

   b) Maneuverability -- elapsed time through a sports car rally type course with both left and right turns. A 10-second penalty is added to the elapsed time for each course marker or pylon that is hit.

c) Reliability and Overall Performance -- endurance run through a level paved course with left and right turns. Elapsed time will determine the winner. Any vehicle becoming mechanically disabled must be pushed by the driver to a designated pit area for repairs by the team. The driver has the option of repairing the vehicle using tools in his possession at the time of the breakdown, providing he pushes the vehicle off the race course.

d) Fuel Economy -- the car completing the most laps using a given volume of fuel will determine the winner. All laps must be completed within the two hour period following the start of this event.

The relative importance of all the above events is:

1.	General appearance	15%
2.	Safety	10%*
3.	Design and Creativity	10%
4.	Acceleration	10%
5.	Maneuverability	10%
6.	Reliability and Endurance	20%
7.	Fuel Economy	15%
8.	Cost	10%

*If the judges deem a vehicle unsafe, it will not be allowed to race until the safety defect is corrected.

Concerning items (1) through (3), 0 to 100 points are awarded to each vehicle based on the decision of the judges (see appendix for the Judges Scoring Sheet). The eight judges will be chief engineers and chief manufacturing engineers from large corporations located throughout the United States. Items (4) through (6) receive points as follows: on a points awarded vs. time for competition graph (see Fig. 1), award 100 points to the first place finisher and 20 points to the last place finisher. A straight line between these two points provides the score for those vehicles finishing in between. Should a vehicle not complete the endurance run, partial points will be awarded based on the number of laps completed and the average speed as compared to cars that finish the run. Points awarded for fuel economy (7) will use a scheme similar to that shown in Fig. 1, except that the abscissa becomes distance traveled rather than time. 100 points are awarded to the entrant completing the greatest number of laps within the time period allotted for this race and 20 points to the entrant completing the least number of laps. Points awarded for cost (8) will also use a scheme similar to that shown in Fig. 1, except that the abscissa becomes cost. 100 points are awarded to the least expensive entrant and 20 points to the most expensive entrant (not to exceed $600).

Each vehicle will receive a total score based upon the following equation:

TOTAL SCORE: 1.5 (General Appearance) + (Safety) + (Design)
0-100 0-100 0-100

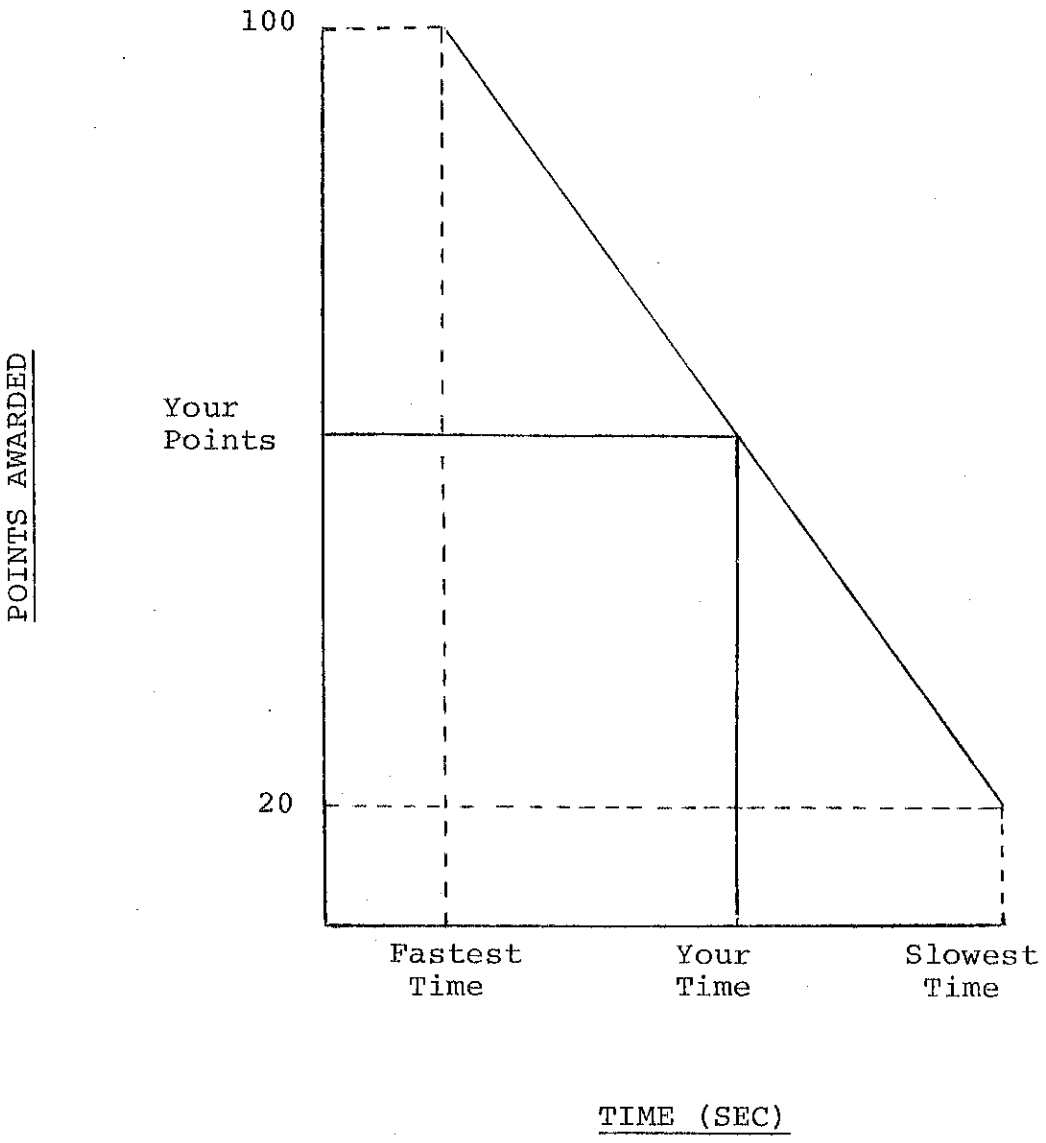
+ (Acceleration) + (Maneuverability)
0-100 0-100

+ 2(Overall Performance) + 1.5(Fuel Economy)
0-100 0-100

+ (Cost)
20-100

On the first day of the competition, the judges will evaluate the appearance, safety, design and cost. A judges scoresheet (see appendix) will be given to the judges as a suggested evaluation form, however, they will not be required to follow every detail of this sheet. On the second day of the competition, the performance events will be held. That night, an Awards Banquet will recognize all participants as well as the winners with an award plaque or trophy.

Figure 1 Scheme for Awarding Points



School _____

Car No. _____

Judge _____

Judges Score Sheet: Mini-Indy 1979

I. General Appearance

(1)	Vehicle dimensions in appealing proportion	0-15	
(2)	Appearance consistent with Indy styling	0-20	
(3)	Attention to detail	0-15	
(4)	Quality of construction (welds, parts, paint, etc.)	0-15	
(5)	Practicality of trim	0-10	
(6)	Colors well coordinated	0-10	
(7)	Styling provides for adequate comfort for a 6 ft. plus operator	0-15	
	Total Points	0-100	

Weighted Points = 1.5 x Total Points*

II. Safety

(1)	Roll cage provides adequate driver protection and is properly mounted	0-15	
(2)	All critical safety related connections secured with self-locking fasteners	0-10	
(3)	Driver, fuel tank, and fuel lines are properly shielded from the drive train and engine	0-15	
(4)	Emergency engine shut-off properly located	0-10	
(5)	Fire extinguisher appropriately mounted	0-10	
(6)	Absence of sharp edges or protrusions	0-10	
(7)	Driver restraint system is appropriate for type of vehicle	0-10	
(8)	Special safety features	0-15	
(9)	Guards or shields to prevent foreign matter from getting between chain and sprockets	0-5	
	Total Points	0-100	

Weighted Points = Total Points

*Judges are not required to add or weight points. Race officials can perform the arithmetic.

School _____

Car No. _____

Judge _____

(D) General Design Factors

(1)	Frame adequately supported and braced	0-3
(2)	Systems well integrated (i.e., parts have more than one use)	0-6
(3)	Number of parts kept to a minimum	0-6
(4)	Unique design features	0-10
	Total Points	0-100

Weighted Points = Total Points

School _____

Car No. _____

Judge _____

III. Design

(A) Power Transmission		
(1) Engine, jackshaft, and axle mounting sufficient for severe loading	0-5	
(2) Power transmission system appropriate for the intended use of the vehicle	0-5	
(3) Adequate provision for belt and chain adjustment and removal	0-5	
(4) Ease of engine servicing (fuel fill, oil fill, oil drain, air cleaner, spark plug, removal of entire engine)	0-5	
(5) Design is easily manufactureable	0-5	
(B) Braking System		
(1) Type braking used is appropriate for type of vehicle	0-4	
(2) Firm pedal feel	0-3	
(3) Brakes easily adjusted	0-4	
(4) Braking system mounted so that it is not susceptible to damage and has little chance of failure	0-5	
(5) Brake pedals or hand levers of proper size and adequately mounted	0-4	
(6) Design is easily manufactureable	0-5	
(C) Steering System		
(1) Steering linkages are protected from damage	0-4	
(2) Positive front wheel stops (lock to lock) are present	0-4	
(3) Design able to withstand frequent loading from quick turning	0-4	
(4) Design minimizes the chance of failure	0-5	
(5) Front end geometry tends to return front wheels to "straight ahead" position while vehicle is in motion	0-3	
(6) Design is easily manufactureable	0-5	