Baja SAE Brazil – Northeast Event 2019

Informative 10 – Evaluations and Scores

Salvador, Oct 24th, 2019

Dear Participants,

In line with the national competition evaluation structure, teams on "Baja SAE Brazil – Northeast Phase 2019" 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. Design Evaluations

The design evaluations will be held as published on ***Informative 08 – 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 dimensions of the tube 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 must be **delivered by Oct 15th up to 13h59min** (Brasília time). Documents submission will be made through SAE BRASIL Northeast Comitee 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.

Teams with rechecks will have 1h30 to present in line for revalidation and be approved if the team misses this timing window they will be automatically considered in repechage condition.

Teams in repeschage condition will receive half approval stick and will be allowed only one passage in each dynamic event during arena (be aware of arena time limit for entrance).

1.2.1. Dynamic Evaluation of Design (Comfort)

This event will be as described on RATBSB C 4.12.

1.2.3 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, the teams will have 1h30 to be approved in braking performance without punishment, if the teams fail to be approved within this window they will be considered in repechage condition.

2. DYNAMIC EVALUATIONS

The dynamic evaluations will be divided in **Traction**, **Acceleration, Speed Recovery, 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.

Excluding the Super Prime, all dynamics events will allow the teams to run twice, considering that the team was approved in safety inspection inside the time range. If not, team will have only one pass for each event.

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.

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

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

Table 1: Dynamics Score Distribution

This information supersedes the RATBSB 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 figure 1.

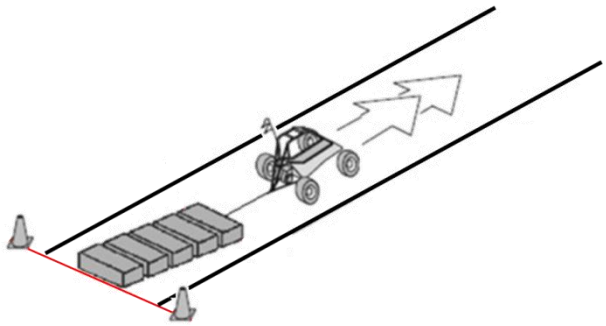

Figure 1 – Traction event illustration.

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 that pulls the longest distance (**Dmax**).
- The minimum score is **0** points and it will be attributed to the car that pulls 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 reach 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:

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

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 is designed to verify the ability to overcome different obstacles (ex.: bumps, drop-offs, inclines, gullies, etc.).

This event will have three sectors with increasing difficulty levels.

The score evaluation will be based on the vehicle's time in each waypoint, including penalties. The maximum score of this event is 50 points and it will be distributed as shown below:

For vehicles that completed only Stage 1:

$$Team\ Score\ = 12{,}5\ X\ \frac{Worse\ sector\ 1\ time - Team\ sector\ 1\ time}{Worse\ sector\ 1\ time - Best\ sector\ 1\ time}$$

For vehicles that completed Stage 2:

$$Team\ Score = 12{,}5 + \left[12{,}5\ X\ \frac{Worse\ waypoint\ 2\ time - Team\ waypoint\ 2\ time}{Worse\ waypoint\ 2\ time - Best\ waypoint\ 2\ time}\right]$$

For vehicles that completed Stage 3 (Total lap):

$$Team\ Score = 25 + \left[25\ X\ \frac{Worse\ total\ time - Team\ total\ time}{Worse\ total\ time - Best\ total\ time}\right]$$

In all teams times, in each stage, will be added the penalty time, if it happens.

The track will be limited by cones. There are two penalty types that may be selected by the Staff, those will be added on “Penalty Time”.

Penalties:

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

Two attempts will be allowed to each vehicle, in which the best passage (considering penalties) will be scored.

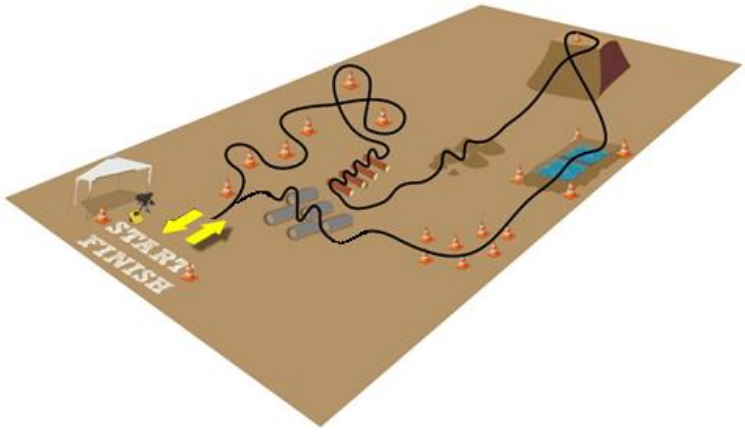

Figure 2 – Example of S&T track

2.5 Acceleration and Speed Recovery

This is a combined event that aims to evaluate vehicle’s performance on acceleration on 30 m and speed recovery on a path of parallel 50 m lanes.

The run will be forfeited if the vehicle rolls over or stops advancing in the course. If the track has cones, a 2-second penalty will be added to the *Speed Recovery* time if the wheels cross the line between the center points of the two adjacent cones or if the vehicle knocks down a cone. Different methods to measure the time might be used depending on equipment availability.

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.

The second part of the combined event is the Speed Recovery. It will measure the time taken by a vehicle to go through two 50 m straight lanes, in which the vehicle needs to make a U-turn after the first 50 m to enter the second straight lane as depicted in Figure 3.

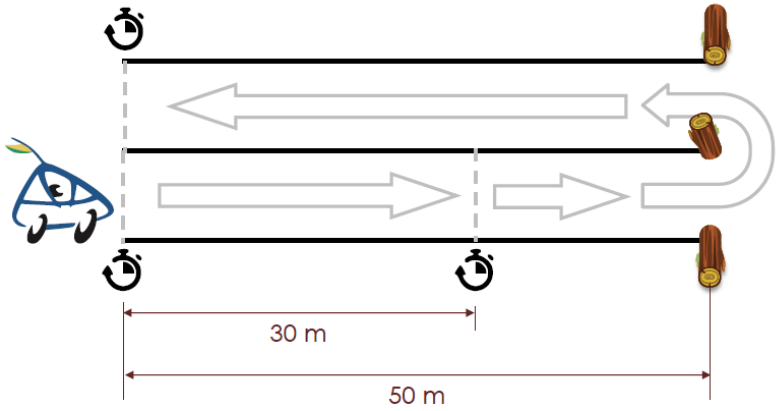

Figure 3- Acceleration & Speed Recovery scheme

The Speed Recovery score is based on the lesser time of a vehicle's run, as follows:

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

Where:

- S_{max} is the maximum score defined for the Speed Recovery 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.

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 event (Secondary Bracket).

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.

Teams approved at safety inspection but do not reach to attend the dynamic events can participate normally.

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 4 - 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 distribution will depends of the number of cars participants. It will be shown on the Friday night briefing, but the Super Prime Winner will score 50 points.

Teams that start at least one pass will receive points.

3. ENDURANCE RACE

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

The starting grid will use **Total Dynamics** score. The start will be given to the first vehicle and each one will be allowed to run approximately 5~10 seconds after the previous vehicle has left. Vehicles that fail to align for grid or that had not disputed the Dynamic Events will start from the box area.

Only one member of each team will be allowed on the race track during the event, in the event of a failure that keeps vehicles from driving itself to the boxes area, that member along with the team's driver shall be able to put the vehicle back

running. Transport of big tools/equipment which can't be hand-carried won't be allowed on the race track.

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 in table 1 below:

Evaluation	Score
Statics Evaluations	**420**
Design Validation	100
Design Presentation	135
Business Event	135
Design Finals	30
Dynamic Evaluation (Comfort)	20
Dynamics Evaluation	**280**
Traction	45
Acceleration	45
Max Speed	45
Maneuverability	45
Suspension	50
Super Prime	50
Endurance	**300**

Table 2 – Evaluation scores

Baja SAE Brazil – Northeast Phase Committee