

Baja SAE Brazil – Northeast Event 2022

Informative 14 – Evaluations and Scores

Oct 14th, 2022 - Salvador

Dear Participants,

In line with the national competition evaluation structure, teams on “Baja SAE Brazil – Northeast Phase 2022” will be evaluated by a composition of statics, dynamics and endurance race evaluation scores. This informative will provide details of each evaluation such as its contribution to the final score.

1. STATIC EVALUATIONS

1.1. Projects Evaluation

The project evaluations will be held as published on [Informative 07 – Design Evaluations](#).

1.2. Technical Inspection

The evaluation will follow the procedures already established on the RATBSB.

Each team is responsible for printing its own check list and taking it to technical inspection where it must be delivered to the judges (separate pages); in the event of safety re-checks, the form will be returned unsigned to the team. The checklist can be found at SAE Baja NE portal.

For this year the team shall send the following documents previous to the competition:

- Roll cage spec sheet.

- Tubes equivalence calculation – Needed only if the tubes dimensions are not in accordance with the standard reference indicated in the RATBSB.
- Raw material Invoice for all structural elements indicated on section RATBSB.
- Technical report considering the material properties of all structural elements presented in the invoice. Note: The technical report is optional if the invoice presents explicitly the dimensions and material used for the structural element.

All of these documents shall be **delivered by Oct, 21st up to 13h59min** (Brasília time). Documents submission will be made through SAE BRASIL Northeast Committee email (bajasaene@gmail.com). Teams that do not attend this requirement will receive a penalty of 15 points and still needs to present to documents during technical inspection.

1.2.1. Dynamic Evaluation of Design (Comfort)

This event will be as described on RATBSB C 4.12

1.2.2. Braking Performance Evaluation

The braking performance evaluation will be conducted by a Safety Judge from SAE staff during the Comfort Evaluation, in which the vehicle will be submitted for braking evaluation on standard track twice. If approved, the vehicle will receive a sticker allowing students to operate the vehicle; if not approved, the vehicle will be returned to retrofit and the rechecks will be made by a team's driver on two new attempts each time.

2. DYNAMIC EVALUATIONS

The dynamic evaluations will be divided in **Traction, Acceleration, Maximum Speed, Maneuverability, Suspension** and a **Super Prime**. Changes to these procedures can be made based on the facilities availability, weather conditions, measuring devices, etc. Any modification will be informed during the event at the Friday night briefing meeting.

2.1 Dynamics Procedure

For safety purposes, the driver (in vehicle) and the captain will be the only ones allowed on the queue during the evaluations, if any other component wants to approach the vehicle, he/she needs to ask for permission from nearby Staff members.

Vehicles may be inspected at any time to confirm if they still comply with the requirements and rules of RATBSB even after being already approved in technical inspection. They can be penalized in case any irregularity is found.

During the dynamic evaluations, all vehicles must first be available in the area indicated by the Staff members before moving the vehicle to the evaluation's queue.

These informations supersedes the RATBSB score distribution.

The dynamics score distribution will be as shown at the table below:

Event	Score
Traction	45
Acceleration	45
Maximum Speed	45
Maneuverability	45
Suspension	50
Super Prime	50
Endurance	300
Total Dynamics:	580

Table 1: Dynamics Score Distribution

A Briefing will happen on Friday night, after technical inspection and design presentation, where we will explain some points about the dynamics Events. In this briefing is mandatory the presence of the team captain and drivers.

2.2 Traction

The main objective of the Traction event is to evaluate prototype's traction capacity and demonstrate capacity to improve, challenging students to innovate. The goal is to pull a sequence of "blocks" linked one to another by a rope, allowing a gradual increase of load resistance as far as the vehicle moves as shown on image 1.

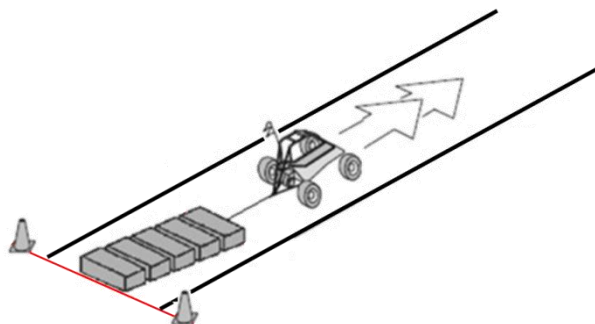


Image 1 – Traction event illustration.

The blocks are initially aligned touching one to another. As the vehicle moves, the blocks will be gradually separated increasing the pull resistance. At the beginning of each pass, the first block must be aligned with the start reference mark.

The attempt will be considered completed when one of the listed situations below is reached:

- Vehicle pull all the blocks until the end of the traction track.
- Vehicle got the maximum of itself and did not reach the end of traction track.
- Vehicle indicates that turnover is about to happen or likely to happen.
- A Staff member defines that the attempt is finished.

The scores of this event will be distributed as this way:

- Only the distances will be considered.
- The maximum score is **45** points, and it will be attributed to the car who pull the longest distance (**Dmax**).
- The minimum score is **0** points, and it will be attributed to the car who pull the shortest distance, considering its best try (**Dmin**).
- Finally:

$$Team\ Score = 45 * \frac{Team\ Distance - Dmin}{Dmax - Dmin}$$

- If one or more cars attain to pull all blocks, we will attribute the maximum score for them, 45 points. Time measurement will be used only for trophy distribution, if two or more cars reaches the maximum score. Shorter time gets the first place and so on.

2.3 Maneuverability

The maneuverability event will test some capacities of the vehicles like slaloms, small turn radius, abrupt line changes, burnouts (zeros), eights (∞), etc.

The maximum score of this event is 45 points, and the distribution will be as shown below:

$$Team\ Score = 45 \times \frac{Worse\ Time - Team\ Time}{Worse\ Time - Best\ Time}$$

Penalty times will be added at the team time. See it below:

- Each cone moved = **5 seconds**
- Each missed gate/obstacle: **15 seconds**

2.4 Suspension

This evaluation consists of traversing a winding course with obstacles where the vehicle's maneuverability and traction will be tested. The test course may contain both sharp and high speed turns, climbs, descents, inclines, and obstacles such as sand, mud, stones, tree trunks, etc.

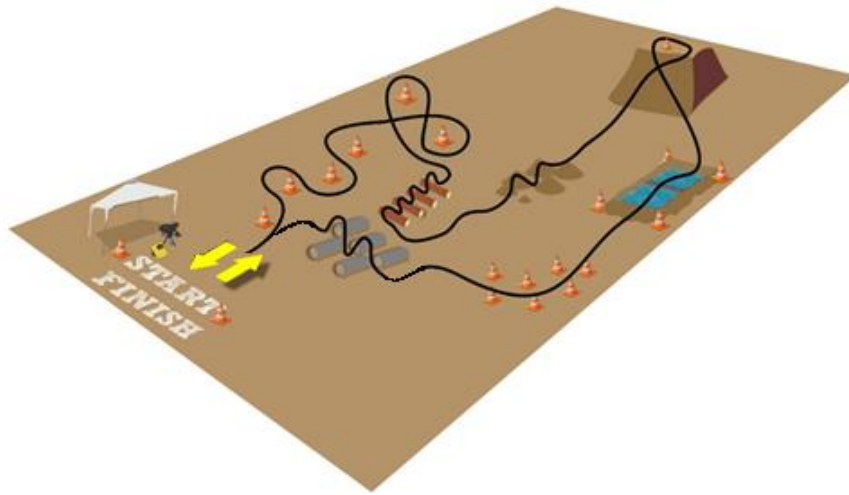


Image 2 – Example of S&T track

There will be two scoring groups for this test:

2.4.1. Group that completes all obstacles. Scores will be calculated based on the time taken to complete the course. The calculation will be given as follows:

$$\begin{cases} Pontuação_{Suspensão} = P_{máxima} \cdot \left(p_{conclusão} + (1 - p_{conclusão}) \cdot \frac{T_{pior} - T_{equipe}}{T_{pior} - T_{melhor}} \right) \\ p_{conclusão} = @ \cdot \left(1 - \frac{N_{completaram}}{N_{participaram}} \right) \end{cases}$$

Where:

- ***P_{máxima}*** is the maximum event score defined in Table 1.
- ***p_{conclusão}*** is the share of the maximum score guaranteed to the slowest team completing a pass.
- ***T_{pior}*** is the longest time taken to cover the route.
- ***T_{melhor}*** is the shortest time taken to cover the route.
- ***T_{equipe}*** is the lowest team time for which the calculation is made.

- *Ncompletaram* is the number of teams that managed to complete at least one pass.
- *Nparticiparam* is the number of teams that started a run.
- The value of @ will be given by the table below:

Number of Participants*	@
2 a 5	0.95
6 a 9	0.8
10 a 19	0.7
20 a 29	0.65
30 +	0.6
* = started at least 1 run	

Table 2 - @ Factor

2.4.2. Group that fails to overcome all obstacles. Their score will be calculated by dividing the *Pconclusão* equally by the obstacles:

$$Pontuação = Pconclusão \cdot \frac{No\ de\ obstáculos\ transpostos}{No\ de\ obstáculos\ existentes}$$

- Obstacles that have one or more cones tipped over will not count for points. The vehicle can continue the run, but the score will be given as in 2.4.2.
- If none or only one team passes all the obstacles, the point value for each sector will be the total points of the event divided by the number of sectors.
- When the run is interrupted, the team scores the sector it stopped in to zero, and the previous sectors that do not have a dropped cone will be counted.

The run is interrupted when:

- the vehicle intentionally knocks over cone, caused by the front of the vehicle (front tip or front axle).
- all 4 wheels of the vehicle go out of the track.
- Clear attempt to circumvent or evade the obstacle, identified by the judges.
- the vehicle stops making further progress.
- The vehicle rolls over.

The run is finished when the vehicle crosses the finish line.

2.5 Acceleration and Max. Speed

This is a combined event that aims to evaluate vehicle's performance on acceleration and maximum speed of the vehicles in a path of 30 and 100 meters, respectively.



Image 3: Acceleration and Max. Speed event illustration

The first part of this evaluation will be to measure the average acceleration during the first 30m running on a fairly flat and straight path; The acceleration score is based on the team's shortest time measured on their two attempts:

In the first part, it will be measured the time taken by the vehicle to travel, from repose, an approximately flat and straight 30 m long path.

The Acceleration score is based on the team's shortest time measured between the 2 runs:

$$Acceleration\ Score = S_{max} * \frac{(T_{worst} - T_{team})}{(T_{worst} - T_{best})}$$

Where:

- **S_{max}** is the maximum score defined for the Acceleration event. For us, it will be 45 points.
- **T_{worst}** is the lesser value between (**1.5*T_{best}**) and the best time of the team with the slowest run.
- **T_{best}** is the shortest time of the team with the fastest result.
- **T_{team}** is the shortest time of the team whose score is being calculated. If T_{team} be more than **1.5*T_{best}** the team will score 0 (zero) points.

In the second part of each attempt, the vehicle speed is measured by the end of a 100m track in which vehicle is running from idle to top speed on the same fairly flat and straight path; The Max. speed score is based on the team's highest speed on their two attempts:

The Max. Speed score will be distributed as follows:

$$\text{Max. Speed Score} = S_{\max} * \frac{(V_{\text{team}} - V_{\text{worse}})}{(V_{\text{best}} - V_{\text{worse}})}$$

Where:

- $S_{\max}$ is the maximum score defined for the Speed Recovery event. For us, it will be 45 points.
- V_{best} is the highest speed measured for a team during the event.
- V_{worse} is the lowest speed measured for a team during the event.
- V_{team} is the highest speed measured for the team whose score is being calculated.

2.6 Super Prime

This event is a double-elimination tournament, which means it is a type of elimination tournament competition in which a participant ceases to be eligible to win upon having lost two passes. It allows participants who lost initial passes to meet qualifying standards to continue to the next round in a repechage.

The position of each team in the bracket is determined by the classification of the maneuverability event so the first qualified team faces the last, and so on.

In case of a tie, the comitee will held a draw.

Teams approved by the safety inspection but did not attend the dynamic events can participate normally.

Repechage winners will enter the main group bracket with a classification defined by blind draw in lower rank than the teams that did not go through the repechage.

In the repechage, each team participates in a head-to-head pass, defined by a draw.

The winning team from each repechage round pass, wins a spot in the event's main bracket.

If there is an odd number of teams in the repechage, one of the teams, defined by a blind draw, will automatically advance to the main bracket.

Each dispute consists of a head-to-head race, in which two vehicles run the same circuit, starting from different points on the track.

The track has two rings (A and B). Those rings share a straight line between them as illustrated below.

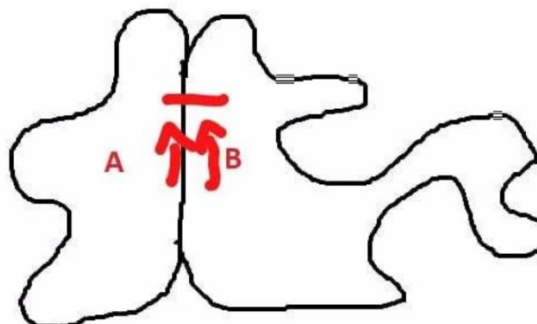


Figure 1- Super prime dual ring track

The two cars in a pass start simultaneously side by side on the straight, in the same direction. One of the cars runs first through the ring "A" and then the "B". The other runs first in "B" and then the "A" without stopping. Ring "A" is sufficiently smaller than ring "B" to prevent the cars from reaching the same point of the track simultaneously during the ring change. The car that completes the circuit of the two rings first will be the winner of this pass.

The committee builds the track in a way to minimize differences of performance due starting positions. Vehicle's position in each pass is determined by flipping a coin.

The straight (Start / ring change / finish) has a strip drawn in the middle. The pilot can only cross it only during the ring change. Crossing this line during start or finish causes automatic defeat.

If any of the cars stop in the middle of the course for any reason, the marshal will show the yellow flag at the previous station. The other car must complete the lap carefully to be declared the winner of this pass.

Deliberately leaving the track, avoiding obstacles and other attitudes that may bring undue advantages, will lead to automatic defeat in this pass.

The first vehicle to complete the course is the winner of the pass.

The score will be distributed in a way where the winner wins 50 points, and the cars that loses 2 rounds in a row, 5 points. For example, a 14 cars bracket will have this Score distribution:

Pontuação (14 carros)	
Colocação	Pontos
Campeão	50
Vice	42.5
3º	35
4º	27.5
5º à 8º	20
9º à 12º	12.5
13º e 14º	5

Table 3: Super prime 14 cars Score Distribution

3. ENDURANCE RACE

In order to best simulate the conditions found on national competition, the Endurance Race will be disputed by one battery of 4 hours.

Starting grid will use Total Dynamics final score. The start will be given to the first two vehicles in line and each following line will be allowed to run approximately 5~10 seconds after the previous line has left. Vehicles that fail to align for grid or that have not disputed drag race will start from box area.

Only one member of each team will be allowed on the racetrack during the event, in the event of a failure that keeps vehicles from driving itself to the boxes area, that member along with team's driver shall be able to put vehicle back running. Transport of big tool/equipment which can't be hand carried won't be allowed on the racetrack.

All important information on this document and any changes to it will be reinforced during morning briefing meetings.

4. TOTAL SCORE

Competition's scores can be found on table 4 below:

Evaluation	Score
Statics Evaluations	420
Design Validation	100
Design Presentation	150
Management and Budget Presentation	100
Business Presentation	40
Design Finals	-
Dynamic Evaluation of Design (Comfort)	30
Dynamics Evaluation	280
Traction	45
Acceleration	45
Max. Speed	45
Maneuverability	45
Suspension	50
Super Prime	50
Endurance	300
TOTAL	1000

Table 4 – Evaluation Scores

Baja SAE Brazil – Northeast Phase Committee