UNIVERSIY:	
VEHICLE NUMBER:	
INSPECTION ORDER:	
SES PASSED:	
IAD PASSED:	
-	
ESF PASSED:	
TS VOLTAGE:	
BODY PROTECTION R:	

e vehicle for
:he following order:
pection
ılator inspection*

1. Electrical Inspection*
   Mechanical Inspection
   Driver Egress
2. Tilt Test*
3. Rain test*
4. Brake Test*

* the vehicle is marked with a sticker if this part has been passed successfully.

Used Symbols:

- ● Information
- ▶ Action
- Δ Check in responsibility of the team
- ◯ Check

NOTES:

- This form must stay with the vehicle at all times!
- Technical inspection approval voids if inspection sheet is lost.
- If there is a conflict between this form and the rules, the rules prevail

PART I: COMMENTS FROM DOCUMENT REVIEW

ACCUMULATOR

ELECTRICAL

MECHANICAL

PART II: PRE-INSPECTION

☐ TIS STATUS UPDATE

► Set online TIS status to **Present**

► Write down inspector names legibly, sign only when passed

☐ TIRES

1 ◯ **DRY TIRES** - Make:_____

2 ◯ **DRY TIRES** – Size._____

3 ◯ **DRY TIRES** - Compound:_____

4 ◯ **DRY TIRES** – Recommended manufacturer pressure: _____bar

5 ◯ **DRY TIRES** - Dry tires marked.

6 ◯ **RAIN TIRES** – Make:_____

7 ◯ **RAIN TIRES** - Size:_____

8 ◯ **RAIN TIRES** - Compound:_____

9 ◯ **RAIN TIRES** - 2,4 mm min. tread depth molded by tire manufacturer

_____

10 ◯ **RAIN TIRES** - Recommended manufacturer pressure: _____bar

11 ◯ **RAIN TIRES** - Rain tires marked.

☐ RIMS

12 ◯ **DRY TIRE RIM** – Made/Bought:

_____

13 ◯ **DRY TIRE RIM** – Material.

_____

14 ◯ **RAIN TIRE RIM -** Made/Bought:

_____

15 ◯ **RAIN TIRE RIM -** Material:

_____

☐ DRIVER GEAR & SAFETY

16 ◯ **FIRE EXTINGUISHERS** - Two (2) hand-held, 0.9 kg (2 lb.) minimum, dry chemical (10BC, 1A10BC, 34B, 5A 34B, 20BE or 1A 10BE, with Russian marking no lower than 1A 34B), with pressure/charge gauge, Aqueous Film Forming Foam (AFFF) fire extinguishers are prohibited, 1 WITH VEHICLE securely installed on push-bar, 1 in paddock. (Must see BOTH at inspection.)

17 ◯ **UNDERWEAR** - Nomex or equivalent, fire-resistant underwear (no cotton, no polyester, no bare skin). No holes. If clothing is embroidered team must prove compliance with T13.3. Max. 10 years old.

18 ◯ **SOCKS** - Nomex or equivalent, fire-resistant socks (no cotton, no polyester, no bare skin). No holes. Max. 10 years old.

19 ◯ **GLOVES** - Fire resistant material. Leather allowed only over fire resistant material. No holes. Max. 10 years old.

20 ◯ **ARM RESTRAINTS** - SFI Standard 3.3 or equivalent.

21 ◯ **HELMETS** - Snell K2015, K2020, M2015, M2020, SA2020, EA2016 or newer, 31.1/2015, 31.1/2020, 41.1/2015, 41.1/2020 or newer, FIA 8860-2010, FIA 8860- 2018, FIA 8859-2015 (with SA 2015), FIA 8858 2010 (with SA(H) 2010) or newer. Closed Face, no Open Face, must have integrated shield (no dirtbike helmets). No camera mounts. Communication equipment only allowed, if compliant with FIA regulations (International Sporting Code - Appendix L).

22 △ **COMMUNICATION EQUIPMENT -** Must be securely attached to the vehicle or to the driver. Communication equipment except microphone and headphones (e.g. mobile phone), must be rigidly mounted to the chassis OR to the driver (e.g. carried in a belt under the suit). It must not interfere with the driver harness. It must be worn during egress test, if used at any discipline.

23 ◯ **DRIVER SUITS** - Single piece SFI 3.2A/5 (or higher), SFI 3.4/5 (or higher), FIA 8856-2000/2018 (or higher), and LABELED AS SUCH. No holes. If clothing is embroidered team must prove compliance with T13.3.

24 ◯ **FHR/HANS** - If used, must be certified to one of these standards: FIA 8858-2010, FIA 8860-2004, SFI 38.1.

25 ◯ **HAIR COVER** - Fire resistant (Nomex or equiv.) balaclava of full helmet skirt REQUIRED FOR ALL DRIVERS. No holes. Max. 10 years old.

26 ◯ **SHOES** - SFI 3.3 or FIA 8856-2000/2018. Max. 10 years old.

27 ◯ **SEWING OR STITCHING** - Teams must show compliance to T13.3 if driver's clothing is embroidered. Fire resistant material must be used, examples: Nomex, Aramid, Belcotex and Indura

☐ TIS STATUS UPDATE

► Set online TIS status to **Passed** or **Failed**

NON-COMPLIANCE / COMMENTS

APPROVAL

Inspector Names	Date, Time	Signature when passed
1. _____/ _____	_____	_____ _

PART III: EGRESS TEST

☐ DRIVER EGRESS TEST

28 ◯ **ARM RESTRAINTS** – Must be installed so the driver can release them and exit unassisted regardless of vehicle's position.

29 ◯ **HEAD RESTRAINT** – Near vertical. Max. 25 mm from helmet. Helmet contact point 50 mm min. from any edge.

30 ◯ **MAIN HOOP & FRONT HOOP HEIGHTS** – Helmet of driver to be 50 mm below line between top of front and main roll hoop AND between top of main hoop to rear attachment point of main hoop bracing.

31 ◯ **LAP BELT MOUNTING** - Must pass over pelvic area between 45-65 deg. to horizontal for upright driver, 60-80 deg. For reclined. The lap belts must not be routed over the sides of the seat.

32 ◯ **SHOULDER HARNESS MOUNTING** – Angle from shoulder between 10 deg. up and 20 deg. down to horizontal.

☐ DRIVER EGRESS TEST

- All drivers must be able to exit the vehicle in less than 5s.
- Driver must be seated in ready to race condition.
- Communication equipment installed, if intended to use at any dynamic discipline.

☐ EGRESS PROCEDURE

► Both hands on the steering wheel. (in all possible steering positions)

► Pressing cockpit-mounted shutdown button.

- The egress time will stop when the driver has both feet on the ground

☐ DRIVER APPROVAL & RUN DOCUMANTATION

Driver's Name	Wristband ID	Signatures when passed	Valid driver license	Helmet marked	Comm. equip. used?	Acc	SkidPad	AutoX	Endu rance
_____	_____	_____	◯	◯	◯	◯◯	◯◯	◯◯	◯
_____	_____	_____	◯	◯	◯	◯◯	◯◯	◯◯	◯
_____	_____	_____	◯	◯	◯	◯◯	◯◯	◯◯	◯
_____	_____	_____	◯	◯	◯	◯◯	◯◯	◯◯	◯
_____	_____	_____	◯	◯	◯	◯◯	◯◯	◯◯	◯
_____	_____	_____	◯	◯	◯	◯◯	◯◯	◯◯	◯

Checked during egress test	Checked by officials only after a dynamic run!

PART IV: ACCUMULATOR INSPECTION

The time limit for this part of the inspection is 180 minutes. Continuation of the inspection is possible after requeuing. During technical inspection all work carried out on the vehicle must be approved by a technical inspector.

☐ TIS STATUS UPDATE

► Set online TIS status to **Present**

► Write down inspector names legibly, sign only when passed

☐ COMMENTS

► Check comments from first page

☐ REQUIRED RESOURCES

33 ◯ An ESO must attend.

- All accumulator containers to be used during the event.

34 ◯ No spare TS accumulator containers

- Accumulator Container Hand Cart.
- Charger.
- Tools needed for (dis-)assembly of Accumulator Container.
- PDF or print-out of rule questions, if necessary.
- Pictures of accumulator internals, if necessary.
- Datasheets for used wiring, insulation materials, and TS components (printed or properly sorted on one laptop, not on a cell phone).
- Samples of all wire types used inside the accumulator container.
- Samples of all used accumulator container material.
- Fully assembled spare boards of all inaccessible TS boards inside the accumulator.
- Laptop and cables to display data of the AMS.

☐ SAFETY BRIEFING

- no jewelry, no rings
- no cell phone
- no batch / no necklace
- no sources of distraction
- do not wear synthetic clothes
- wear safety glasses
- wear safety gloves

☐ BASIC SET OF HV-PROOF TOOLS

35 ◯ Insulated cable shear.

36 ◯ Insulated screw driver.

37 ◯ Insulated spanners (n/a if no screwed connections in TS)

38 ◯ Multimeter with protected probe tips.

39 ◯ Two 4mm banana plug test leads (600V CAT III).

☐ SAFETY EQUIPMENT

40 ◯ Face shield.

41 ◯ Safety glasses (minimum three).

42 ◯ HV insulating gloves (minimum two pairs) without holes and with appropriate expiration date.

43 ◯ HV insulating blankets (two) (min 1m^2) with label or serial number and datasheet.

☐ SELF DEVELOPED PCBS

► Ask for fully assembled spare PCB of self-developed PCBs inside accumulator container.

44 ◯ Sufficient spacing regarding system voltage and implementation.

45 ◯ Sufficient insulation and temperature rating of coating if used, datasheet available.

46 ◯ Coating process according to datasheet. Check coating with UV lamp (Note: not all coatings contain fluorescent markers!).

☐ HAND CART

47 ◯ Handcart present with four wheels. Max. floor space dimensions 1200mm x 800 mm.

48 ◯ Handcart has always-on type brake system.

49 ◯ Hand cart can be easily moved if brake is released.

50 ◯ The accumulator must be mechanically fixed to the handcart while on the handcart.

51 ◯ The accumulator must be protected from vibrations and shocks.

52 ◯ Firewall (same width as hand cart, from lowest point to 30cm above TSAC/handle) must protect operator.

53 ◯ Label according to EV5.3.7 on hand cart firewall, max 1.3m above ground.

ACCUMULATOR CONTAINER LABELING

54 ◯ Vehicle number, university name and ESO phone number(s) written on a high contrast background.

55 Δ Roman Sans-Serif characters of at least 20mm high are used.

56 ◯ Warning stickers with side length of ≥100mm and text "Always Energized" and "High Voltage" (if TS >60V) installed. (triangle with black lightning bolt on yellow background)

57 ◯ If spare cells are present, their container must be labeled as specified in EV5.3.7. If this container is placed within another container, the outer container must also be labeled.

CHARGER ASSEMBLY

58 ◯ Completely closed. Check opening in HV/TS enclosures, try to reach HV/TS potentials with insulated test probe (100mm length, 6mm diameter).

59 ◯ The TS charging leads are securely anchored to withstand at least 200 N.

60 ◯ Interlock integrated.

61 ◯ TSMP integrated

62 ◯ Emergency shutdown integrated

63 Δ Emergency button ≥24mm diameter clearly labeled.

64 ◯ TSAL green light indicator integrated, easily visible. Must be hard-wired electronics.

65 ◯ TS wiring is orange, marked with gauge, temperature rating >85 C and voltage rating.

66 ◯ Conductive parts of charging equipment and accumulator are connected to protective earth (PE) while charging. Mind new grounding rules, see EV 3.1

67 ◯ Switches, plugs and indicators must be labeled.

DISCHARGE CIRCUIT AND BODY PROTECTION RESISTORS

► Switch off Charger. Measure resistance between TS+ and TS- measuring points.

68 ◯ Resistance = _____ (Discharge resistor + 2x Body Protection Resistor (BPR))

► Press shutdown button.

69 ◯ Measured resistance remains the same.

70 ◯ Body protection resistor power rating is _____ (sufficient to short circuit TS+ and TS-)

OPEN ACCUMULATOR CONTAINER

► Open container housing, remove maintenance plugs.

► Check if no voltage is present.

► Get mechanical inspector for ASES checks

► A stack selected by the scrutineer shall be removed from the TSAC.

ASSEMBLY — ELECTRICAL

71 ◯ All components and parts of the accumulator container need to be properly fixed.

72 ◯ If spare cells are present, they also must be stored securely fixed in an electrically insulated container made of fire retardant material (see T1.2.1).

73 ◯ TS potentials are insulated against inner wall of accumulator container if container made from conductive material.

74 ◯ A minimum of 30% of cells are monitored with temperature sensors.

75 ◯ All temperature sensors must be in direct contact with the conductive surface of the cell. The placement must represent the maximum temperature location on that conducting surface.

76 ◯ No cells are damaged or can be damaged by the segment structures.

77 ◯ No soldering in high current path

78 ◯ Every container contains at least one appropriately sized and rated fuse (max. current <500A).

79 ◯ Every container contains at least two appropriately sized and rated isolation relays (current and voltage).

80 ◯ Pre-charge relay is of mechanical type with appropriate voltage rating.

ASSEMBLY — MECHANICAL

81 ◯ Isolation relays and fuses are separated from cells by barrier according UL94-V0 or equivalent.

82 ◯ Maintenance plugs are located at both poles of each stack (including first and last stack).

83 ◯ Maintenance plugs removable without tools.

84 ◯ Maintenance plugs have positive locking mechanism.

85 ◯ Maintenance plugs must not be able to unintentionally create circuits or short circuits.

86 ◯ Stacks separated by Maintenance plugs ≤ 120VDC.

87 ◯ Stacks separated by Maintenance plugs ≤ 6 MJ.

88 ◯ Stacks are insulated and separated by a fire-resistant barrier according to UL94-V0 for min. used thickness or equivalent.

► Check opening in TS enclosures, try to reach TS potentials with insulated test probe (100mm length, 6mm diameter).

89 ◯ If completely sealed, equalizing valve implemented.

WIRING

90 ◯ All TS wires have proper overcurrent protection.

91 ◯ No other wires than TS wires are orange.

92 ◯ Securely anchored to withstand at least 200 N, if outside of enclosure.

93 ◯ Located out of the way of possible snagging or damage.

94 ◯ TS and LV wires separated (not valid for Interlock).

95 ◯ Every wire used in the Accumulator container (TS and LV) is rated for ≥_____V (max TS voltage).

96 ◯ Possible to clearly assign and prove gauge, temperature and voltage rating of TS wires.

97 ◯ Positive locking mechanism or if no positive locking possible, automotive certified components.

► Check if insulated tools needed for the assembly of certified components are available

98 ◯ Insulation is not only insulating tape or rubber-like paint.

99 ◯ IMD is integrated into the charging system

100 ◯ One IMD ground line is connected to the accumulator container and one ground line is connected to the charger casing by a separate wired connection.

☐ ACCUMULATOR MANAGEMENT SYSTEM

► Disconnect AMS current sensor connector

101 ◯ The AMS must open the shutdown circuit within 0.5 s + AMS response time.

► Disconnect any other AMS internal connector

102 ◯ The AMS must open the shutdown circuit within 1 s + AMS response time.

► Disconnect one SINGLE voltage sense signal on a stack selected by the scrutineer.

103 ◯ The AMS must open the shutdown circuit within 0.5 s + AMS response time.

► Disconnect one SINGLE temperature sense signal on a stack selected by the scrutineer.

104 ◯ The AMS must open the shutdown circuit within 1 s + AMS response time.

► Ask the team to connect their laptop to the AMS.

► Connect charger to battery/batteries, start charging process.

105 ◯ Cell voltages can be displayed. The lowest and highest value can be identified easily on one screen.

106 ◯ Cell temperatures can be displayed. The lowest and highest value can be identified easily on one screen.

107 ◯ Plausible accumulator current can be displayed.

☐ INDICATOR LIGHT OR VOLTMETER AND TSAL GREEN LIGHT INDICATOR

108 ◯ Red indicator light or voltmeter installed

109 ◯ Marked with “Voltage Indicator”

110 ◯ Visible while opening the battery connector.

111 ◯ Hard wired electronics, supplied by TS.

►Activate LVS

112 ◯ TSAL green light indicator on.

113 ◯ Green and easily visible.

► Connect power supply with _____ VDC (60 V or half the nominal tractive system voltage, whichever is lower) to accumulator TS connector. Use proper plugs, no measuring probes.

114 ◯ Indicator light on or voltmeter showing present TS voltage.

115 ◯ Indicator light continuously illuminates at its full brightness independent of the TS voltage.

116 ◯ Visible in bright sunlight.

117 ◯ TSAL green light indicator off.

☐ CLOSE ACCUMULATOR CONTAINER

118 ◯ All ASES checks have been performed.

► Install maintenance plugs, close container housing.

119 ◯ Seal accumulator container. Choose also positions where seals can be checked when TSAC is installed in vehicle

☐ INSULATION MEASUREMENT TEST

► Check low resistance connection between LV ground MP and PE/casing

► Choose test voltage to _____V[1].

► Connect insulation tester to charger TS+ and LV ground.

► Connect charger (do not activate charger) to accumulator, keep AIRs opened.

► Measure resistance: R_{iso}+ = _____MΩ

120 ◯ Resistance is much higher than _____ kΩ[2].

► Connect insulation tester to TS- and LV ground.

► Measure resistance: R_{iso}- = _____MΩ

121 ◯ Resistance is much higher than _____ kΩ[2].

122 ◯ Resistances are nearly equal.

1 $U_{MAX} \leq 250\ V_{DC}$ $U_{TEST} = 250\ V_{DC}$ $U_{MAX} > 250\ V_{DC}$ $U_{TEST} = 500\ V_{DC}$

2 *Minimal resistance = 500 Ω/V * U_{MAX} + BPR*

☐ CHARGER SHUTDOWN CIRCUIT

► Connect charger to battery/batteries, start charging process

123 ◯ Voltage indicator shows that HV is present

► Press shutdown button

124 ◯ AIRs open

125 ◯ Voltage indicator shows voltage <60V

► Start charging, unplug TS accumulator connector

126 ◯ AIRs open.

127 ◯ Charger disabled, no voltage at charger connector

► Reconnect TS accumulator connector

128 ◯ Charger stays off, no voltage at TSMPs, AIRs remain open

INSULATION MONITORING DEVICE

► R_{TEST} = (max TS voltage * 250 Ohm/V) – BPR = _____ kΩ.

► Activate charger output, connect R_{TEST} between TS+ and LV GND.

129 ◯ Shutdown circuit opens within 30 s.

130 ◯ TS voltage decreases below 60VDC within 5 s after shutdown circuit opens.

131 ◯ Reactivation of charger output is not possible.

► Push the reset button, if any.

132 ◯ Reactivation of charger output is not possible.

► Remove R_{TEST}. Wait 40 s until IMD resets status output.

133 ◯ Reactivation of charger output is not possible.

► Activate TS, connect R_{TEST} between TS- and LV GND.

134 ◯ Shutdown circuit opens within 30 s.

ASES – ACCUMULATOR CONTAINER

► Team must show approved ASES for accumulator container.

► Team must show ASES test samples for accumulator container if alternative materials are used.

135 ◯ Accumulator container manufactured according to ASES. Appropriate material and bonding quality.

136 ◯ Internal vertical walls have to be rigidly fastened to the container. Extend to the lid.

137 ◯ Holes in container only for wiring harness, ventilation, cooling or fasteners, if mechanical properties are not influenced and max 25%. AIRs and main fuse separated from cells, no holes in separation.

138 ◯ Cells securely fastened towards all 3 directions. Minimal play only for form-fitting solutions.

139 ◯ Tabs of pouch cells must not carry mechanical loads.

140 ◯ All parts carrying cells and loads: UL94-V0 certified materials.

141 ◯ External openings not pointing towards driver or hand cart operator.

142 ◯ Check if all parts and the cover/lid of the housing are rigidly fastened.

143 ◯ All used fasteners must be secured by the use of positive locking, except non-conductive and non-structural fasteners.

WEIGHING OF ACCUMULATOR

► Weight of each used accumulator: _____

SEALING OF COMPONENTS

► After all tests have been passed successfully seal the inspected TS housings:

144 ◯ Accumulator container(s) including spares

145 ◯ Charger

146 ◯ Additional Part:

147 ◯ Additional Part:

TIS STATUS UPDATE

► Set online TIS status to **Passed** or **Failed**

NON-COMPLIANCE / COMMENTS

5

APPROVAL

Inspector Names	Date, Time	Signature when passed
1. _____/ _____	_____	_____ _
2. _____/ _____	_____	_____ _
3. _____/ _____	_____	_____ _

PART V: ELECTRICAL INSPECTION

The time limit for this part of the inspection is 180 minutes. Continuation of the inspection is possible after requeuing. During technical inspection all work carried out on the vehicle must be approved by a technical inspector.

☐ TIS STATUS UPDATE

► Set online TIS status to **Present**

► Write down inspector names legibly, sign only when passed

☐ COMMENTS

► Check comments from first page

☐ REQUIRED RESOURCES

148 ◯ An ESO must attend

- LV battery or cell datasheet
- For self-developed LV battery packs: an opened battery pack, laptop and cables to display data of the AMS.
- Laptop and cables to display data of the TS accumulator AMS
- Datasheets for used wiring, insulation materials, and TS components (printed or properly sorted on one laptop, not on a cell phone).
- At least all non-passed parts of the ESF (printed or properly sorted on one laptop, not on a cell phone)
- Samples of all wire types used for the tractive system
- Fully assembled spare boards of all inaccessible TS boards outside the accumulator
- The connector to safely close the SDC while the HVD is removed
- The connector to safely supply the TS using shrouded receptacles when the TS accumulator is unconnected
- Photographs of all inaccessible TS connections.
- “TSAL green” sign

☐ TS VOLTAGE

► Measure voltage at TS measuring points.

149 ◯ Equal or less than 60VDC.

☐ LV BATTERY

150 ◯ Voltage ≤ 60VDC.

151 ◯ Rigid and sturdy casing.

152 ◯ Li-Ion: UL94-V0 or equivalent casing

153 ◯ Short circuit protection (e.g. fused).

154 ◯ Li-Ion: Over current protection

155 ◯ Proper insulation of internal electrical connections.

156 ◯ Proper mounting of cells.

157 ◯ Li-Ion: Temperature sensors for at least 30% of the cells

☐ SELF-DEVELOPED PCBS

► Fully assembled spare PCB of self-developed PCBs.

158 ◯ Body protection resistor power rating is _____W (sufficient to withstand short circuit).

159 ◯ Dis-charge power rating is sufficient for continuous dis-charge.

160 ◯ Sufficient spacing regarding system voltage and implementation, mind new rules (clearance, creepage)

161 ◯ Sufficient rating of isolators regarding system voltage, check datasheets.

162 ◯ Sufficient insulation and temperature rating of coating if used, datasheet available

163 ◯ Coating process according to datasheet.

164 ◯ BSPD PCB(s) is standalone with only minimum interface.

165 ◯ BSPD PCB(s) are directly suppled from the LVMS.

166 ◯ Ends of a BSPD current transducer’s auxiliary winding must be insulated.

☐ MASTER SWITCHES

167 ◯ TSMS & LVMS installed easily accessible on the right side of the vehicle and located next to each other.

168 Δ All master switches are located above 80% of shoulder height of percy.

169 ◯ Rigidly mounted and no need to be removed during maintenance.

170 ◯ Rotary type with removable handle.

171 Δ Handle length ≥ 50mm.

172 ◯ "ON" position in horizontal.

173 ◯ "ON" and "OFF" positions marked.

174 ◯ TSMS with locking mechanism for “OFF” position.

175 ◯ LVMS marked with “LV” and symbol showing a red spark in a white edged blue triangle.

176 ◯ LVMS mounted on a red circular area on high contrast background.

177 Δ Circular area diameter ≥ 50mm.

178 ◯ TSMS marked with “TS” and triangle with black lightning bolt on yellow background.

179 ◯ TSMS mounted on an orange circular area on high contrast background.

180 Δ Circular area diameter ≥ 50mm.

MEASURING POINTS

181 ◯ Two TS measuring points on exclusive orange background.

182 ◯ A black LV ground measuring point installed.

● An additional LVS ground measuring point may be installed for 4-wired grounding checks

183 ◯ Next to the master switches.

184 ◯ 4mm shrouded banana jacks, color matches the polarity.

185 ◯ Non-conductive cover, mechanically linked to the vehicle.

186 ◯ Cover removable without tools.

187 ◯ Correctly marked (“TS+”, “TS-”, “GND”).

TS SHUTDOWN DEVICES

188 ◯ Two red latching shutdown buttons installed next to the main hoop, right and left on the vehicle at approx. height of the driver’s head.

189 ◯ Marked with red sparked sticker.

190 Δ Diameter > 39mm.

191 ◯ One red latching shutdown button installed inside the cockpit.

192 ◯ Marked with red sparked sticker, color matches the polarity.

193 ◯ Easy actuation by the driver.

194 Δ Diameter ≥ 24mm.

195 ◯ Inertia switch rigidly mounted to the chassis and can be demounted for functionality test.

HIGH VOLTAGE DISCONNECT

196 ◯ Clearly marked with "HVD".

197 Δ Distance to ground greater than 350mm.

198 ◯ No remote actuation (e.g. through wires).

199 ◯ Integrated interlock.

► Let ESO remove the HVD.

200 ◯ Removed within 10 s without tools.

201 ◯ TS protection still given (insulated test probe). If dummy connector is used, it must be stored at the push-bar.

ACCELERATION PEDAL POSITION SENSOR

202 ◯ Returns to original position if not actuated

203 ◯ At least two sensors with different transfer functions, non-intersecting transfer functions, with either different gradients and/or offsets to the others are installed. (For digital sensors, a checksum is necessary).

204 ◯ Sensors are protected from being mechanically overstressed (positive stop of pedal)

205 ◯ Minimum two springs installed to return pedal

206 ◯ Each spring still returns pedal with the second one disconnected (springs in the torque encoders not counted)

BRAKE LIGHT

207 ◯ Only one brake light in red color

208 ◯ Located on vehicle centerline, height between wheel centerline and driver’s shoulder

209 ◯ Round, triangle, or rectangular on black background

210 Δ 15 cm^2 minimum illuminated area *OR* LED strips with a total length greater than 150mm with elements < 20mm apart

ACCUMULATOR MANAGEMENT SYSTEM

► Install TS accumulator, activate LVS, and connect laptop to the AMS

211 ◯ TS accumulator’s AMS data can be displayed

212 ◯ If Li-Ion LV battery: LV battery’s AMS data can be displayed

► Disconnect TS accumulator

● AMS indicator light…

213 ◯ ...is illuminated red

214 ◯ …is inside the cockpit and marked with “AMS”

215 ◯ …is visible in bright sunlight, even from outside

216 ◯ …is visible for the driver

TS WIRING

217 ◯ TS wiring channels are orange

218 ◯ No other wires than TS wires are orange

219 ◯ TS wiring outside electrical enclosures in separate nonconductive conduit or orange shielded cable

220 ◯ Securely anchored to withstand at least 200 N, if outside of enclosure

221 ◯ Located out of the way of possible snagging or damage

222 ◯ Shielded against rotating/moving parts

223 ◯ TS and LV wires separated (n/a for interlock)

224 ◯ Possible to clearly assign and prove gauge, temperature and voltage rating of TS wires

225 ◯ All TS wires and connectors have proper overcurrent protection

226 ◯ Suitable temperature rating for used position

227 ◯ Positive locking mechanism on every screwed connection. (Photographs for all inaccessible TS connections)

228 ◯ TSMPs: positive locking mechanism on every connection. (Photographs for all inaccessible TS connections)

229 ◯ All connectors are manufactured properly, e.g. crimped connections inside the enclosure. (Photographs for all inaccessible TS connections)

230 ◯ Insulation is not insulating tape or rubber-like paint

231 ◯ All energy from accumulator flows through the data logger

232 ◯ TS wires of outboard wheel motors must not be able to reach the cockpit opening in case of a wire break. Wiring outside of impact structure is shortest possible distance.

► Check interlocks on ...

233 ◯ …TS accumulator container(s).

234 ◯ …Inverters.

235 ◯ …Power distribution boxes.

236 ◯ …Data Logger enclosure.

237 ◯ … outboard wheel motors have a dedicated interlock wire routed along the TS wiring, must act before the TS wiring or its clamping fails

238 ◯ … outboard wheel motors have a dedicated interlock wire routed along a suspension member, must act if the suspension fails

239 ◯ …interlock(s) can opened for demonstration

TS ENCLOSURES

► Check for each TS enclosures

240 ◯ …Not possible to reach any TS potentials with insulated test probe (100mm length, 6mm diameter)

241 ◯ …protected from moisture

242 ◯ …HV warning stickers placed (triangle with a black lightning bolt on yellow background).

243 ◯ Data logger is fully enclosed in a housing

244 ◯ Data logger is rigidly mounted

245 Δ Check data logger functionality and connectivity

246 ◯ Seal data logger enclosure

GROUNDING CHECK

● A conductive part is grounded when having ≤100mΩ measured at 1A to LVS ground and being able to continuously carry ≥10% of the TS main fuse.

● It is possible to join two TS enclosures one following EV 3.1.1 point 1 and the other one following EV 3.1.1 point 2 if each individual TS enclosure is fully closed.

► Check for each TS enclosure…

247 ◯ …all materials used to build a TS enclosure separately have a resistance ≥2MΩ @500V => fully isolated TS enclose, no grounded layer needed

248 ◯ …expect e.g. screws, (shielded) connectors, backing plates isolating materials used => fully isolated TS enclose, no grounded layer needed but protruding elements must be properly grounded (max. 100 mΩ @1 A)

249 ◯ …at least one material has <2MΩ => ≥0.5mm thick solid grounded layer made of aluminium or better required and properly grounded

► Measure resistance of conductive parts to LVS ground next to TSMPs (max. 100mΩ @1A)…

► Use second LVS ground measurement point for 4-wire connection if available.

250 ◯ …main hoop

251 ◯ …seat mounting points

252 ◯ …driver harness mounting points

253 ◯ …firewall mounting points

254 ◯ …TS firewall

255 ◯ …TS accumulator container

256 ◯ …TS motors

257 ◯ …TS enclosures if applicable

258 ◯ …TS enclosure protruding parts if applicable

259 ◯ Each grounding is able to carry ≥10% of TS main fuse

260 Δ Conductive parts within 10cm around TS part are ≤100Ω to LVS ground

DISCHARGE CIRCUIT AND BODY PROTECTION RESISTORS

► Switch off LV. Measure resistance between TS+ and TS- measuring points.

261 ◯ Resistance is _____ kΩ[3] + discharge resistor.

[3] *2 x Body Protection Resistor (BPR)*

INSULATION MEASUREMENT TEST

► Choose test voltage to _____ V[4].
► Connect insulation tester to TS+ and LVMP.
► Measure resistance: R_{ISO}+ = _____ kΩ.
262 ○ Resistance is much higher than _____ kΩ[5].

► Connect insulation tester to TS- and LVMP.
► Measure resistance: R_{ISO}- = _____ kΩ.
263 ○ Resistance is much higher than _____ kΩ[5].
264 ○ Resistances are nearly equal

4 $U_{MAX} \leq 250$ V_{DC} $U_{TEST} = 250$ V_{DC} $U_{MAX} > 250$ V_{DC} $U_{TEST} = 500$ V_{DC}

5 *Minimal resistance = 500 Ω/V*· U_{MAX}+BPR*

NON-COMPLIANCE / COMMENTS

5

!! TEST AT HIGH VOLTAGE !!

TRACTIVE SYSTEM POWER-UP

► All driven wheels are off the ground, driven wheels removed.

► Connect multimeter between TS+ and TS-.

► Switch on TSMS with LVMS deactivated.

265 ○ Voltage at TS measurement points ≤60VDC.

► Switch on LVMS with TSMS deactivated.

266 ○ IMD and AMS indicator light illuminate for 1 s to 3 s for visible check.

267 ○ Voltage at TS measurement points ≤60VDC.

► Switch on TSMS and all shutdown buttons.

► Reset any IMD or AMS errors.

268 ○ TS still deactivated.

► Activate TS, measure TS voltage during TS power-up. Use the team's multimeter and test leads. Set multimeter into manual range

269 ○ System is pre-charged before second AIR closes.

► Switch off TSMS.

270 ○ TS voltage decreases below 60VDC within 5s.

► Try to power-up TS with switched off TSMS.

271 ○ TS still deactivated.

► Switch on TSMS.

272 ○ TS still deactivated.

TRACTIVE SYSTEM SHUTDOWN

► Connect multimeter between TS+ and TS-.

► Check all of the following switches, deactivation leads to TS shutdown, the voltage decreases below 60VDC within 5s.

273 ○ Cockpit shutdown button.

274 ○ Shutdown button left.

275 ○ Shutdown button right.

276 ○ Inertia switch.

277 ○ Break-over-travel-switch.

278 ○ Interlocks.

TRACTIVE SYSTEM ACTIVE LIGHT

279 ○ Max. 75mm below highest point of the main roll hoop and within the roll-over protected envelope (including mounting).

280 Δ Full illuminated surface visible by a person standing 3m away from TSAL (1.6m eye height).

281 Δ ≤ 10° blocked by main hoop

► Activate LVS.

282 ○ TSAL is green only.

● TS off indicator light…

283 ○ …is illuminated green

284 ○ …is inside the cockpit and marked with "TS off"

285 ○ …is visible in bright sunlight

286 ○ …is visible for the driver

► Activate TS.

287 ○ TSAL flashes red with freq 2-5 Hz 50% duty cycle, and CI is off.

288 ○ TSAL is clearly visible (horizontal position, entire illuminated surface).

► Deactivate TS, disconnect TSAC state detection connector if applicable, activate LVS and TS. Skip test if disconnecting the connector also opens the interlock and/or stops LVS supply.

289 ○ TSAL flashes red and CI is off.

► Deactivate TS, reconnect TSAC state detection, disconnect TS from TSAC, connect power supply >60VDC[6] to vehicle TS[7], activate LVS.

290 ○ TSAL is both green and read flashing simultaneously and CI is on.

► Disconnect power supply, reconnect TS to TSAC, remove HVD, override HVD interlock (!! cover TS potentials !!), activate LVS and TS.

291 ○ TSAL and CI is off.

► Reinstall HVD

[6] $25V_{AC}$ equal $42.5V_{DC}$ when the signal is sinusoidal

[7] Do not use measuring points. The team needs to provide a method of connection which uses same receptacles as used for TSMP

☐ INSULATION MONITORING DEVICE

292 ◯ One IMD ground line is connected to the accumulator container[8] and one ground line is connected to the main hoop by a separate wired connection.

► R_{TEST} = _____ kΩ[9].

► Activate TS, connect R_{TEST} between TS+ and LV GND.

293 ◯ Shutdown circuit opens within 30 s.

294 ◯ TS voltage decreases below 60VDC within 5 s after shutdown circuit opens.

● IMD indicator light…

295 ◯ …is illuminated red

296 ◯ …is inside the cockpit and marked with “IMD”

297 ◯ …is visible in bright sunlight, even from outside

298 ◯ …is visible for the driver

► Try to activate the TS by the required additional action (EV4.11.7).

299 ◯ Reactivation of TS is not possible.

► Push the reset button which is not accessible to the driver, if any and/or restart LVMS.

300 ◯ Reactivation of TS is not possible.

► Remove R_{TEST}. Wait 40 s until IMD resets status output.

301 ◯ Reactivation of TS is not possible.

► Push all reset buttons in the cockpit, if any.

302 ◯ Reactivation of TS is not possible.

► Push the IMD reset button which is not accessible to the driver, if any.

303 ◯ Reactivation of TS is possible.

► Push *and hold* the reset button which is not accessible to the driver, if any.

► Connect R_{TEST} between TS- and LV GND.

304 ◯ Shutdown circuit opens within 30 s.

305 ◯ IMD indicator light illuminates.

[8] or the IMD’s enclosure

[9] R_{TEST} = (max. TS voltage * 250 Ohm/V) – BPR

☐ READY-TO-DRIVE ACTIVATION SEQUENCE

► Activate TS, press torque pedal.

306 ◯ No turning of motors.

► Let the team set the vehicle to ready-to-drive mode.

307 ◯ Pressing brake pedal WHILE activating is necessary.

308 ◯ Ready to drive sound duration is 1 s to 3 s continuously.

309 Δ Ready to drive sound is min 80 dBA (2m around the vehicle).

310 ◯ Ready to drive sound is easy recognizable and no animal sound or song part.

► Repeat the activation sequence but push the brake pedal only once before finally pushing the activation button.

311 ◯ No ready to drive mode possible.

► Disconnect the brake sensor.

312 ◯ No ready to drive mode possible.

► Reconnect the brake sensor.

☐ APPS AND BSPD

► Set vehicle to ready to drive state.

► Disconnect ≥50% of APPS.

► Move the accelerator pedal over the entire pedal travel.

313 ◯ Motors do not turn.

► Disconnect all APPS.

► Move the accelerator pedal over the entire pedal travel.

314 ◯ Motors do not turn.

► Team simulates 5kW power (complete BSPD circuitry must be used), press brake representing hard braking (>0.5 s).

315 ◯ TS shuts down.

316 ◯ Reactivation of TS is only possible after 10 s without implausibility

► Reactivate TS. Disconnect current sensor, press brake representing hard braking (>0.5 s).

317 ◯ TS shuts down.

☐ TIS STATUS UPDATE

► Set online TIS status to **Passed** or **Failed**

NON-COMPLIANCE / COMMENTS

5

APPROVAL

5

Inspector Names	Date, Time	Signature when passed
1. _____/ _____	_____	_____ _

2. _____/ _____ _____
3. _____/ _____ _____

PART VI: MECHANICAL INSPECTION

The time limit for this part of the inspection is 120 minutes. Continuation of the inspection is possible after requeuing. During technical inspection all work carried out on the vehicle must be approved by a technical inspector.

TIS STATUS UPDATE

► Set online TIS status to **Present**

► Write down inspector names legibly, sign only when passed

COMMENTS

► Check comments from first page

VEHICLE WITH TALLEST DRIVER READY TO RACE

318 ○ **PUSH BAR (red color)** – Securely attached to vehicle, detachable, push & pull function for 2 people. University must be written on. Two pair of HV gloves in protecting case and multimeter must be installed. The inspection sheet must always stay with the push bar.

319 Δ **CAMERAS** – Must be secured by two points, see T11.12. No cameras mounted to helmet. If tether is used the camera cannot contact the driver. All cameras and components must be positioned within the surface envelope, see T1.1.18.

320 ○ **VISIBILITY** – Minimum of 100 deg. field either side. Head rotation or mirrors allowed. If mirrors, must be firmly installed and adjusted.

321 Δ **VEHICLE CONTROLS** – All controls, including shifter, must be inside cockpit. No arms or elbows outside the SIS plane.

322 ○ **DRIVER FLUID PROTECTION** – Rigidly mounted firewall (or heat resistant cover for cooling systems using plain water (except wheel motors and their cooling hoses)). For points less than 100 mm above the bottom of the tallest driver's helmet, the firewall must extend sufficiently far upwards and/or rearwards to prevent a direct line of sight to: cooling system and low voltage battery.

323 ○ **ROLL BAR PADDING** – Must cover areas that could be hit by the driver's helmet with 12 mm thick, SFI spec 45.1 or FIA 8857-2001 padding.

324 Δ **OTHER SIDE TUBES** – Design prevents driver's neck hitting bracing or other side tubes.

325 ○ **HEAD RESTRAINT** – Near vertical. Must take 890N load. 40mm thick, SFI 45.2 standard or FIA (type B material from technical list №17). Max. 25mm from helmet. Helmet contact point 50mm min. from any edge. May be changed for different drivers. Minimum 150x150mm. Rectilinear.

326 ○ **DRIVER RESTRAINT HARNESS** – SFI 16.1, SFI 16.5, SFI 16.6, FIA 8853/2016. 6- or 7-point system – Two-piece lap belt (min. width 50mm), two shoulder straps (min. width 75mm) and two leg or anti-submarine straps (min. width 50mm). (7-point system must have three anti-submarine straps). Must be securely attached to prim. structure.

327 ○ **LAP BELT MOUNTING** – Pivoting mounting with eye bolts or shoulder bolts attached securely to Primary Structure. Centerline of the belt should be between 0-76 mm forward of the seat back. Attachment brackets must be compliance with T5.4.

328 ○ **LAP BELT POSITIONING** – Must pass over pelvic area between 45 - 65 deg. to horizontal for upright driver, 60 - 80 deg. for reclined. The lap belts must not be routed over the sides of the seat.

329 ○ **SHOULDER HARNESS MOUNTING** – Mounting points 180 - 230mm apart (measured center to center). Angle from shoulder between 10 deg. up and 20 deg. down to horizontal. Attach to Primary Structure - 25.4 x 2.4mm or 25.0 x 2.5mm steel tube min. NOT to put bending loads into Main Hoop Bracing without extra bracing. Additional braces if not straight to main hoop. Cannot pass through a firewall. Attachment brackets to the monocoque must be steel.

330 ○ **SUSPENSION** – Fully operational with dampers front and rear; 50mm minimum wheel travel (minimum jounce of 25mm) with driver in vehicle.

VEHICLE WITHOUT DRIVER

331 Δ **TECH STICKER SPACE** – 45mm x 175mm on centerline of front of vehicle in front of the cockpit opening.

332 Δ**SCHOOL NAME & OTHER DECALS** – University name, or recognized initials - min. 50 mm tall (all letters) in Roman letters. In front of the Main Hoop on both sides of the vehicle. The top of each character must not be more than 50mm below the top of the bodywork. Must be clearly visible.

333 Δ**VEHICLE NUMBERS** – On front & both sides of vehicle, minimum 150mm tall, 20mm stroke & spacing, 25mm min. between number and background edge, Black on White, White on Black only, specified background shapes. Must be clearly visible, font: Roman Sans-Serif characters.

334 Δ **BODY & STYLING** – Open wheeled, open cockpit, formula style body. Vertical keepout zones 75mm in front and behind tires (no aero exceptions), tires unobstructed from sides.

335 ○ **BODYWORK** – Min. 38mm radius on nose. No large openings in bodywork into driver compartment in front of or alongside driver, (except cockpit opening). There are no external concave radii of curvatures (exception T8.2) in according with T2.3.2.

336 ○ **AERODYNAMIC DEVICES** – Securely mounted. The deflection may not exceed 10mm when a force of 200N is applied over a surface of 225 cm^2 and not more than 25mm when a point force of 50N is applied.

337 Δ **AERODYNAMICS** – ALL aerodynamic devices maximum 250mm rearward of rear tires, maximum 700mm forward of front tires. Devices lower than 500mm from the ground rear-ward of the front axle must be no wider than vertical plane from the outside of the front and rear tires. Devices higher than 500mm behind the front axle must not be wider than the inside of the rear tires.

338 Δ **AERO VERTICAL HEIGHT** – Devices forward of a vertical plane through the rearmost portion of the front face of the driver head restraint support, excluding any padding, set to its most rearward position, must be lower than 500mm from the ground. Rear device max 1.1 m above ground (incl. end plates); Front device max 250mm above ground outside of the inside plane of the front tires inside this plane max 500mm.

339 ○ **BODYWORK AND AERODYNAMIC EDGES/RADII** - For forward facing edges that could contact a pedestrian must have a minimum radius of 3mm and for all other is 1mm.

340 Δ **SEAT** – Insulated against heat conduction, convection and radiation. Lowest point no lower than top of the upper surface of the lowest SIS member OR must have longitudinal, 25.4 x 1.65mm steel tube underneath.

341 ○ **COCKPIT OPENING** – Fig. 12 (left) template passes down from above cockpit to below the upper side impact member.

Steering wheel, seat & padding can be removed. No removing of firewall.

342 ◯ **COCKPIT INTERNAL CROSS SECTION** – Fig. 12 (right) template passes from the cockpit opening to 100mm rear of rearmost pedal contact area (in most forward position). Steering wheel and paddings can be removed (without tools) while the driver is seated.

343 Δ **STEERING WHEEL** – Continuous perimeter, near round (no concave sections) with driver operable quick disconnect. 250mm max from front hoop.

344 ◯ **ROTATING PARTS** – Finger guards are required to cover any parts (e.g. fans) that spin while the vehicle is stationary. No holes >12mm dia.

345 ◯ **FANS -** The total rated power of all active devices designed to move air is max. 500W in total.

□ REMOVE BODY PANELS

346 ◯ **JACK(S) (red color)** – One or two devices must be available to lift up all driven wheels min. 100mm above the ground. In lifted position the jack(s) must be locked/secured and function without the support of a person or additional weights. Safe for a driver to enter and exit the vehicle. Pickup points must be indicated by orange triangles. University name must be written on.

347 ◯ **DRIVER'S LEG PROTECTION** - Covers inside of cockpit over any sharp edges or moving suspension / steering components.

348 ◯ **DRIVER'S FOOT PROTECTION** - Feet must be rearward of the Front Bulkhead and no part of shoes or legs above or outside the Major Structure (25x1.2 or equivalent) in side or front views when touching the pedals. Front bulkhead, together with the AIP, must cover the driver's feet in front view.

349 ◯ **PERCY** - Helmet of 95th percentile male (PERCY) to be 50mm below the lines between top of front and main roll hoops and between top of main hoop to rear attachment point of main hoop bracing. Center of bottom circle placed minimum 915mm from pedals.

350 ◯ **BRAKES** - Dual hydraulic system & reservoirs, operating on all four wheels, (one brake on limited slip differential is OK). System must be protected by structure or shields from drivetrain failure or minor collisions. No plastic brake lines. No brake-by-wire. No parts below chassis in side view. Brake pedal capable of 2000N, no failures if official exerts max force (seated normally in vehicle). Must be sealed to prevent leakage. Pedal face must be steel, aluminium or titanium (T6.1.10).

351 ◯ **PEDAL BOX** - Adjustable pedals must have a positive stop to prevent loosening from the chassis.

352 Δ **BRAKE OVER TRAVEL SWITCH** - In the event of a failure in one or both of the brake circuits the brake pedal over travel will result in the shutdown circuit being opened. Push-pull or flip type.

353 ◯ **WHEELS** - 203.2mm (8") min. diam. No Aluminium or hollow wheel bolts. Single retaining nut must incorporate a device to retain the nut. Aluminium wheel nuts must be hard anodized.

354 ◯ **RIM CLEARANCE** - The radial clearance between any nonrotating part and the inside of the rim must be at least 5 mm in static condition at any steering angle and any ride height.

355 ◯ **FIREWALL** - Fire resistant material; must separate driver compartment from cooling, oil system & LV battery. Passthroughs OK with grommets. No gaps at sides or bottom. Must be rigidly mounted to the chassis. Material must meet UL94-V0, FAR25 or equivalent. If multiple panels – overlap is 5 mm. On tractive side min. 0.5 mm aluminium plate grounded, on the driver side a rigid insulating layer (no CFRP) UL94-V0 or equivalent should be installed that can withstand a 250 N 4 mm screwdriver penetrating test.

□ SES, IAD & REQUIRED TESTS PRESENTED

356 ◯ **TUBING & MATERIALS** - Team must show an APPROVED SES. No Magnesium tubes in primary structure.

357 ◯ **SES TEST SPECIMEN** - Team must show all relevant test specimen. Labeled (non-removable) with structure acronym and date. Specimen width, skin & core thickness according to SES.

358 ◯ **MONOCOQU**E - Must see laminate test specimen. Steel backing plates (2mm thick) used at attachment points (must be fully supported).

359 ◯ **INSPECTION HOLES** - 4.5mm inspection holes required in non-critical areas of front & main hoops. Must be accessible with standard caliper. Inspectors may ask for holes in other tube(s).

360 ◯ **SES DIMENSIONS & THICKNESSES** - All chassis dimensions according to SES: tube diameter and wall thickness; laminate skin thickness, core thickness, panel height.

361 ◯ **HOLES & CUTOUTS** - All holes/cut-outs in primary structure < 60 mm² or deducted from panel height. No opening larger that 625 cm² (total) in front hoop bracing or a front bulkhead support.

362 ◯ **INSPECTION HOLES** - 4.5mm inspection holes required in non-critical areas of front & main hoops. Inspectors may ask for holes in other tube(s).

363 ◯ **LAMINATE ORIENTATION** - Tested structures must be correctly oriented or quasi-isotropic (T3.6.5, especially MHBS). No UD fibers allowed in outermost primary laminate layers.

364 ◯ **BOLTED JOINTS** in primary structure - Distance hole centerline to the nearest free edge > 1.5 x hole diameter.

365 ◯ **HARNESS ATTACHMENTS** for shoulder harness, lap belt and anti-submarine belt according to SES calculation, simulation and/or physical test. Test/calculation conducted according to realistic belt angle.

366 ◯ **MAIN HOOP** - MUST BE STEEL. Check dimension as shown in approved SES. Must be made of one piece and extend to lowest frame member. Above Major Structure, must be within 10 deg. of vertical plane. Smooth bends without wrinkles, not oval after bending.

367 ◯ **MAIN HOOP BRACING** - MUST BE STEEL. One straight brace on each side. Dimension as shown in the approved SES. Attached within 160mm from the top. Min. 30 deg. Included angle with hoop. If main hoop is not vertical, bracing must not be on same side of the vertical plane as the main hoop. No bends. No rod-ends. Proper design for removable braces (capping etc.) on BOTH ENDS. Must take load back to bottom of main hoop and node of upper side impact tube through proper triangulated structure. (25.4 x 1.2mm or equivalent)

368 ◯ **FRONT HOOP** - Must be closed section metal tube. Can be multi- piece with gussets or additional attachments to the monocoque. Must extend down to lowest frame member. No lower than top of steering wheel. Max. 20 deg. to vertical. Check dimension as shown in approved SES.

369 ◯ **FRONT HOOP BRACING** - Two straight forward facing braces, 25.4 x 1.65mm or 25.0 x 1.75mm or 25.4 x 1.6mm wall steel or equivalent, attached within 50mm of top. Min. 100 mm between tubes at the front hoop. Extra rearward bracing required if Front Hoop leans backwards more than 10 deg.

370 ◯ **FRONT BULKHEAD SUPPORT** - Support back to front roll hoop; 3 tubes per side, all 25mm x 1.5mm wall steel tube or equiv. 1 bottom; 1 top within 50mm of top of bulkhead, and connecting within 100mm above and 50mm below upper SIS tube; 1 or more node-to-node diagonal to completely triangulate connections to upper and lower SIS tubes.

371 ◯ **SIDE IMPACT PROTECTION** - Min. of 2 tubes + diagonal must connect the main and front hoops in straight line. Upper tube between 240 - 320mm above lowest inside chassis point between FH and MH. Dimension as shown in approved SES.

372 ◯ **FRONT IMPACT PROTECTION** - No non-crushable objects forward of bulkhead. IMPACT ATTENUATOR forward of bulkhead, 200mm long x 200mm wide x 100mm high. No portion of the minimum required volume can be positioned more than 350 mm above

the ground. No wing supports through the IA. IA must be securely fastened directly to AIP capable of taking transverse & vertical loads (no tape, etc.) Test piece presented and same as IA on vehicle. Standard IA: Requires diagonal brace if bulkhead >25.4mm from IA on any side.

373 ◯ **IA POSITION** - The minimum volume dimensions cannot not be more than 350 mm above ground (measured with driver seated)

374 ◯ **ANTI INTRUSION PLATE** - A 1.5mm solid steel or 4.0mm solid aluminium sheet. Must be welded (size: min. to centerlines) or min. one M8 Grade 8.8 bolt(s) for each 200 mm of reference perimeter – see T3.16.6 (critical fasteners T10).If bolted backing plates 2mm steel. CFRP plate is accepted if SES approved.

NON-COMPLIANCE / COMMENTS

5

VEHICLE LIFTED AND WHEELS REMOVED

375 ○ **SUSPENSION PICK-UP POINTS** - Inspected thoroughly for integrity.

376 ○ **FASTENERS** - Steering, braking, harness and suspension systems must use SAE Grade 5 or Metric Grade M8.8 or higher specs (AN/MS) with visible positive locking mechanisms, no Loctite or lock washers. Minimum of 2 exposed threads with locking nuts. For suspension and steering alternative fasteners may be used if provided equivalency. Rod ends in single shear are captured by a washer larger than the ball diameter. Adjustable tie-rod ends must have jam nuts to prevent loosening. No Nylon lock nuts for Brake calipers or Brake discs. No button head cap, pan head or round head screws in critical locations, e.g cage structure or harness mount. Primary structure e/D > 1.5. Snap or retaining rings must not bear any loads under normal conditions.

377 ○ **STEERING** - All steerable wheels must have positive stops placed on the rack to prevent linkage lock up or tires from contacting any part of the vehicle. 7 degrees max. free play at the steering wheel. Must attach to primary structure and within rollover protection. NO STEER-BY-WIRE on front wheels. Rear wheel steering, max. 6 deg. and mechanical stops installed. Bonded joints must compliance with T3.2.8.

378 ○ **ADDITIVE MANUFACTURING** - No additive manufactured parts with anisotropic strength in steering, braking or suspension systems.

379 Δ **FLOOR CLOSEOUT PANEL** - Required from foot area to firewall; solid, non-brittle material; multiple panels are OK if gaps less than 3mm.

380 ○ **GAS CYLINDERS LOCATION** - Axis not pointed at driver, within the rollover protection envelope, insulated from any heat source, must be shielded from the driver. The shields must be steel or aluminium with a minimum thickness of 1 mm.

381 ○ **GAS CYLINDERS** - Proprietary manufacture & labeled (π, DOT, TC), securely mounted, appropriate lines & fittings. Positively retained,
40 g longitudinal & lateral, 20 g vertical. Working gas air or pure nitrogen N_2. Maximum of 10 bar allowed, except cylinders/tanks with directly mounted pressure regulator (-> 10 bar).

382 ○ **SCATTERSHIELDS INCL. MOUNTING** - Required for clutches, chains, belts, etc. No holes. 6mm diam. Grade 8.8 minimum. End parallel to lowest part of the sprocket/pulley in front and rear.

383 Δ **SCATTERSHIELD MATERIALS** - 2mm min. thick solid STEEL or 3mm min. thick Al 6061-T6 (or equivalent), 3 x chain/belt width. Finger guards: cover all drivetrain parts that spin while vehicle is stationary. No holes >12mm dia. Fasteners diameter must be 6 mm min. and Metric Grade 8.8.

384 ○ **LV BATTERY** - Rigid and sturdy casing and attached securely to frame or chassis. Battery behind firewall; wet-cells in IPX7 rated and acid resistant casing if inside cockpit. Must be contained within the rollover protection envelope, see T1.1.14. Grounded to chassis; hot terminal insulated; protected for short circuits (fused). No circuits >60VDC.

385 ○ **HIGH PRESS HYDRAULICS** - Pumps and lines must have 1mm steel or aluminium shields protecting driver and workers.

386 Δ **COOLANT** - 100% water. NO ADDITIVES WHATSOEVER.

387 ○ **CATCH TANKS** - Any coolant overflow or lube system vents must have separate catch tanks. 0.9 l minimum each, 120 deg. C material, behind firewall, below shoulder level. 3mm min. dia. vent away from driver down to the bottom level of frame. Trans or diff., cooling systems using plain water, unless sealed, require 100 ml catch tanks.

388 Δ **FLUID LEAKS** - Oil, grease, coolant, brake fluid -> none permitted.

389 ○ **BELLYPANS** - In total minimum of two venting holes of at least 25mm diameter in the lowest part of the structure to prevent accumulation of liquids. One in each enclosed chassis structure. Additional holes are required when multiple local lowest parts exist in the structure.

390 ○ **ACCUMULATOR CONTAINER POSITION** - All TSACs must lie within and be attached to the primary structure lower than the top of the SIS. Surrounding structure must protect from side, rear & front impacts; bolted attachments follow T3.16. Min. 25 mm air gap between the TSAC, motor(s) and their mountings and the rearmost impact structure; TSAC must not be attached directly to it (non-structural components such as cooling ducts are permitted). (T3.15.3). (EV5.5.1, EV5.5.2)

391 ○ **ACCUMULATOR CONTAINER ATTACHMENT** – Accumulator container must be attached to the primary structure with fasteners min. Grade 8.8. Fasteners have to follow T10. Mounting as designed in SES. Brackets 1.6mm steel or 4mm aluminium with gussets to withstand bending loads. Monocoque needs 2mm steel backing plates or equivalent, mentioned in SES. Equivalent attachment may be according to SES.

392 ○ **POSITION OF TRACTIVE SYSTEM PARTS** - All parts belonging to the tractive system must be located within the rollover protection envelope, excluding outboard motors (EV4.4.3).

393 ○ **PROTECTION OF TRACTIVE SYSTEM PARTS** - All parts belonging to the tractive system including cables and wiring must be contained within the envelope of any part of the frame which is made from any regulated tubing defined in T3.2. If tractive system parts are mounted in a position where damage could occur from a rear or side impact (below 350mm from the ground), they have to be protected by a fully triangulated structure with tubes of a minimum outer diameter of 25.4mm and a minimum wall thickness of 1.25mm or equivalent.

394 ○ **MOTOR CASING** – Must have housing or separate scatter shield from 2mm 6061-T6 (or equivalent), non-perforated. May be split into two equal sections, each 1mm thick. If motor casing is rotating around the stator or is perforated an additional 1 mm aluminium 6061-T6 scatter shield around the motor should be installed.

TIS STATUS UPDATE

► Set online TIS status to **Passed** or **Failed**

NON-COMPLIANCE / COMMENTS

5

APPROVAL

Inspector Names	Date, Time	Signature when passed
1. _____/ _____	_____	_____ _
2. _____/ _____	_____	_____ _

PART VII: TILT TEST

TIS STATUS UPDATE

► Set online TIS status to **Present**

► Write down inspector names legibly, sign only when passed

COMMENTS

► Check comments from first page

TILT TEST

395 ○ **FLUID LEAKAGE** - No fluid spill permitted when vehicle is tilted to 60 degrees in the direction most likely to create spillage.

396 ○ **VEHICLE STABILITY** - All wheels in contact with tilt table when tilted to 60 degrees to the horizontal.

397 Δ **GROUND CLEARANCE** - At least 30mm min. with driver. Active suspension in lowest position.

NON-COMPLIANCE / COMMENTS

5

APPROVAL

Inspector Names	Date, Time	Signature when passed
1. _____/ _____	_____	_____ _

PART VIII: RAIN TEST

TIS STATUS UPDATE

► Set online TIS status to **Present**

► Write down inspector names legibly, sign only when passed

COMMENTS

► Check comments from first page

RAIN TEST

► Apply seal sticker to all additional sealing material, that can be removed (e.g. tape, as not mentioned in IN1.5.1).

► The vehicle is lifted off the ground. Tractive system has to be active (TSAL ON).

► All active cooling fans must be switched on.

398 ◯ Tractive system voltage is present at TSMPs.

► **RAIN PROOF** - No driver is allowed to sit in the vehicle during the test. Water like rain will be sprayed at the vehicle for 120 sec. Another 120 sec of waiting without water spray.

399 ◯ The Insulation Monitoring Device does not react and no shut down the tractive system.

► Connect R_{TEST} between any TSMP and LVS GND.

◯ Shutdown circuit opens within 30 s.

TIS STATUS UPDATE

► Set online TIS status to **Passed** or **Failed**

NON-COMPLIANCE / COMMENTS

5

APPROVAL

Inspector Names	Date, Time	Signature when passed

1. _____/ _____ _____
_____ _

PART IX: BRAKE TEST

☐ TIS STATUS UPDATE

► Set online TIS status to **Present**

► Write down inspector names legibly, sign only when passed

☐ COMMENTS

► Check comments from first page

☐ BRAKE TEST

400 ◯ **BRAKING PERFORMANCE** - Must lock all four wheels and stop the vehicle in a straight line at the end of an acceleration run specified by the officials without electrical braking from motors. The tractive system has to be shut down by the driver before braking. The Tractive System Active Light has to be Green during breaking or shortly after the vehicle stopped (may take up to 5 sec. after shut down).

401 ◯ **BRAKE LIGHT** - has to be clearly visible even in bright sunlight.

402 ◯ **DRIVABILITY** - Vehicle must be able to continue driving after braking under its own power without external assistance.

403 ◯ **LEAKS –** Check brake calipers, brake master cylinders (pedal) and connections for leaks.

404 ◯ **TIRE PRESSURE** - tire pressure must be written immediately after the brake test has passed.

FL _____ bar; FR _____ bar;

RL _____ bar; RR _____ bar;

☐ TIS STATUS UPDATE

► Set online TIS status to **Passed** or **Failed**

NON-COMPLIANCE / COMMENTS

5

APPROVAL

Inspector Names	Date, Time	Signature when passed
1. _____/ _____	_____	_____ _