INFI LEAGUE MOTORSPORTS

Present

ATVC INDIA

Season-2022

Applicable For Electrical ATV Event Being Conducted in 2022

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1. Team Participation Requirements:

A team must have an official name and logo.

A team shall consist of 30 members. Team having less than 15 members will not allowed to participate.

1.1 **Current Status:** Team members must be enrolled as degree seeking undergraduate student in a college or university. Team members must be 18 years or more in age at the time of the competition.

1.2 **Driver's:** Both the drivers must hold a valid, government issued driver's license of four wheelers driver license. No learner's driver license will allowed to drive during the competition. Driver must hold their license during a competition.

1.3 **Insurance:** Individual accident insurance coverage is required and is the sole responsibility of the participant.

1.4 **Liability Waiver:** All on-site participants and faculty are required to sign a liability waiver upon registering on-site.

1.5 **Responsibility:** All participating team members and faculty advisors must be sure that they are individually linked to their respective college. During the event all the team member's compulsory to wear shoes.

Changes in Team Member: Any registered team can replace Team Captain, Manager, Driver, Members and Faculty advisor only once at the event registration desk while submitting document.

Team Captain and Vice-Captain are primary point of contact for his/her team toward the organizer.

2. General Vehicle Requirement:

2.1 General Requirements

The vehicle must be capable of carrying one person 190 cm (75 in.) tall weighing 113 kg (250 lbs). The vehicle must have four (4) or more wheels not in a straight line.

2.2 Ergonomic Design

Drivers must comply with the roll cage minimum clearances, sit comfortably in a driving position, and wear all the necessary driver's equipment. All controls on a vehicle must be accessible to all drivers.

Teams shall be prepared to demonstrate the compliance to T.I. requirement in the design event.

3. Faculty Advisor:

Each team can consist minimum one and maximum two faculty advisors appointed by the College/university.

3.1 **Responsibility:** Faculty advisors can only advise their teams on general engineering and project management. Also, they can review, monitor their overall design, fabrication, testing, and ensure the safety of vehicle and driver in house manufacturing as well on-event too.

During the event presence of a faculty adviser is mandatory.

3.2 **Limitations:** Faculty advisors are not allowed to involve directly or indirectly in report writing, fabrication or repair any part of a vehicle and ensures it is done by the participants.

Faculty Advisors are not allowed to participate during technical inspection, cost, business or design presentations.

The team captain or other designated members of the team must do all the presenting work. However, Faculty Advisors may silently observe the process and work for improvement in future participation years.

4. ELECTRICAL POWERTRAIN AND SYSTEMS

4.1 HIGH VOLTAGE (HV) AND LOW VOLTAGE (LV)

4.1.1 Whenever a circuit has a potential difference where the nominal operation voltage is greater than or equal to 48V DC, it is defined as part of the High Voltage or tractive system.

4.1.2 Low voltage is defined as any voltage below 48V DC.

4.1.3 The maximum permitted voltage that may occur between any two electrical connections is 60 V DC.

4.1.4 The tractive system accumulator is defined as all the battery cells that store the electrical energy to be used by the tractive system

4.1.2 GROUNDED LOW VOLTAGE AND TRACTIVE SYSTEM

4.1.2.1 The tractive system of the car is defined as every part that is electrically connected to the motor(s) and tractive system accumulators.

4.1.2.2 The grounded low voltage (GLV) system of the car is defined as every electrical part that is not part of the tractive system.

4.1.2.3 The tractive system must be completely isolated from the chassis and any other conductive parts of the car.

4.1.2.4 The tractive-system is a high-voltage system by definition, see 4.1.1.1.

4.1.2.5 The GLV system must be a low-voltage-system, see 4.1.1.2.

4.1.2.6 All components in the tractive system must be rated for the maximum tractive system voltage.

4.1.2.7 The tractive system motor(s) must be connected to the accumulator through a motor controller (Traction Controller). Bypassing the control system and connecting the tractive batteries directly to the motor(s) is strictly prohibited.

4.1.3 E-KIT REQUIREMENTS

4.1.3.1 The e-kit Comprises of all major aggregates of electric power train such as Battery, Motor, Battery & Motor Controllers and Chargers etc.

4.1.3.2 Traction Motor shall be a BLDC motor with Peak Power not more than 6 kW.

4.1.3.3 Battery Specifications shall not exceed 48V, 110Ah. It is recommended to deploy Li-ion battery pack.

4.1.3.4 All the e-kit components shall compulsorily follow International Electro Technical Commission (IEC) 60529 IP67 standards (i.e. no dust and water entry) to achieve the required protection from failures, when the tractive system comes in contact with water.

4.1.3.5 The e-kit components from any Supplier can be used in ATVC provided all the components are in compliance with the relevant AIS - Automotive Electric Vehicle standards. Certificates confirming the same shall be submitted to the ATVC Technical Team through ESF Part-1.
Note: Only the components approved by the ATVC Technical Committee shall be used by the teams in building their vehicle's powertrain.

4.2.2 POWER and VOLTAGE LIMITATION

4.2.2.1 The maximum voltage in the tractive system must not exceed the voltage defined in 4.1.1.3 Violating these values will lead to disqualification for the entire event.

4.2.3 ACCELERATOR PEDAL

4.2.3.1 The accelerator pedal must be a right-foot-operated foot pedal. The Traction Motor controller must be actuated by a foot pedal.

4.2.3.2 The foot pedal must return to its original rearmost position when released. The foot pedal must have positive stops at both ends of its travel.

4.3.1 TRACTIVE SYSTEM ACCUMULATOR – GENERAL REQUIREMENTS

4.3.1.1 All Batteries shall be in compliance with AIS 048 or other similar standards (Refer Part H, Article 1). The battery pack which stores the tractive system energy will be built into accumulator (segments), must be enclosed in an electrically insulated accumulator container(s).

4.3.1.2 The accumulator container(s) should be located behind the firewall and should be easily accessible anytime during the entire event for inspection, in case of any failures in the functioning of the kit.

4.3.1.3 The Tractive System Accumulator pack shall include at least one AIR and one Fuse, which will open the circuit and disconnect the energy flow from accumulator to the remaining tractive system whenever a fault is detected.

4.3.1.4 The accumulator isolation relays should isolate the Accumulators from the HV system and must be Normally Open type. The fuse protecting the accumulator tractive system circuit must have a rating lower than the maximum switch off current of the isolation relays.

4.3.2 TRACTIVE SYSTEM ACCUMULATOR CONTAINER - ELECTRICAL CONFIGURATION

4.3.2.1 The tractive system accumulator container must be made from an insulating material.
If the container is made from an electrically conductive material, then the poles of the accumulator segment(s) and/or cells must be isolated from the inner wall of the accumulator container with an insulating material that is rated for the maximum tractive system voltage.
All conductive surfaces on the outside of the container must have a low-resistance connection to the GLV system ground, see article on Grounding.
Care must be taken to ensure that conductive penetrations, such as mounting hardware, are adequately protected against puncturing the insulating barrier.
Note: Wood/Rubber is not permitted to be used for building and mounting the Accumulator Containers.

4.3.2.2 The Accumulator container along with the mounting structure must be electrically insulated in all the directions using suitable material (UL 94-V0 Grade) for the container to prevent arc flashes caused by contact with any other parts and tools. AIR is not considered to be a suitable insulation material.

4.3.2.3 The Accumulator Isolation Relays (AIRs) and the main fuse must be separated with an electrically insulated and fire proof material from the rest of the accumulator. AIR is not considered to be a suitable insulation material in this case.

4.3.2.4 Contacting / interconnecting the single cell's by soldering in the high current path is strictly prohibited. Soldering wires to cells for the voltage monitoring input of the BMS is allowed, since these wires are not part of the high current path.

4.3.2.5 Every wire used in an accumulator container, no matter whether it is part of the GLV or tractive system, must be rated to themaximum tractive system voltage.

4.3.3 TRACTIVE SYSTEM ACCUMULATOR CONTAINER - MECHANICAL CONFIGURATION

4.3.3.1 All accumulator containers must be rugged and rigidly mounted to the chassis to restrict its motion in all direction. If fasteners are used for mounting an accumulator container, they must comply with PART C.

Any Tampering/break opening of the Battery pack is STRICTLY PROHIBITED.

4.3.3.2 Accumulator containers must be placed behind the firewall. Mounting the accumulator containers in the cockpit area is strictly prohibited. Examples of some accumulator container mounting positions which are strictly prohibited are provided below:

4.3.3.3 The mounting system must be designed to withstand forces in dynamic condition. Usage of any type of Belts/Ropes to support or hold the accumulator container is prohibited.

4.3.3.4 All accumulator containers must be protected from side or rear impact collisions, by providing equivalent structure as defined in B 3.2.

4.3.3.5 The accumulator container must be built from mechanically robust material. The container material must be fire resistant.

4.3.3.6 Holes, both internal and external, in the container are only allowed for the wiring-harness, ventilation, cooling or fasteners. External holes must be thoroughly sealed. Proper cooling system should be designed dissipation of excessive heat and maintaining adequate temperature of the tractive system.

4.3.3.7 A 750 mm² sticker showing the text "High Voltage" and a "red or black lightning bolt on yellow background" OR "red lightning bolt on white background" must be applied on accumulator container.

4.3.4 ACCUMULATOR ISOLATION RELAY(S) (AIR)

4.3.4.1 The accumulator isolation relays should be provided to isolate the Accumulators from the HV system and must be "Normally Open Type".

4.3.4.2 The fuse for protecting the accumulator tractive system circuit must have a rating lower than the maximum switch off current of the isolation relays.

4.3.5 BATTERY MANAGEMENT SYSTEM (BMS)

4.3.5.1 Cells must be monitored by a battery management system whenever the tractive system is active, or the accumulator is connected to a charger.

4.3.5.2

The BMS must continuously measure the cell voltage of every cell, in order to keep the cell voltage levels (within the allowable minimum and maximum cell voltage) as stated in the cell data sheet. If individual cells are directly connected in parallel, only one voltage measurement is needed.

4.3.5.3 Any GLV connection to the BMS must be galvanically isolated from the tractive system, including any connections to external devices such as laptops.

4.3.5.4 The temperature of all the cells should be monitored and if the temperature exceeds the permissible battery temperature specification, BMS should shut down the system.

4.3.5.5 BMS must be rigidly fastened to sustain vibrations in dynamic condition.

4.3.5.6 BMS should follow International Electro Technical Commission (IEC) 60529 IP67 i.e. no dust and water entry.

TRACTIVE SYSTEM – GENERAL REQUIREMENTS

4.4.1 SEPARATION OF TRACTION SYSTEM AND GROUNDED LOW VOLTAGE SYSTEM

4.4.1.1 The complete layout of electric circuit designed by the team must be documented accurately in the in ESF Part-2 .

4.4.1.2 There must be no connection between the frame of the vehicle (or any other conductive surface that might be inadvertently touched by a crew member or spectator), and any part of any tractive system circuits.

4.4.1.3 Tractive system and GLV circuits must be physically segregated such that they are not run through the same conduit, except for interlock circuit connections.

4.4.1.4 GLV systems must not be contained within / existent in the accumulator container except for required purposes (for example the BMS and AIR). The BMS should contain its own galvanic isolation. Any connections between the BMS and the Low Voltage wiring outside of the accumulator must be galvanically isolated.

4.4.1.5 When both tractive system and GLV are present within an enclosure, they must be separated by insulating barriers made of moisture resistant, UL94-V0/FAR25 Standard recognized or equivalent insulating materials (e.g. Nomex based electrical insulation).

4.4.1.6 Tractive system components shall be rigidly mounted with electrically insulating and fire-resistant materials. Components and cables capable of movement must be positively restrained to maintain safe spacing.

4.4.2 POSITIONING OF TRACTIVE SYSTEM PARTS

4.4.2.1 All parts belonging to the tractive system including cables and wiring must be contained within the envelope of any part of the frame and/or an additional envelope of tubing which meets the minimum specification defined in B3.2 or equivalent, such that they are protected against being damaged in case of a crash or roll-over situation.

4.4.2.2 If tractive system parts are mounted in a position where damage could occur from a rear / side impact or has clearance from ground < 350mm, then it has to be protected by a fully triangulated structure with tubes of a minimum outer diameter of 25.4 mm and a minimum wall thickness of 1.25 mm or equivalent – see B3.2.

4.4.2.3 When observed from side view or front view, no part of tractive system can project below the lower surface of the frame.

4.4.3 TRACTIVE SYSTEM FIREWALL

4.4.3.1 The tractive system firewall must comply with the main firewall regulations as defined in B7.3. Firewall must separate the driver compartment from all tractive system components.

4.4.3.2 The firewall must be made from an electrically insulating material. In case the firewall made from an electrically conductive material, it should be completely covered by an electrically insulating material on both sides. Firewall shall act as an insulating barrier between all the tractive system components and the driver.

4.4.3.3 The firewall must be resistant to puncture and scratch. The insulating material must be fire resistant, made of UL94-V0, FAR25 or equivalent grade.

4.4.4 GROUNDING

4.4.4.1 All electrically conductive metallic parts of the vehicle (and also any driver harness mounting points, seat mounting points and driver controls) which are within 100 mm of any tractive system or GLV component, must have a resistance below 300 mΩ (measured with a current of 1A to GLV system ground).

4.4.4.2 All parts of the vehicle which may become electrically conductive (e.g. completely coated metal parts, carbon fiber parts, etc.) which are within 100 mm of any tractive system or GLV component, must have a resistance below 5 Ohm to GLV system ground.

4.4.4.3 Electrical conductivity of any part which is likely to be conductive may be tested, for example the driver's harness attachment bolt. But, where ever no convenient conductive point is available then an area of the coating may be removed.
NOTE: Carbon fiber parts may need special measures such as using copper mesh or similar to keep the ground resistance below 5 Ohms.

4.4.4.4 All HV components should have a low contact resistance (i.e. resistance between enclosure of HV components and ground), preferably below 1 mΩ.

4.4.5 TRACTIVE SYSTEM INSULATION, WIRING AND CONDUIT

4.4.5.1 All parts, especially live wires, contacts, etc. of the tractive system need to be isolated by non-conductive material or covers; to protect each of them from being touched. All the wires shall be properly routed. The battery terminals and other HV contact points shall be properly insulated with best engineering practices.

4.4.5.2 All HV Cables must be in orange color (Fig. C-5). All the GLV wires shall be color coded to differentiate between the positive and negative current paths.

Figure C-5: HV Cables

4.4.5.3 Tractive system components and containers must be protected from moisture in the form of rain or puddles.

4.4.5.4 Only insulation material that is appropriate for the expected surrounding temperatures may be used and this must have a minimum temperature rating of 90°C. Usage of insulationtape or rubber-like paint for insulation purposes is prohibited.

4.4.5.5 All wires and terminals and other conductors used in the tractive system must be sized appropriately for thecontinuoustractivesystemcurrent and thewiresmust be marked with wire gauge, temperature rating and insulation voltage rating. Alternatively, a data sheet based on specified wire characteristics norms for serial number of wires printed on the wire is sufficient. Theminimum acceptable temperature rating for tractive system cables is 90°C.

NOTE: Sizing of the conductors for the ‘continuous tractive system current’ can take account of the RMS or average electrical current or maximum electrical current that will be pass / used for the anticipated duration of time.

4.4.5.6 All tractive system wiring must be done as per professional standards with appropriately sized conductors and terminals and with adequate strain relief and protection from loosening due to vibration etc.
It is advisable not to use extension of cables. However, in case any extensions are provided, both the connected wires must be of the same gauge and rigidly connected.

4.4.5.7 All tractive system connections must be designed to use intentional current paths (through conductors such as copper or aluminum). Steel bolts should not be used as the primary conductor. The connections must not include compressible material (such as plastic in the stack-up).

4.4.5.8 Tractive system wiring must be shielded against damage by rotating and / or moving parts. Packaging the wires in any kind of plastic containers is strictly prohibited.

4.4.5.9 If external, un-insulated heat sinks are used, they must be properly grounded to the GLV System ground, Refer 4.4.4

4.4.5.10 All electrical connections in the high current path of the tractive system that rely on screwed connectionsmust have a rigid lockingmechanism.

4.4.6 TRACTIVE SYSTEM ENCLOSURES

4.4.6.1 All housings or enclosure containing parts of the tractive system, except motor housings, must be labeled with (a) reasonably sized sticker(s) with a red or black lightning bolt on yellow background or red lightning bolt on white background. The sticker must also contain the text “High Voltage” or something similar, if the voltage is more than or equal to 48V DC.

4.4.7 ACTIVATING THE TRACTIVE SYSTEM

4.4.7.1 The driver must be able to (re-)activate or reset the tractive system from within the cockpit without the assistance of any other person except for situations in which the BMS have shut down the tractive system.

4.4.7.2 Only by closing the shutdown circuit, the car must not set to “Ready to Drive Mode”. Additional actions are required by the driver to set the car to ready-to-drive-mode. The car will be ready to accelerate as soon as the motor(s) will respond to the input of the torque encoder / acceleration pedal.

4.4.7.3 Ready-to-Drive-Mode: The tractive system should be activated by pressing the dedicated start button. In order to set the vehicle in Ready-to-drive-mode brake pedal should be in pressed condition along with vehicle in Neutral mode.
Note: After the kill switch has been released, the above process shall be followed to set the vehicle into “Ready-to-drive-mode”.

4.4.7.4 The Tractive system should not be activated while charging is in progress.

4.4.7.5 The Tractive system should not be activated if the gear is not in neutral position.

4.4.7.6 The Tractive system should not be activated if the accelerator pedal is pressed (without pressing the brake pedal), immediately after starting the vehicle.

4.4.8 TRACTIVE-SYSTEM-ACTIVE LIGHT (TSAL)

4.4.8.1 TSAL should be continuously flashing when Tractive system is in active state (when vehicle is in "Ready to Drive Mode"). Tractive system is defined to be active, when the accumulator isolation relay is closed, and the energy is available to the tractive system.

4.4..2 The TSAL must be single Red flashing light (Refer images below) with the frequency of 2Hz-5Hz. It must be clearly visible in all the directions even in very bright sunlight. It should have opening from at least three sides.
Note: Using more than one light, LED Strips/strobe lights as TSAL is strictly prohibited.

4.4.8.3 The TSAL shall be rigidly mounted to roll cage to protect from any kind of damage during rollover. It should be located in the center plane of vehicle on RRH Plane, 2 inches below from the center line of BLC. TSAL housing should be at minimum distance of 1.5 inches above the driver's helmet reference plane. (Ref. Fig C-9)

4.4.8.4 With the reference Fig. C-10, the member BR should be at a minimum angle of 30 degrees from the RHO reference plane. Use of body panel to cover BLC to RLC member is prohibited in order to maintain visibility of TSAL.

4.4.8.5 The TSAL must be visible to a person standing up to 3m away from the TSAL. It is prohibited to mount other lights in the proximity to the TSAL.
NOTE: In case of any malfunction or improper visibility of the TSAL on the track, the vehicle will be black flagged until the problem is resolved.

4.4.8.6 There should not be any object/sticker placed in the peripheral distance of 50 mm from the center of the TSAL.

4.4.8.7 TSAL shall be rigidly mounted by using fasteners on a member supported by at least two primary members of the roll cage to protect from any kind of damage during rollover.
NOTE: Use of cable ties, straps, adhesive tapes for TSAL mounting is prohibited.

4.4.8.8 Any cut-out in the firewall for mounting TSAL, should be compliant to Firewall guidelines mentioned in section B7.3 & 4.4.3.

4.4.9 READY-TO-DRIVE-SOUND

4.4.9.1 The car must make a characteristic sound, once but not continuous, for at least 1 second and a maximum of 3 seconds immediately after it is set in ready to drive mode.

4.4.9.2 The car is ready to drive as soon as the motor(s) will respond to the input of the torque encoder /accelerator pedal.

4.4.9.3 The Sound level Must be maintained at a minimum levelof70dB, fastweighting, inradius of 2maroundthe car, while the e-car is in running condition (at all times).

FUSE

4.5.1 FUSE SPECIFICATIONS

4.5.1.1 Each of the electrical systems (both low and high voltage) must be protected by providing a fuse of the rating greater than the current rating of the electrical system. The current rating of a fuse must not be greater than the continuous current rating of any electrical component, for example wire, bus bar, cell or other conductor that it protects.

4.5.1.2 All fuses and fuse holders shall be of automotive standards and must be rated for the highest voltage in the systems they protect. Fuses used for DC must be rated for DC and must carry a DC rating equal to or greater than the system voltage.

4.5.1.3 All fuses must have an interrupt current rating which is higher than the theoretical short circuit current of the HV system that it protects.

4.5.1.4 If multiple parallel strings of batteries or capacitors are used, then each string must be individually fused to protect all the components on that string, e.g. Any conductors, wires, bus bars, cells etc. conducting the entire (pack current inclusive of all parallel strings) current. Fuse must be appropriately sized for the total current that the individual string could transmit, or an additional fuse must be used to protect the conductors.

ARTICLE 6: HIGH VOLTAGE PROCEDURES & TOOLS: The recommendations below are advisable to be followed while the team members are working at their own institute or during their presence at event site for ATVC competition:

4.6.1 WORKING ON TRACTIVE SYSTEM ACCUMULATOR CONTAINER

4.6.1.1 Only appropriate insulated tools should be used whenever work is being carried out on the Accumulator or tractive system.

4.6.1.2 Safety glasses with side shields and safety gloves must be worn by all participating team members when (a) parts of the tractive system are exposed while it is active, or (b) work is being done on the accumulators.

4.6.2 CHARGING

4.6.2.1 There will be a separate charging area on the event site. Charging tractive system accumulators is only allowed inside this area.

4.6.2.2 Accumulators may be charged inside the car.

4.6.2.3 It is also possible to charge the accumulators outside the car with a removable accumulator container.

4.6.2.4 The accumulator containers or the car itself, depending on whether the accumulators are charged externally or internally, must have a label with the following data during charging: Team name and phone number(s) of Electrical System Officer of the respective Team.

4.6.2.5 WHEN THE ACCUMULATORS ARE BEING CHARGED INSIDE THE CAR, NO WORK IS ALLOWED ON ANY OF THE CAR'S SYSTEMS (DURING CHARGING).

4.6.2.6 No grinding, drilling, etc. is allowed in the charging area.

4.6.2.7 At least one team member who has knowledge about the charging process must stay with the accumulator(s) / car during charging.

4.6.2.8 Moving accumulator cells and/or accumulator segment(s) around at the event site is allowed only if accumulator container is completely inside a closed enclosure.

4.6.2.9 Charging circuit shall include a Kill Switch to de-energize the HV system when the vehicle is charging

4.6.3 CHARGERS

4.6.3.1 Charger shall be of 48V.

4.6.3.2 Only chargers presented and sealed at Electrical Tech. Inspection are permitted for usage at event site. All connections of the charger(s) must be isolated and covered. No open connections are allowed.

4.6.3.3 All chargers must either be accredited to a recognized standard e.g. CE or wherever they were built by the team they must be built to high standards and conform to all electrical requirementsforthe vehicle tractivesystem.

4.6.3.4 The charger must incorporate an interlock such that the connectors only become live if it is correctly connected to the accumulator.

4.6.3.5 HV charging leads must be orange.

4.6.3.6 During the process of charging of accumulator, the BMS must be live and must be able to turnoffthechargerif a fault isdetected.

4.6.3.7 BatteriesshallnotberechargedbyTractionMotor or an alternator.

GROUNDED LOW VOLTAGE SYSTEM (<=48VDC)

4.7.1 GENERAL ELECTRICAL SYSTEM OVERVIEW

4.7.1.1 The electrical system must include at least two kill switches, a brake light, a reverse light, TSAL, RTDS and a reverse alarm. The battery power source for the above-mentioned items may be given from the tractive system accumulators or teams may use an additional auxiliary battery for the same.

4.7.1.2 Kill Switches \ Master Switches: Each vehicle must be equipped with two (2) easily accessible kill switches turning off the tractive system, Refer Part B Article 10. The Kill switch must not de-energize the Brake Light.

4.7.2 AUXILIARY BATTERIES

4.7.2.1 Batteries shall not be recharged by Traction Motor or an alternator and it may be used to power only safety items (brake light, reverse light and alarm) and instrumentation (driver display, data acquisition), and may not power any control or actuation function in the drive-train, steering and suspension systems. Batteries must be mounted with good engineering practice and not come loose during a roll over. The battery must be safely placed & concealed. Failing this, the team may not get “Technical scrutiny” sticker.

4.7.2.2 Auxiliary batteries must be attached securely to the frame. Installing auxiliary batteries in cockpit is prohibited. The Battery terminals should be covered with standard battery caps.

4.7.2.4 The batteries must be factory sealed (incapable of being opened or serviced) and not leak in the event of a roll over.

4.7.3 DRIVER DISPLAY

4.7.3.1 Battery pack Voltage (Over all Voltage of HV system), Battery Pack Temperature (Over all Temperature), State of Charge (SOC) shall be displayed (all at a time) on the driver dashboard, when key is turned ON. Any other information displayed to the driver, by using the Data Acquisition system is up to the team's choice. Any system that provides data back to the driver or to the team for tracking must be included in the Cost Report. Additionally, any batteries used to power the system must comply with the battery rules in Section 4.7.2.

ACCUMULATOR SWAPPING (For Endurance only)

4.8.1 SECONDARY ACCUMULTOR

4.8.1.1 Teams may have spare battery pack which will be referred as Secondary accumulator. The secondary accumulator, if so available will be permitted (provided TI is cleared as per competition rule) to be used to swap with the primary tractive system accumulator, if the team so desires; during endurance event. Both primary and secondary accumulators are required to be presented at the time of Technical Inspection and seek approval.

4.8.1.2 The secondary accumulator set up must be compliant with Part C, Article 3. It should be of the same size and having identical mounting design as per the primary tractive system accumulator, which will be replaced.

4.8.1.3 The secondary accumulator must be stored in an electrically insulated container made of fire-retardant material, as per Accumulator Container guidelines (Refer Part C Article 3).

4.8.2 SWAPPING MECHANISM / PROCESS

4.8.2.1 Teams shall avail the option of Battery Swapping when the SOC drops less than 50% during the Endurance race only.

4.8.2.2 Accumulators shall be easily accessible and removable from the vehicle for the team to qualify to be allowed for swapping during the endurance race. Same shall be demonstrated by the team during the Electrical Technical Inspection. Teams should have HV insulated tools and gloves to execute the swapping activity.

4.8.2.3 Before swapping, the HV system should deenergized by activating the kill switch. The Negative terminal of the battery should be removed first and insulted with caps followed by removing the positive terminal.

4.8.2.4 The accumulator setup shall be carefully removed and installed without interfering with the surrounding components at any time during the entire process.

4.8.2.5 Removing the accumulator setup shall be restricted to the respective plane in which the setup is mounted. Refer to the figure C- 12 mentioned below,

1. If accumulator container is placed completely below plane S-R, its removal is allowed only via horizontal path through side or rear of the vehicle below plane S-R (i.e. Path of removal should be such that no part for accumulator container is raised above plane S-R during process of battery removal.)

2. If accumulator container is placed completely or partially above SR plane, path of accumulator removal should be completely above plane S-R. Path of removal can consist of motion in vertical as well as horizontal direction but, vertical motion of accumulator more than 10 inches during removal process is prohibited.

5. Brake System

The vehicle must have a hydraulic braking system that acts on all wheels and is operated by single foot. Pedal must directly actuate the master cylinder through a rigid link (i.e., Cables are not allowed). At static and dynamic condition, Braking system must be capable of locking and sliding all wheels on paved or unpaved surface.

5.1 Independent Circuits:

The braking system must consist of two or more independent hydraulic circuits such that in case of a leak or failure at any point in one system, braking power shall be maintained on at least two wheels. Each hydraulic circuit must have its own separate fluid reservoir either through physically separate reservoirs or by the use of a full-height dam in an OEM-style reservoir.

5.2 Brake Location:

The brake(s) on the driven axle must operate through the final drive. Inboard braking through universal joints is permitted. Braking on a jackshaft through an intermediate reduction stage is prohibited.

5.3 Cutting Brakes:

Cutting brakes are permitted. They can be hand or feet operated. The primary brake system must be able to lock all four wheels with a single foot. If using two separate pedals to lock two (2) wheels apiece; the pedals must be close enough to use one foot to lock all four wheels.

Any application of the brakes, must cause the brake light to illuminate.

5.4 Brake Lines:

All brake lines must be securely attached to the vehicle frame, and not hang below the vehicle frame or suspension components. All brake lines must be placed in such a manner, that they are not damaged by suspension and steering components, or any other sharp edges.

All brake lines shall have full range of motion within the steering and

suspension system.

At no time shall the brake lines be loaded in tension or become engaged with the vehicle's tires and wheels.

All brake lines shall be designed for the pressures expected in the braking system, and be chemically compatible with the brake fluid in use.

Only Steel lines, or steel braided rubber hoses are permitted. Plain plastic and rubber brake lines are prohibited.

6. Throttle System

The vehicle's throttle system must be able to move the throttle arm to full throttle on the engine and return to idle when released. Any changes to the throttle after inspection is not permitted.

Electronic or hydraulic throttle engagement is not permitted.

6.1 Pedal:

Only mechanical foot operated pedal is allowed. The throttle pedal shall actuate a throttle cable. The foot pedals must be positioned ensuring ease of egress by the driver. The driver's feet should not get trapped behind any pedal.

Any mechanical extensions on top of the pedals are prohibited.

6.2 Pedal Stop:

A substantial, mechanical, wide-open throttle stop must be mounted at the pedal. Body panels or other flexible materials are explicitly prohibited.

6.3 Throttle Cable:

One end connects to the throttle pedal and other end to the throttle lever at the engine.

The cable can be tension type or push-pull type. It is essential that the cable

is covered (sheathed or jacketed) through its entire length from the front of the cockpit to the firewall. The throttle cable should be routed such that the movement of the cable through the sheath is smooth.

Cables systems with any jerky movement or signs that the cable might get stuck will not be allowed.

Fail Safe: All throttle controls shall be designed to return to the idle-stop in the event of a failure.

Note: Ensure sufficient gap is provided between the Accelerator pedal & steering column to that of Brake Pedal. Pedal Actuation shall not be hindered at any cause by the nearby components.

7. Driver Equipment

7.1 Helmet:

All drivers must wear a well-fitting Motocross style helmet with an integrated (one-piece composite shell) chin/face guard and a rating of: Snell M2010, 2015, SA 2005, British Standards Institution BS 6658-85 types A or A/FR. ISI rating is also acceptable. DOT rated helmets are not allowed.

Note: Some Motocross helmets have extended chin guards that will not contact the required neck collars when the head is flexed forward. This combination of helmet/collar system is prohibited.

Note: Any non-specification helmets will be confiscated by the TEJ for the duration of the event. At the close of the endurance race, all confiscated items will be available for pick up.

7.2 **Eye Protection:** All drivers must wear motocross-style goggles with a full-circumference elastic band that wraps completely around the driver's helmet. "Quick Straps" or other quick-release systems are explicitly prohibited.

7.3 Lens Protection: All goggles used by drivers must have tear-off or roll off lens protectors. These tear-offs or roll-offs are used to ensure the driver has unobstructed vision through their goggles. Teams must present their goggles and properly installed tear offs or roll-offs at tech inspection.

Teams without tear offs or properly functioning roll offs will not be allowed to take part in any dynamic event and also subject to being black flagged.

7.4 Neck Support:

All drivers must wear an adult size neck support / neck collar. The neck support must be a full circumference and SFI 3.3 rated. Horseshoe collars are not allowed. The support/collar must be in overall good condition and show no signs of wear or other injurious defects. The support/collar must bear the appropriate dated labels, and on Jan 1st 2022, be no more than three years old.

7.5 Clothing:

7.5.1 **Gloves:** Drivers must wear gloves to protect their hands. Durable, abrasion resistant gloves are required.

7.5.2 **Shoes:** Drivers shall wear socks and shoes. Any toe covered shoes are permitted.

Fire resistant shoes are not mandatory, regular sneakers/ running shoes would suffice. However, a shoe with narrow heel is preferable for drivers to ensure ease of pedal actuation.

7.5.3 **Upper Garments:** Drivers shall wear a fire-resistant shirt. The shirt must have a factory label showing an SFI rating, FIA rating, NFPA 2112 rating, or other fire-resistant rating.

7.5.4 **Lower Garments:** Drivers shall wear long pants made of natural materials such as cotton, denim, etc.

Drivers may also wear fire resistant pants having an SFI, FIA, NFPA 2112, or other fire-resistant rating.

Note: Jerseys, gloves, socks or other garments made from nylon or any other synthetic material which will melt or combust when exposed to open flame or extreme heat, are explicitly prohibited from use during competition.

8. Driver Resistant:

The purpose of the restraint system is to hold the driver securely in position within the frame of the vehicle at all times. It should also be capable of disengaging quickly, and allow the driver to leave the car in the shortest possible time.

Only 5-point driver harness systems are allowed, such that all the belts join at a single, centrally located buckle. The restraint includes two shoulder belts, two arm restraints, the anti-submarine belt and the driver seat.

All driver restraint systems shall meet either SFI Specification 16.5/16.1,

or FIA specification 8853/98. The material of shoulder and lap belts shall be of Nylon or Dacron polyester and in new or like-new condition, 76 mm (3.0 in.) in width, and free from injurious defects. Anti-submarine belts shall meet the same conditions, but have a minimum width of 51 mm (2.0 in.).

Release Mechanism: All belts in the driver harness must join to a single, central, metal-to-metal, lever-type, and quick-release buckle. Cam-Lock, and other enclosed buckles susceptible to jamming from small debris (such as sand particles) are explicitly prohibited. The release mechanism (buckle) shall be protected against accidental unfastening from a direct pull, rollover or slide along the side.

8.1 SHOULDER BELTS:

The shoulder belt mounting point onto the chassis must be no higher than the vertical level of the shortest driver's shoulders. It should also not be lower than 100mm below the tallest driver's shoulder height.

The lateral spacing between the centers of the shoulder belt should be between 180mm and 230mm. The lateral movement of the shoulder belts must be restricted along their mounting by a separate structure. The shoulder belts should not come into direct contact with the firewall at any point. A layer of protection must be used to prevent the firewall damaging the belts.

The shoulder belts should be looped around a straight horizontal tube. This tube must be welded within the plane of the RRH, and must meet the requirements of a secondary tube.
The shoulder belts must run directly to the driver's shoulders, without being redirected by any part of the frame, bodywork or seat.

The shoulder belts should be protected from damage from the aft of the RRH. The firewall can be extended to cover the shoulder belts from behind. Alternatively, pockets can be added around the shoulder belt mounting points. The belts should be entirely concealed from behind, and any material used for covering should be the same material as that of the firewall.

8.2 Lap Belts:

The lap belts must be connected to buckles on one side, and be directly connected to release mechanism. There should not be any redirection on any part of the vehicle including the driver seat. The belts must be mounted to the frame tabs with brackets suppled with the safety harness. . Lap belts may not be mounted by wrapping around tubes.

The belts must meet such that the release mechanism lies in the pelvic region of the driver, and not on the abdomen.

The lap belts need to be bolted to the vehicle frame with metal tabs. The bolts have to be graded, and be half threaded bolts, such that the part in contact with the lap belt is not threaded. Lap belts cannot be wrapped around tubes or secured with eye-bolts. All bolts in the driver harness must have the same nominal diameter as the mounting holes in the bracket.

<u>The frame tabs for the lap belt must meet the following requirements:</u>

The frame lap belt tabs shall be no less than 2.3 mm (0.090 in.) thick and configured for double shear mounting. Frame lap belt tabs configured in bending are explicitly prohibited.

The frame lap belt tabs shall be attached to the frame with no less than 38 mm (1.5 in.) of weld length per tab.

The frame lap belt tabs shall have no less than 6.4 mm (0.25 in.) of edge distance. (Edge distance is the measurement from the edge of the bolt hole to the outside edge of the tab.)

The frame lap belt tabs and lap belt shall be installed such that the lap belt tabs pivot freely.
The frame lap belt tabs and their mounting shall be stiff and not readily deformed.

No lightening holes or other cutouts are permitted on the frame lap belt tabs

8.3 Anti-Submarine Belts:

Anti-submarine belts must be placed a location behind the chest line. The chest line is denoted by a straight-line parallel to the chest of the driver that extends to the floor of the vehicle. The anti-submarine belt must be positioned ahead of the lap belt mounting points. The anti-submarine belt must either be bolted to a frame tab (not in bending) or be wrapped around a secondary frame member. Tab must be in double shear.

If the tab is bolted, the belt must be firmly attached to the chassis by metal tabs, using a graded, semi threaded fastener, similar to the lap belts. The tab and welding specifications are same as that of lap belt tabs.

If the anti-submarine belt is wrapped around a secondary member, the lateral movement of the belt must be restricted to less than 25mm. Further, the belt must be protected from coming into contact with any other part of the vehicle, such as the belly pan. The mounting member must not be cantilevered.

In case the belt has to be redirected (such as by the seat), the maximum angle of redirection is 30 degrees with respect to the line of the belt.

Note: Quick disconnect fasteners for body panels are recommended that facilitate faster technical inspection process.

8.4 Arm Restraints:

The purpose of the arm restraints is to prevent the driver's arms from going outside the frame at all times. Arm restraints need to be securely attached to the driver harness. Arm restraints meeting SFI 3.3 ratings are allowed.

The restraints must show no damage or wear. They must have SFI rating labels stitched onto them. Arm restraints have the same date and age requirements as the rest of the driver harness system.

Arm restraints must allow the driver to release the harness and egress the vehicle unassisted, regardless of the vehicle's position. The arm restraints are to be position on the driver's forearm, just below the elbow. The arm restraints should not restrict the driver's ability to reach the steering wheel, kill switch, harness release, or any other item needed to control the vehicle.

8.5 Head Restraint:

A head restraint must be mechanically fastened to the frame of the vehicle or the driver's seat. The purpose of the head restraint is to prevent the driver's head from moving rearward.
Any other methods of attachment are prohibited.

Note: Head restraints mounted directly on firewalls are explicitly prohibited.

8.6 Seats:

The seat shall work in concert with the driver harness to secure the driver within the envelope of the roll cage. The seat must be designed to support the driver in an upright position. An upright seating position is when the seat back angle is greater than 65 deg. with respect to the horizontal plane of ground. Seats may be conventional type, or a suspension seat.

8.7 Seat Construction:

8.7.1 Conventional Seats:

If a conventional seat is used, then it must be rigid and be made of metal or composite material. Seats made of any other material such as wood, plastic, etc. are prohibited. Conventional seats may have a removable seat cover and foam padding. Seats may be purchased from a manufacturer or constructed by teams.

8.7.2 Suspension Seats:

Suspension seats, or hammock seats need to be made of a material that is capable of supporting the weight of the driver without permanent damage or deformation. The suspension seat must be rigidly mounted in the car, such that the driver is held in place. The seat must not have more than 25mm of left-right or fore-aft movement. The suspension seat must not allow any part of the driver's body or limbs to leave the frame of the vehicle.

Suspension seats must be made of such a material that it is capable of taking load greater than the weight of the driver. The material must be stitched properly to prevent fraying or tearing of the material under

stress. Any visible damage to the seat or excess movement when the driver is seated is not allowed, and can lead to being black flagged during the event. If carabiners are used to attach the seat to frame tabs, then they must be load rated to take the weight of the driver. The final discretion lies with the Technical Inspectors.

8.8 Seat Mounting Points:

All seats must use at least six mounting points to attach the seat to the vehicle frame. Conventional seats must have atleast four mounting points to attach the bottom plane of the seat and at least two mounting points to attach the seat back plane to the frame.

All the seat mounting points must be symmetric about the fore-aft center line of the vehicle. The back plane mounting points must be at or near the RRH plane of the frame. All members to which the seat mounting points are attached must meet the conditions of a secondary member. The seat bottom mount must be designed such that the vertical load is evenly distributed across the seat and the mounts.

Suspension seats must also be attached atleast six points to the frame of the vehicle. The suspension seat must be connected on both sides to the RHO or the RRH, within 50mm of the point at which the RHO and the RRH meet. The suspension seat must also be connected to the SIM on both sides, at a point such that there is a bracing member to the LFS within 50mm of this point. The seat should also be attached to the base of the RRH or LFS, at a point that is less than 50mm from the point at which the LFS meets the RRH. The seat should be designed such that it does not allow the driver to move within the frame of the car, thus ensuring he is within the vehicle frame envelop at all times.

All tabs used for mounting the seat must have a minimum thickness of 2.3 mm and at least 38 mm of weld length per tab. Mounting Tabs must not deform under load. The distance from the tab hole center to the weld line must not exceed 25 mm. If a frame member is drilled, a sleeve must be used as mentioned in the frame regulations.

8.9 Powertrain Guard

All powertrain components (CVTs, Gears, Sprockets, Belts and Chains) shall be shielded to prevent injury to the driver, track workers, or bystanders. Guards shall protect against hazardous release of energy should rotating components fail. Guards shall also protect against fingers, loose clothing, or other items from being entangled in the rotating components (pinch points). Universal joints, CV joints, hubs, rotors, wheels and bare sections of shafts are exempt from this requirement, and no need to be shield them.

Powertrain guards and shields must extend around the complete periphery of the rotating components (chains, gears, sprockets, belts, and CVT's) and have a width wider than the rotating part the guard is protecting.

Note: This means the entire periphery of the primary CVT pulley, not just the belt width.

All powertrain guards shall be constructed of the following required materials:

- Steel, at least 1.5 mm thick, meeting or exceeding the strength of AISI 1010 steel.
- Aluminum, at least 3.0 mm thick, meeting or exceeding the strength of 6061-T6 aluminum.

Holes and/or vents in the portion of the powertrain guard surrounding the rotating components are acceptable provided that in the event of a powertrain failure, no parts can escape. No direct path shall exist tangent to any rotating components.

Powertrain guards must be rigidly secured with sound engineering practices in order to resist vibration and shock.

Hence, holes or air vents made for using a CVT cooling system should have a diversion made of above-mentioned materials such that there exists no direct exit trajectory tangent to the rotating parts. Rather than periphery guard, component which rotate faster than the final drive shall be guarded on all sides.

- Guarding for pinch points shall prevent small, searching fingers from getting entrained in any rotating part.

- Flexible, non-rigid, fabrics are unacceptable for use as finger guards.
- Powertrain covers fastened with adhesive, ratcheting tie-downs, and other temporary methods are explicitly prohibited.

Any OEM, Factory Stock guardthat are exempt from the requirements of this rule. But care should be taken that it complies with being completely protected including finger guards.

Note: Inboard Braking rotors should meet the rules of powertrain Guard & should prevent the unintentional contact of hands with the rotor.

9. Electrical System:

An electrical system comprising of at least two engine kill switches, a brake light, two brake pressure switches, battery, and wiring is required. While designing and constructing this system proper engineering and electrical practices must be followed.

9.1 Battery Mounting:

All batteries must be mounted with sound engineering practices, and not come loose at any point during the event. The terminals of the battery must be insulated and protected against a short electrical from each other.

9.2 Sealed Batteries:

All batteries must be factory sealed and maintenance free. Batteries shall be incapable of being opened or serviced and not leak in the event of a collision or rollover.

9.3 Wiring and Connectors:

All vehicle wiring and connectors shall be cleanly and neatly installed. Wiring should not pass close to sources of excessive heat, abrasion, chafing, and possible short circuit. Wiring must not get in the way of the driver, when entering/leaving the vehicle. All wiring must be shielded at all points, with electrical tape or heat shielding. No exposed wiring must be present on the vehicle.

9.4 Kill Switch:

Each vehicle must be equipped with two engine kill switches.

The vehicle shall be equipped with one or more of the following required switches:

- Polaris Part 4013381
- Ski-Doo Part 01-171 (http://www.mfgsupply.com/01-171.html)
- WPS 27-0152 (http://www.parkeryamaha.com/skidoostopswitch.aspx)
- WPS 27-0154(http://www.parkeryamaha.com/skidoostopswitch.aspx)

Note: Older versions of the approved switches are allowed.

9.5 Location:

9.5.1 Cockpit Switch:

The cockpit kill switch shall be mounted on the **Left side of the driver**, along the SIM, within reach of a driver that is properly secured in the vehicle.

9.5.2 External Switch:

One of the required kill switches must be located in such a way that easy to access by track marshals in emergency on the right side of the vehicle, aft of the plane of the RRH, and forward of the right FABUP. The external kill switch shall be generally perpendicular to the firewall (±15 deg), below frame point BR, and no further than 180 mm (7.0 inches), dimension "Z" in given figure, below frame point BR, and shall be mounted on a tab connected directly to the RRH. The external kill switch shall not be recessed more than 51 mm (2.0 inches) from the outside edge of the RRH tube.

9.5.2.1 Mounting:

All engine kill switches must be mounted rigidly to the frame of the vehicle with clear unobstructed access for track marshals. They must not contain any sharp edges or be mounted in an unsafe manner using any kind of adhesives. Riveting the kill switches to the mounting tab is allowed.

9.5.3 **Brake Light:**

All vehicles are mandated to have a functioning brake light to indicate that the brakes have been applied. Only stock OEM brake lights are allowed with no modifications being permitted on them. The wiring of the brake lights should be such that they fully light upon application of the brake but are not operational when the brake pedal is released.

9.5.3.1 **Mounting:**

The brake light must also be within the frame of the chassis. No part of the brake light should be outside the envelope of the frame. The vehicle must be equipped with a red brake light that must be clearly visible and appear bright in daylight. The brake light must be mounted at a minimum of 1 meter (39.4 in) above the ground. Light must be mounted such that it shines parallel to the ground, not up at an angle. A person standing 10 meters from the brake light in a 90 degrees cone behind the car should be able to tell if the brake light is on without any difficulty in bright daylight.

10.5 Brake Light Switch: Only two hydraulic pressure switches installed in each independent brake hydraulic circuit must be able to activate the brake lights. For cutting brakes, brake light activation is done through a hydraulic pressure switch. Mechanical switches or push pull type switches are not allowed.

10. Vehicle Identification and Markings:

11.1 Transponder: All vehicles that would be participating in the dynamic event would need to have a transponder. The transponder must be properly mounted and functioning properly at all times during the dynamics.

11.1.1Required Transponder:

All vehicles must be equipped with at least one MYLAPS rechargeable transponder. The only acceptable transponder type is the X2 MX.

X2 MX transponders must have current (during the event) subscription for the event and must be checked and activated prior to attending the dynamic events. All teams are responsible for their own transponders. Visit http://www.mylaps.com for more information.

11.1.2 **Mounting:** All vehicle transponders shall be mounted in the proper location, correctly oriented, and using sufficient fastening methods.

11.1.2.1 **Orientation:** The transponder shall be installed vertical to the

frame in the orientation shown in figure. The transponder shall also be oriented so the transponder number can read "right-side up."

11.1.2.2 **Location:** The transponder shall be mounted on the right side of the vehicle, forward of the seat, and preferably within the lower horizontal plane of the front suspension. The transponder shall be no more than 61 cm (24 in) above ground level.

The transponder shall have an open, unobstructed path between the antenna on the bottom of the transponder and the ground.

The signal can be interrupted by metal and carbon fiber but can function normally through fiberglass and plastic.

11.1.2.3 **Fastening:** Each transponder is supplied with a mounting bracket. The vehicle is advised to contain a small plate welded to the frame at the correct location as specified above to attach the transponder mounting bracket. The bracket can be attached with rivets, cable ties or bolts although attaching the bracket with 4 mm pan head or flat head bolts with locknuts or lock wire is advised.

11.2 Vehicle Numbers: Vehicle numbers are used by officials and track marshals to identify the teams. Teams must design numbers to be visible in all race conditions or keep them clean and conspicuous. Numbers shall not be obscured by any other portion of the vehicle.

> **Caution:** Numbers that are not easily read may be black flagged and might not be scored during the endurance event.

11.3 Required Numbers: There must be three primary numbers present in the car making it clearly visible from the front, left and right side of the vehicle. Use of adhesive to stick the numbers to the body panels is prohibited.

11.4 Location:

11.4.1 **Side Numbers:** The side numbers must be located on both sides of the vehicle, positioned above the Side impact member and behind the plane of the Rear Roll Hoop.

11.4.2 **Front Numbers:** The plane containing the front number should be inclined less than 45 degrees with the vertical when it is above the side impact member and less than or equal to 15 degrees with the vertical when placed below the side impact member.

11.4.3 **Number Size:** Size suitable for viewing from a distance, generally greater than 152 mm in height and be in contrast with the background to ensure easy visibility. No sharp edges should be present anywhere.

11.5 Sponsor Identification: Teams are free to display any form of advertising or graphics, as long as it is in good taste and not in conflict with the event or the organizers. The Organizers reserve the right to ban a

certain graphic if found in contempt.

11. Firewall:

All vehicles shall have a firewall separating the cockpit from the engine compartments. The firewall shall be constructed of metal, at least 0.50 mm (0.02 in.) thick. The firewall shall be mounted in the plane of the RRH and cover the area between the ALC and BLC. Multiple metal panels may be used to form the firewall, provided there are no gaps between the joints. Select cutouts are allowed for control cables, brake lines, electrical cables, and 4WD/AWD components, provided the cutouts have proper grommets and sealing to prevent them from leaking into the cockpit. Large cutouts in the firewall are explicitly prohibited. Large cutouts include those for CVT ventilation, and other similar items. Air intakes may not penetrate the firewall and must remain within the roll cage envelope. CVT ventilation intakes may extend outside the roll cage envelope. Engine air intakes may not extend outside the roll cage envelope.

12. Body Panels: The cockpit must be protected with body panels that completely cover the area between the LFS and the SIM. No gaps can exist that are larger than 6.35 mm (0.25 in) and will be checked with a 6.35 mm (0.25 in dowel rod). These panels must be made of puncture resistant material, including: plastic, fiberglass, metal, or similar material .They must be designed to prevent debris and foreign particles intrusion into the Cockpit. The panels must be mounted securely to the frame using sound engineering practices (cable ties or hook-and-loop fastening is not acceptable).

13. Belly Pan: The entire length of the cockpit must be fitted with a belly pan, so that the no debris may enter the cockpit whileseated normally. Material must be metal, fiberglass, plastic, or similar material. Expanded metal, fabric, or perforated panels are not allowed.

Note: Belly pan should withstand the load of the driver at all conditions.

13.1 **Leg and foot shielding:** All steering or suspension links exposed in the cockpit shall be shielded with a sturdy, robust, metal cover.

The shielding must prevent the driver's legs and feet from coming in

contact, becoming entangled, or struck by during operation or a failure. Universal joints in the steering system near the driver's feet must be shielded or sealed such that the driver may not become entangled in the joint.

14. Fire Extinguisher: All teams must carry two functional fire extinguishers. One fire extinguisher must be installed on the vehicle, and the remaining extinguishers shall kept in pit area all the time. All team members shall be familiar with the use and operation of fire extinguishers.

14.1 **Mounting and Location:** The fire extinguisher mounting bracket shall be mounted in the plane of the vehicle's RRH. The fire extinguisher mounting bracket shall be affixed to the RRH via steel tabs with a minimum thickness of 3 mm (0.125 in.) thick.

The fire extinguisher shall be positioned on the right side of the driver, within the cockpit such that the fire extinguisher is below the driver's head, and the top half of the fire extinguisher is above the SIM. The fire extinguisher shall be easily accessible by track marshals.
The pull knob of the required bracket shall be easily actuated. To facilitate this, a minimum radial clearance around the pull knob of 64 mm (2.5 in.) is required. It is understood the area aft of the pull knob will be less than 64 mm (2.5 in.) due to the design of the bracket.

The fire extinguisher shall be affixed to the mount via hose clamps. The hose clamp adjusters shall be installed as not to interfere with the operation of the pull-knob on the Drake bracket. The hose clamp adjusters and protruding material shall be installed as not to snag on the clothing of a driver during egress.

Note: Radial clearance is the unoccupied space between the edge of the pull knob and the nearest obstruction. The measurement is not made to the center of the pull knob.

14.2 **Rating and Required Features:** All fire extinguishers for use on the vehicle shall have a minimum UL rating of 5BC. The dial pressure gauge shall be readily visible and indicate the unit has been properly charged. Each fire extinguisher shall be labelled with team and college name and vehicle number.

15. Fasteners:

Fasteners used for securing are following as:

1.) Driver harness
2.) Fire Extinguisher
3.) Engine Kill Switch
4.) Steering, Braking, and SuspensionSystem
5.) Battery and Powertrain mount

Fasteners must meet the following criteria:

1.) Grade – The fasteners should meet or exceed the strength grades of either of SAE Grade 5/ Metric Grade 8.8 / AN/MS Specification.
2.) Captive - By using Nylon locknuts, cotter pins, safety wire. Thread sealants will not be considered captive.
3.) Thread projection – The threaded fasteners on which locknuts are used shall have at least two threads projecting past the end of the nut.
4.) Modification - Custom or unmarked fasteners are prohibited. Any modifications except for drilling holes for safety wire or shortening threads is prohibited.

16. Tow Points: At front and rear vehicle must have towing hitch points, along its longitudinal centerline. These hitch points are used both for dynamic events and for vehicle recovery. Tow points must be attached to the vehicle frame and must allow for transmission of both longitudinal and lateral towing loads. Towing loads will be imparted to the tow point by way of hook or clevis. Tow points shall have sufficient strength to serve as a vertical lift point for the vehicle.

16.1 **Front Tow Point:** Front tow points shall be constructed of tubular steel, not to exceed 31.75 mm (1.25 in.) and not less than 25.4 mm (1.0 in.) in diameter. Tubing thickness shall not be less than 0.89 mm (0.035 in.).
Front tow points shall be mounted no higher than the vehicle's SIM and not below the vehicle's LFS.
The front tow point shall be able to freely pass a gauge measuring 50.8 mm tall, 50.8 mm deep, and 203.2 mm wide (2.0 in. x 2.0 in. x 8.0 in.) behind the front tow point tube. Tow point may not interfere the front numbers.
Note: Front or Rear Bumper can't be considered as hitch point. If tubes are being used, they must be made of primary members. In addition, there must be lateral constraints for the hook or clevis to be properly in place which is optimum for the effective transmission of vehicle loads while lifting. Note that a bumper must be a FIXED one and not removable part and should be present from GO-NO-GO till end of the event.

16.2 **Rear Tow Point: Rear** tow points shall be constructed from steel and meet the following requirements. Rear Hitch Plate may be directly welded to the frame and latch type hitch point both are acceptable.

Table: Tow Points and Dimensions

Dimension	Symbol	Minimum	Maximum
Tab Thickness	None	8 mm (0.31 in)	9.5mm (0.375 in.)
Hole Diameter	D	25.4 mm (1.0 in.)	31.75 mm (1.25 in.)
Hole-to-Tube Offset	X	19.0 mm (0.75 in.)	25.4 mm (1.0 in.)
Edge Distance	R	15.9 mm (0.625 in.)	25.4 mm (1.0 in.)
Width at frame connection	Y	76.2 mm (3.0 in.)	Unrestricted
Material	None	Steel 1080	

17.Scoring

Event	Static Events
Design Evaluation	150
Cost Report	75
Business Plan	75
Total	300
	Dynamic Events
Acceleration	50
Sledge Pull	50
Maneuverability	100
Suspension and Traction	100
Endurance	400
Total	700
Total Score = Static + Dynamic=1000	

18. Technical Evaluation

All ATVC vehicles must pass a technical inspection before they are permitted to operate under power.
The evaluation will determine if the vehicle satisfies the requirements and restrictions of the ATVC 2022 rules.
If vehicles are not ready for technical evaluation when they arrive at the inspection site, they will be sent away.
Any vehicle may be re-inspected at any time during the competition and correction of any non-compliance will be required.

19.1 Engine inspection and governor setting- Governor Setting Check

Briggs & Stratton Technical Representatives will set the governors of all vehicles. Each vehicle engine will be confirmed by Briggs and Stratton technical staff that will:
(1) Confirm whether it's comes under the specifications mentioned above and
(2) Set the governor to the specified rpm. (3800)

19.2 Technical Safety Scrutiny -

Each vehicle will be inspected to determine if it complies with the requirements and restrictions of the **ATVC 2022** rules. This inspection will include an examination of the driver's equipment including helmet and arm restraints, a test of driver exit time and to ensure that all drivers meet the requirements of the rules. Each team must bring the following items to inspection.

19.2.1 Frame Material Documentation: Receipts documenting the materials purchased, or otherwise acquired, and used to build the frame. Note that material certificate from supplier as well as certificate of **MATERIAL COMPOSITION& MECHANICAL PROPERTIES CONFIRMATORY TESTAT AUTHORIZED LABORATORY ARE MANDATORY**. Roll cage tube material suppliers test report and Local Test Reports need to be submitted.

19.2.2 Roll Cage Specification Sheet: A completed copy of the Roll

Cage Specification Sheet. In case of higher grade of Steel is used then the supportive calculations should prove that cross-section is adequate and bending stiffness & strength is achieved.

19.2.3 Technical Inspection check sheet: At college level, **Technical Inspection check sheet** compliance is expected and the same should be submitted while technical evaluation is being done.

19.2.4. Drivers Present: All drivers must be present at technical inspection with a valid license and complete safety gears.

The safety scrutiny will also check for electrical systems, kill switch, lighting, reverse lamp, Buzzer (if installed), horn, wiring and their mountings etc. Both the external and cockpit kill switches will be tested for functionality. The system should pass the test.

19. Brake Test:

The objective of this test is to ensure the vehicle is safe for driving, while it goes up to its maximum speed. The test demands to attain the vehicle completes the patch of 30m in maximum time of 8sec and should be capable to stop with all four wheels locked within the distance of 10 ft.
Every team should demonstrate that all four-wheel brakes are effective for high-speed braking. Each vehicle must come to rest in an approximately straight line after acceleration run specified by the inspectors. If a vehicle fails to pass any part of the inspection, it must be corrected/modified and brought into compliance with the rules before it is permitted to operate.

20. Design Evaluation:

21.1.1 The objective of the engineering design event is to evaluate the engineering effort that went into the design of the vehicle and how the engineering meets the intent of the market. Students will be judged on the creation of design specifications and the ability to meet those specifications, computer aided drafting, analysis, testing and development, manufacturability, serviceability, system integration and how the vehicle works together as a whole. Each of these parts of the engineering product development cycle will be judged within the following subsystems: Suspension, Steering, Brakes, Drive-train/Power-train, Chassis and Ergonomics.
21.1.2 The vehicle that illustrates the best use of engineering to meet the design goals and the best understanding of the design by the team members will win the design event.
21.1.3 The engineering design evaluation will be conducted online via any linking platform which will be intimated on our website *www.atvcoffical.in*
21.1.4 The engineering design evaluation consists of two parts: Design Evaluation and an un-scored Design Report that will be used as a part of the design evaluation.

21.2 Design Report - Required Submission

21.2.1 Design Report - The design evaluation judging will start with the submission, before the event, of a Design Report. The Design Report will be reviewed by the design judges who will ultimately judge the team and vehicle at off-site Design Evaluation.

21.2.2 The Design Report should contain a brief description of the vehicle with a review of your team's design objectives, vehicle concepts, and a discussion of any important design features. Note or describe the application of analysis and testing techniques (FEA, part/system/vehicle testing, etc.). Evidence of this analysis and back-up data should be brought to the competition and should be made available, on request, for review by the judges.
A video of the vehicle along with each part used should be sent with the report. In case the vehicle is not fabricated by the time of off-site evaluation the team needs to present the engineering design of the vehicle along with the list of parts used and their invoice of purchase.

21.2.3 The Design Report will be used by the judges to sort teams into the appropriate design groups based on the quality of their review.
Note: While the Design Report is not explicitly scored, it may be considered to be the "resume of your car", preparing your off-site Design Evaluation judges to view your design effort in its most positive light. Failure to convincingly point out your design success in theDesign Report will almost certainly lead to Failure of your design judges to be impressed by your success.

21.3 Design Report - Vehicle Drawings

The Design Report must include one set of three (3) view drawings showing the vehicle, from the front, top, and side. The design needs to be computer generated.

21.4 Changes in Design with respect to initial design

Any changes made in the final design of the vehicle, as compared to initial design at the time of first design submission, needs to be documented with justification and presented at the event site failing which the team and machine will face penalty.

21.5 CAE Report - Required Submission

21.5.1 CAE Report - The CAE evaluation judging will start with the submission, before the event, of a CAE Report. The CAE Report will be reviewed by the CAE design judges who will ultimately judge the team and vehicle at on-site Design Evaluation.
21.5.2 The CAE Report may include (but not limited to) the following analysis: **R**oll Cage (Meshing + Analysis + Justification), Static Analysis on Roll Cage, Dynamic Analysis on Roll Cage, Torsional Rigidity and Bending Stiffness Calculation on Roll Cage, Computational Fluid Dynamics Analysis (CFD), Multi- Body Dynamics Analysis (MBD), Thermal Analysis, Calculation and Analysis of Components which are fabricated by team & Fatigue Analysis.
Teams are advised to indicate input parameters, boundary conditions, simulation methods, simulation results and conclusions drawn from the simulations for all the different analysis included in the CAE Report. Evidence of this analysis and back-up data should be brought to the competition and should be made available, on request, for review by the judges. Teams are advised to use dedicated CAE software for carrying out analysis.

21.6 Format for Document Submission

21.6.1 Design Report

The Design Report must be submitted electronically in Adobe Acrobat Format (PDF). The document must be a single file (text, drawings and optional content are all inclusive).
The design report file must be named as follows:
Vehicle #_institution name (full name) _competition_DesignReport.pdf
EXAMPLE: Vehicle # 001_XYZ University_ATVC 2022_DesignReport.pdf.
The maximum size for the file is 25 megabytes and if the video file exceeds the limit, share on google drive.

21.6.2 Design Spec Sheet

Design Spec Sheets must be submitted electronically in Microsoft Excel ® Format (*.xlsx file). The format of the Spec Sheet MUST NOT be altered. Similar to the Design Report, the Design Spec Sheet file must be named as follows: Vehicle #_institution name (full name) _competition_specs.
EXAMPLE: Vehicle # 001_XYZ University ATVC 2022_specs.xlsx.

21.6.3 CAE Report

The CAE Report must be submitted electronically in Adobe Acrobat Format (PDF). The document must be a single file (text, drawings and optional content are all inclusive). The design report file must be named as follows:
Vehicle #_institution name (full name) _competition_CAEReport.
EXAMPLE: Vehicle # 001_XYZ University_ ATVC 2022_CAEReport.pdf.
The maximum size for the file is 5 megabytes.

WARNING:

Failure to exactly follow the above submission requirements may result in exclusion from the Design Event. If your file is not submitted in the required format or is not properly named then it cannot be made available to the design judges and your team will be excluded from the Design Event.

21.7 Document Submission Deadline

21.7.1 The Engineering Design event documents must be submitted online on or before the submission deadline. Failure to do so will lead to the team's disqualification from the design event. The deadline for the design event document submission and the submission procedure will be announced on ATVC website. Teams are advised to check the website on a regular basis to keep themselves updated regarding submission deadlines. Design Report submission will be acknowledged either on the competition website or by email. Teams should have a printed copy of this acknowledgement available at the competition as proof of submission in the event of discrepancy.

Note: It is the responsibility of the team to verify when the report was received by organizers; submission time will be the time the report is received by organizers.

21.8 Online Evaluation.

The design judges will evaluate the engineering effort based upon the team's Design Report, their responses to the judges' questions, and an inspection of the video of the vehicle.

21.9 Support Material for onsite evaluation

Teams are required to bring three (3) color copies of the submitted design documents to the Design Evaluation event on-site. Failure to bring the hard copies of the design documents at the Design Evaluation may result in disqualification from the design evaluation. Teams may also bring with them to Design Evaluation any photographs, drawings, plans, charts, posters, and binders, example components, or other materials that they believe, are needed to support the presentation of the vehicle and the discussion of their development process. Use of laptop or notebook computers might be allowed to support any additional information which teams may like to give. Use of projectors is not permitted.
At the time of off-site evaluation, if the team wants to present additional data, they have to take prior permission from the judges and present it in form of pdf file.

22: COST EVENT-75 Points

22.1 Cost Event consists of two related sections: Cost Report and Prototype Cost. The cost report provides all the background information to verify the vehicle's actual cost. The prototype cost is the actual cost and the points related thereto.

22.2 Cost Report (Required Submission)

The Cost Report may contain a maximum of three sections:

22.2.1 Report Section 1 - Overview (Optional)

The optional overview is intended to give each team the opportunity to point out, and briefly comment on, any design features or fabrication processes that are innovative or are expected to result in significant cost savings. Teams may also use the overview to explain items or processes that might appear to be discrepancies within the report. The overview section is limited to a maximum of four (4) pages and is optional. This should be included as part of the Cost Documentation (.pdf) file.

22.2.2 Report Section 2 - Costing Sheets

The core of the report is the series of costing sheets. This section must contain the one-page summary sheet broken up into the individual subsystems. Each subsystem needs an individual sub-assembly sheet (Form A). Note that Vehicle Assembly Labor cost is for the labor it takes to assemble a subassembly to the frame. All fabricated parts on the sub-assemblies sheets (Form A) require a Form B. Note that the sub-system assembly time is the time it takes to assemble all the parts in that assembly together.

22.2.3 Report Section 3 - Cost Documentation

This section includes copies of receipts, invoices, price tags, catalog pages, on-line prices, or other documentation, to substantiate the costs of the parts and materials of any item costing more than Rs.200. Cost documentation must be at full retail Indian prices. The use of foreign receipts, purchases from discount sites such as Craig's List, eBay or junk yards are not allowed. The report is expected to be comprehensive, well documented, truthful and accurate.

22.2.4 Cost Component Categories

Teams must put items that are specified in the correct component categories and sub categories or the items will not be considered. See Cost Template for more details on component categories.

22.2.5 Cost Event guidelines can be found at *www.atvcoffial.in* in the login section.

22.2.5 Cost Report – Submission Format

1. The Microsoft Excel format (with the extension .xls (no macros) or .xlsx), using the supplied template posted on the ATVC website.

2. **This document should not be modified from its current form. This includes password protecting and embedding macros. Teams will receive zero (0) points for Cost if the report is in the incorrect format or the files have been modified.**
3. A PDF file with all of the cost documentation described above (C 4.2.1 to C 4.2.3). The cost report file must be named as follows: Vehicle #_school name (full name) _competition_ Cost Report. For example: Vehicle # 001_XYZ University_ATVC2022_CostReport.

22.2.6 Cost Report Submission Deadline

The Cost Report for ATVC 2022 must be submitted online. The deadline for the cost report and the submission procedure will be announced on *www.atvcoffial.in*. Teams are advised to check the website on a regular basis to keep themselves updated regarding submission deadlines. In case of failure to submit on time the teams will not be awarded marks for the same. Cost Report submission will be acknowledged either on the competition website or by email. Teams should have a printed copy of this acknowledgement available at the competition as proof of submission.

Note: It is the responsibility of the team to verify when the report was received by organizers; submission time will be the time the report is received by organizers. Teams will be cost audited at the virtual cost event or offsite competition.

22.2.7 Cost Correction

The judges may increase costs and/or fabrication times if they believe that the figures submitted are below current prices for the item, source, or process involved. Prices or times that are higher than the judge expects will not be corrected. Mathematical errors will be penalized. Reports that are highly inaccurate, highly incomplete, or in which the costs cannot be substantiated, may be rejected in their entirety and scored accordingly.
Teams are required to produce a video of the vehicleat the off-site cost judging by their scheduled appointment time. Failure to report by the scheduled appointment time will result in an automatic zero for the event. If teams need to reschedule their appointment, it must be done prior to the start of the cost event evaluation.

22.3 Static Evaluation (Online)

22.3.1 The cost evaluation judges will evaluate the team's total cost, adjustments made, and effort taken to optimize the cost of the vehicle using appropriate pricing for various components of the vehicle.
22.3.2 Cost report hard copy

Teams must bring a hard copy of their cost report to the cost judges on-site. **Teams that fail to bring a hard copy at the event, will receive zero (0) score for their cost evaluation.**

22.3.3 Cost Eligibility

Upon review of the data, the cost evaluation judge reserves the right to disqualify cost reports that have not been sufficiently validated (i.e., either through lack of documentation or outdated receipts), are determined to not be complete based on review, or are outside a reasonable level of cost based on the other cars in the competition (i.e., either too high or too low).

23. BUSINESS PLAN EVENT – 50 Points

23.1 Presentation - Objective

The objective of the Presentation is for the team to convince the "executives" of a hypothetical manufacturing company to purchase the team's ATVC vehicle design and put it into production at the rate of 2000 units per year.

23.1.1 For the presentation, teams are to assume that the judges are following 2 set of people –

Group 1 - Perspective Buyers

Group 2 - Investors (who need to be convinced that factory set up by the teams will make profit)

23.2 Presentation - Format

23.2.1 Up to 3 members from a team are allowed to make the presentation to the judges.

23.2.2 Total time for presentation

Presentation: 10 minutes

Q&A: 15 minutes

23.2.3 Only the judges are permitted to ask questions. Any team member on the presentation floor/stage may answer the questions.

23.2.4 The Sales presentation guidelines and template can be found at website ATVC login panel.

23.3 Static Event

23.4 Teams are required to keep their presentation ready at the time of offsite evaluation on their desktop.

23.5 Presentation - Scoring

23.5.1 The presentation event will be scored based on the following five categories

1) Presentation Content including company financials and break even analysis.
2) Presentation organization, effectiveness & team's response to Judges' questions.
3) USP coverage – Market research, analysis, SWOT.
4) Marketing Strategy.
5) Project Schedule – Time Lines, Project Execution, Capital, Materials.

23.5.2 The team that makes the best presentation will receive the highest score regardless of the finished quality of their actual vehicle.

24: DYNAMIC EVENTS – 700 POINTS

The dynamic events are intended to determine how the ATVC vehicles perform under a variety of conditions. Note that the organizers may modify the dynamic events to address local conditions, weather or resources. Organizers may or may not provide a practice track to teams. A practice track allows teams to test or tune their vehicle within the limits of the rules. If the organizer provides a practice track, the course length and features are at the organizer's discretion.

24.1 Scoring

Event	North	South
	Static Events	
Design Evaluation	150	150
Cost Report	75	75
Business Plan	75	75
Total	300	300
	Dynamic Events	
Acceleration	50	50
Sledge Pull	50	50
Maneuverability	100	100
Suspension and Traction	100	100
Endurance	400	400
Total	700	700
Total Score = Static + Dynamic=1000		

24.2 - PRACTICE

24.2.1 - Objective

Organizers may or may not provide a practice track to teams. A practice track allows teams to test or tune their vehicle within the limits of the rules.

24.2.2 - Course

If the organizer provides a practice track, the course length and features are at the organizer's discretion.

24.2.3 - Procedure

After a safety check, vehicles are signaled to enter the practice track. After a predetermined time set by the track worker, the vehicle is signaled to exit the practice track.

24.2.4 - Penalties

Teams may be signaled to exit the practice track or barred from using the practice track if the track worker or competition officials observe unsafe conditions or behaviors.

24.2.5 - Signals and Signage

See D.8.9 - Signals and Signage.

24.2.6 - Scoring

There is no score awarded for practice.

25 - ACCELERATION

25.1 - Objective

The Acceleration Event is designed to measure each vehicle's ability to come up to speed quickly from a standing start.

25.2 - Course

Acceleration is measured as the time to complete a 30.48 m (100 ft.) flat, straight course from a standing start. The course surface may vary from pavement to loose dirt. The choice of course length and surface is at the organizer's discretion.

25.3 - Procedure

After a safety check, vehicles are positioned at the start line of the course. The track worker will check that the driver is ready to begin. Once the driver is ready, the track worker will signal the driver to proceed down the course. After completing the run on the course, the vehicle will be directed to the course exit.
Each vehicle may make two (2) runs on the course.

25.4 - Penalties

- Stall At Start – Run DQ
- False Start – Run DQ
- Driving off Course – Run DQ

The organizer may modify the penalties imposed for different violations to account for differences in the length or design of specific event courses.

25.5 - Scoring

The maximum number of available points for the traction event is 50 points. Scoring will be based on the better of the two attempts. Timing will be performed with an electronic timing system.

25.6 – FORMULA

$$S_{ac} = 50\ X\ \frac{T_{max} - T_{run}}{T_{max} - T_{min}}$$

26 SLEDGE-PULL

26.1 - Objective

This event tests the vehicle's relative ability to pull designated object, e.g. progressive weight skid, vehicle, or chain along a flat surface.

26.2 - Course

The sledge- pull event may take place on a straight or curved course. The organizer will determine the object to be pulled.

26.3 - Procedure

After a safety check, vehicles are positioned at the start line of the course. The track worker will check that the driver is ready to begin. Once the driver is ready, the track worker will signal the driver to proceed down the course. After completing the run on the course, the vehicle will be directed to the course exit.
Vehicles may not continue the attempt after they have stopped on the course.

26.4 - Penalties

Driving Off Course – Score as maximum progress at point of exiting the course.

26.5 - Scoring

The maximum number of available points for the traction event is 50 points. Scoring will be based on the better of the two attempts. If a vehicle cannot complete the course and get a time, it will be scored on the distance that it travels before stopping. Once the vehicle stops moving forward the attempt is over and the attempt is scored for distance at that point.

26.6.1 - Method 1 (Different Distances)

If none of the vehicles are able to complete the course, then: The following equation will be used for the traction score (Str):

$$S_{tr} = 50\,X\frac{D_{run} - D_{min}}{D_{max} - D_{min}}$$

Where: D_{min} is the shortest distance by any vehicle D_{run} is the distance traveled for the vehicle to be scored. D_{max} is the longest distance by any vehicle.

26.6.2 - Method 2 (Fixed Distance, All Succeed)

If there is (a) a set maximum distance and (b) all teams succeed in completing a full distance hill or pull, then the score will be based on the time for the full distance.
The following equation will be used for the traction score (Str):

$$S_{tr} = 50\ X\ \frac{T_{max} - T_{run}}{T_{max} - T_{min}}$$

Where: T_{min} is the lowest (fastest) time by any vehicle T_{run} is the time recorded for a vehicle's run to be scored. T_{max} is the minimum of the following:

- The longest (slowest) time by any vehicle, or
- 2.5 times T_{min}

26.6.3 - Method 3 (Fixed Distance, Some Succeed)

If there is (a) a set maximum distance and (b) at least one team climbs the hill or makes a full pull and others do not, then the vehicles going the full distance (Group I) will be scored based on time and the vehicles that fail to climb the hill or make a full pull (Group II) will be scored based on distance.
Group 1
Where: T_{min} is the lowest (fastest) time by any vehicle T_{run} is the time recorded for a vehicle's run to be scored.

$$S_{tr1} = 50\ X\ \frac{T_{max}}{T_{run}}$$

Group 2

$$S_{tr2} = \left(S_{tr1}\right)\ X\ D_{run}$$

Where: D_{run} is the distance recorded for a vehicle to be scored. D_{course} is full length of the course to be run by the vehicle.

27 MANOEUVRABILITY

27.1 - Objective

Maneuverability is designed to assess each vehicle's agility and handling ability over off-road terrain. Teams will attempt to maneuver through the course with a minimum time.

27.2 - Course

The course may consist of a variety of challenges at the organizer's option, possibly including tight turns, pylon maneuvers, ruts, bumps, drop-offs, sand, rocks, gullies, logs, and inclines.

27.3 - Procedure

After a safety check, vehicles are positioned at the start line of the course. The track worker will check that the driver is ready to begin. Once the driver is ready, the track worker will signal the driver to proceed down the course. After completing the run on the course, the vehicle will be directed to the course exit.
Each vehicle may make two (2) attempts at the course.

27.4 - Penalties

The organizer will select penalty types imposed for different violations to account for differences in the length or design of specific event courses. Penalties are times added to the total time a vehicle took to complete the course for a given run. The organizer will announce penalties on their event website or at a mandatory team meeting.

27.8 - Scoring

The maximum number of available points for the maneuverability event is 100 points.
Scoring will be based on the best of the two attempts. Only vehicles that complete the maneuverability course within a time not exceeding 2.5 times that of the fastest vehicle will receive a score. If a vehicle is on the course for a time that exceeds 2.5 times the fastest time recorded to that point, then the attempt may be declared over and the vehicle may be removed from the course and scored as "Excess Time."
Maneuverability scoring is based on the vehicle's time to complete the course. Penalties are added to the vehicle's time for a given run.
The following equation will be used for the maneuverability score (Sman):

$$S_{ma} = 100\,X\,\frac{T_{max} - T_{run}}{T_{max} - T_{min}}$$

Where: T_{min} is the lowest (fastest) time by any vehicle T_{run} is the time recorded for a vehicle's run to be scored. T_{max} is the minimum of the following:

- The longest (slowest) time by any vehicle or 2.5 times T_{min}

28– SUSPENSION AND TRACTION EVENTS

Suspension and traction events are designed to test the vehicle under unique off-road conditions that might be unique or specific to a particular ATVC India competition site.

28.1 - Objective

Suspension events may require the vehicle to complete a course in a minimum time

28.2 - Procedure

After a safety check, vehicles are positioned at the start line of the course. The track worker will check that the driver is ready to begin. Once the driver is ready, the track worker will signal the driver to proceed down the course. After completing the run on the course, the vehicle will be directed to the course exit.
Each vehicle may make two (2) attempts at the course.

28.3 - Penalties

The organizer will select penalty types imposed for different violations to account for differences in the length or design of specific event courses. Penalties are times added to the total time a vehicle took to complete the course for a given run. The organizer will announce penalties on their event website or at a mandatory team meeting.

28.4 - Scoring

The scoring system and penalties employed by the event head must adhere to one of the options defined for either (a) the Maneuverability event, or (b) the Traction event. The maximum number of available points for the specialty event is 100 points. Scoring will be based on the best of the two attempts. Only vehicles that complete the S&T course within a time not exceeding 2.5 times that of the fastest vehicle will receive a score. If a vehicle is on the course for a time that exceeds 2.5 times the fastest time recorded to that point, then the attempt may be declared over and the vehicle may be removed from the course and scored as "Excess Time."
S&T scoring is based on the vehicle's time to complete the course. Penalties are added to the vehicle's time for a given run.

The following equation will be used for the S&T score (Sman):

$$S_{ma} = 100\, X_{T_{max}} - T_{run}$$

Where: T_{min} is the lowest (fastest) time by any vehicle T_{run} is the time recorded for a vehicle's run to be scored. T_{max} is the minimum of the following:

- The longest (slowest) time by any vehicle or 2.5 times T_{min}

29 - ENDURANCE

29.1 - Objective

The endurance event assesses each vehicle's ability to operate continuously and at speed over rough terrain with obstacles in potentially adverse weather conditions (rain, snow, etc.). The endurance event may be run for time or for distance. The default is four (4) hours and the vehicle with the most laps (orbits) around the course is declared the winner.

29.2 - Course

The endurance course is a closed loop measuring approximately 1.5 km to 4.5 km. The endurance course may feature different surfaces (e.g. dirt, grass, sand, mud, gravel, stone, and asphalt). The endurance course will feature various obstacles and terrain to test the vehicle's durability, traction, and speed.

29.3 - Procedure

29.3.1 - Pre-Gridding

Teams will pre-grid before the endurance event and be placed into starting position based on each team's acceleration timings, to be determined by the organizer. Pre-gridding will close at a pre-determined time by the organizer. Teams late to pre-grid will be gathered in the pit exit lane and released to the track after the race has started.

29.3.2 - Compliance Check

During pre-gridding, or after pre-gridding closes, vehicle engines will be started and the Technical Inspector will perform a compliance check. During compliance check and gridding, the driver and vehicle may only have one team member accompany them. The compliance check includes, but is not limited to inspection of the following:

- Helmet Certification
- Helmet Fitment and Securement
- Safety Harness
- Driver Equipment
- Driver Wrist Band
- Fire Extinguisher
- Engine Kill Switches
- Brake System

Unprepared drivers or out-of-compliance vehicles deemed unsafe or not ready to drive will be ordered out of the gridding line by Technical Inspectors and sent to the paddocks to make corrections. Vehicles not ready to drive must check in at the pit exit lane to be admitted to the track.

29.3.3 - Gridding

Once the compliance check is complete, vehicles begin to form the grid and approach the start line as marshalled by track workers or Technical Inspectors.

29.3.4 - Starting

The endurance event may be started by a funnel start, standing staggered start or rolling start. A funnel start is when cars are arranged in a conical formation and released all at once. A standing staggered start is used to release cars in groups of two with a delay in between groups. A rolling start allows a run-in distance to the start line. The rolling start may be performed on the course. The start type will be determined by the organizer.
All vehicles will be considered to have begun the race simultaneously at the time when the starter releases the first vehicle onto the course regardless of their actual position in the grid.

29.3.5 - Running

Endurance will be run as either:

- A single four (4) hour race
- A predetermined and published distance
- Elimination heats followed by a final in which the total time of one elimination heat plus the final is 4 hours. The organizer will announce the structure of the event prior to the start.

Vehicles will safely navigate the course and accrue laps (orbits) to be counted and scored.

29.3.6 - Driver Change

Vehicle drivers may be changed at any time. Driver changes occur in the teams own pits. The organizer reserves the right to require at least one driver change during the endurance event.

29.3.7 - Service

29.3.7.1 - Remote Pit

The organizers may elect to create a remote pit for minor repairs and adjustments.

29.3.7.2 - Paddocks

Teams whose vehicle requires service and repairs may exit the track at the designated location and proceed at walking speed to their paddock. No repairs are permitted on the course at any time.

29.3.8 - Recovery

Vehicles disabled on the endurance course may be recovered by track workers, or by designated recovery crews. Track workers will attempt to assist disabled vehicles. It is the driver's responsibility to assist and cooperate with the course marshals in removing the vehicle. Drivers may not exit the vehicle to start the engine. Drivers must be seated and secured in the vehicle before track workers will attempt to restart the engine.
If track workers are unable to assist a disabled vehicle, a recovery crew will transport the disabled vehicle to the paddocks. Drivers being towed to the paddock are required to remain seated and secured in their vehicle with all safety equipment on.
Recovery crews are dispatched and operate on a "first come, first serve" basis. No priority will be given to any team over another.

29.3.9 - Finish

The Endurance event is finished when the lead car crosses the finish line after the time limit or distance has been reached. Vehicles remaining on the track will be allowed to finish their lap. As vehicles cross the finish line, track workers will direct vehicles to the paddocks or the impound area (if required). All post-event traffic shall be at walking speed.

29.3.10 - Impound

The organizer reserve the right to impound and inspect any vehicle during or after the endurance event. The Technical Inspectors will direct and instruct teams in impound on how to proceed.

29.4 - Penalties

Event Co-ordinators are the only personnel permitted to call and assess penalties during the endurance event. Co-ordinators are distributed throughout the endurance course during the event. Penalties during the endurance race will be signaled and vehicles ordered off the track into the black flag area. Event Co-ordinators may stop any vehicle, at any time, if they believe it no longer complies with the requirements and restrictions of the rules. All timed penalties are enforced from when the vehicle is in the black flag area, i.e., the time spent being towed back to the pits does not count towards the penalty.

29.4.1 - Driver Equipment

Any driver that is not using all of the approved and required drivers' equipment will be flagged.

29.4.2 - Mechanical Faults

All cars must remain in the as-approved condition in order to compete; any condition that is deemed to not meet this requirement will be flagged to make necessary repairs or adjustments. If a vehicle is stopped by officials for a mechanical fault, the fault must be corrected before it may re-enter the event.

29.4.3 - Vehicle Assists

Certain areas of the endurance course have been identified as difficult obstacles. If a vehicle is assisted three times on the same obstacle, the vehicle may be black flagged and the driver warned that one more assist will result in removal of the vehicle for the remainder of the event.

29.4.4 - Roll Over

If a vehicle rolls over (end over end, or over on its side) anywhere on the track two times (in any location, regardless of driver), the vehicle will be black flagged and the driver warned that one more roll-over will result in removal of the vehicle for the remainder of the event. Roll overs will be judged at the discretion of the Event Captains. Any vehicle that rolls over must be inspected by the Technical Inspectors before returning to the track.

29.5 - Scoring

29.5.1 - Points

The maximum possible points for endurance are 400 points.

29.5.2 - Determination of Winner

The team that completes the distance of the competition first or the greatest number of scored laps in the time set for the competition will be declared the winner.

29.5.3 - Scored Laps

Scored laps are the number of full laps actually completed during the endurance event. Only full laps count, partial laps do not count for score. A vehicle must cross the timing line under its own power for a lap to be counted.

29.5.4 - Finish Order

Finish order is the sequence in which vehicles cross the finish line after the lap scoring period has ended. Finish order determines the ranking of teams completing the same number of laps. For example, if the top four teams finish with the same number of laps, then they will be ranked 1st to 4th based on their finish order.

29.5.5 - Score

Endurance scoring is based on number of laps the vehicle completes in the allowed time:

$$S_{en} = 400\ X\ \frac{L_{team} - L_{min}}{L_{max} - L_{min}}$$

Where: L_{max} is the maximum number of laps completed by any vehicle. L_{team} is the number of laps completed by the vehicle to be scored. L_{min} is the minimum number of laps completed by any vehicle.

30 - GENERAL EVENT PROCEDURES AND REGULATIONS

30.1 - Safety

30.1.1 - Safety Vision

Safety is the primary consideration in the design of vehicles and the conduct of the competitions. No event or competition is so important that teams and organizers cannot take the time to work safely. All participants will strive to create a safe competition where all participants return home in the same condition in which they arrived.

30.1.2 - First Aid / CPR / AED

While medical services are always on-site at ATVC India events, teams are encouraged to be familiar with or trained in first aid, CPR, and the use of AED machines.

30.1.3 - Approaching Others

All participants are empowered to directly and respectfully approach others if they see a hazardous or unsafe condition and notify the person in danger. Persons approached regarding a safety concern are obligated to respectfully acknowledge the situation and are encouraged to thank those who approached them for their concern.

30.1.4 - Responsibility

At all performance events, it is the responsibility of the team to ensure both the vehicle and driver meet and follow all the requirements and restrictions of the rules.

30.1.5 - Personal Protective Equipment

Teams are required to furnish and use their own PPE, appropriate for the task being performed. This includes, but is not limited to:

- Safety Glasses
- Gloves
- Closed Toe Shoes
- Arc Flash Protection
- Hearing Protection

30.1.6 - Key Hazards

All participants are encouraged to pay careful attention to the following situations:

30.1.6.1 - Ascending and Descending

Maintain 3-point contact when ascending and descending stairs, ladders, steps, or tailgates. Watch for obstructions at the beginning and end of travel.

30.1.6.2 - Pinch Points

Stay clear of pinch points from rotating machinery, doors, and other equipment.

30.1.6.3 - Hazardous Release of Energy

Stay clear of sparks, chips, swarf, or other high-energy material. Check circuits for live wires before working on them. Depressurize high pressure air, oil, or water systems before working on them. Take care when working around presses, rams, or other hydraulic equipment. Use care when jacking or lifting vehicles or other objects

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30.1.6.4 - Vehicle Operations

Do not drive when distracted. Utilize a spotter when backing a vehicle.

30.1.6.5 - Walking / Path of Travel

Take care to keep all walking paths clear of slip, trip, and fall hazards.

30.2 - Rules of Conduct

30.2.1 - Sportsmanlike Conduct

All ATVC India participants can be proud of the excellent sportsmanship and cooperation among teams that are two of the hallmarks of the series. Good conduct and compliance with the rules and the official instructions are expectations and requirements for every team member.
Unsportsmanlike conduct can include arguments with officials, disobedience of official instructions and the use of abusive or threatening language to any official or other participant. Depending on the seriousness of the infraction the penalty for such actions can range from a deduction of up to fifty percent (50%) of the team's points to expulsion of the entire team. Penalties of this type will only be imposed after a complete review of the incident by the organizers.

30.2.1.1 - Prohibited Material

Alcoholic beverages, firearms, weapons of any type, and illegal materials are prohibited at ATVC India sites. The penalty for violation of this rule is the immediate expulsion of the entire team, not just the individual(s) involved. This rule applies to team members, advisors and any individuals working with the team on-site.

30.2.1.2 - Tobacco Products and Electronic Cigarettes

The use of all tobacco products or using e-cigarettes on-site is prohibited.

30.2.1.3 - Footwear

All individuals on-site shall wear durable and sturdy closed toe shoes. Open-toed shoes, slippers, chappals etc. are explicitly prohibited.

30.2.1.4 - Housekeeping

Clean-up of trash and debris is the responsibility of the teams. Please make an effort to keep the paddock area clean and uncluttered. At the close of the day, each team must clean their work area.

30.2.1.5 - Site Condition

Please help the organizers keep the site clean. The sites used for ATVC India are generally private property and should be treated as such. Competitors are reminded that they are guests. All trash should be placed in the receptacles provided. Glass is not allowed on the grounds. Failure to clean the premises will result in an unsportsmanlike conduct penalty. Competitors are encouraged to clean their areas after meals.

30.2.1.6 - Personal Transportation

The use of motorcycles, quads, bicycles, scooters, skateboards, rollerblades or similar person-carrying or motor driven devices by team members and spectators in any part of the competition area, including the paddocks is prohibited.