FORMULA STUDENT INSPECTION SHEET

ELECTRIC – copy for Formula Student Germany

UNIVERSITY:	Metropolis TU
VEHICLE NUMBER:	696
INSPECTION ORDER:	X01
SES PASSED:	✓
IADR PASSED:	✓
-	-
ESF PASSED:	-
TS VOLTAGE:	600 V
BODY PROTECTION R:	15 kΩ

Used Symbols:

- ● Information
- ► Action
- △ 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.

Present the vehicle for inspection in the following order:

	Pre-Inspection	
	Accumulator Inspection*	Mon 04:00-05:45
1.	Electrical Inspection*	Mon 06:00-07:30
	Mechanical Inspection*	Mon 08:00-09:15
	Driver Egress	Mon 09:30-10:00
2.	Tilt Test*	
3.	Rain Test*	
4.	Brake Test*	

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

PART I: COMMENTS FROM DOCUMENT REVIEW

ACCUMULATOR

- Accu Ok
-

ELECTRICAL

- ESF to be checked

MECHANICAL

- Mech Ok
- SES to be checked

PART II: PRE-INSPECTION

☐ TIS STATUS UPDATE

► Set online TIS status to *Present*

☐ TIRES

1 ◯ **DRY TIRES** - Make: _____

2 ◯ **DRY TIRES** - Size: _____

3 ◯ **DRY TIRES** - Compound: _____

4 ◯ **RAIN TIRES** - Make: _____

5 ◯ **RAIN TIRES** - Size: _____

6 ◯ **RAIN TIRES** - Compound: _____

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

☐ DRIVER GEAR & SAFETY

8 ◯ **UNDERWEAR** - Nomex or equivalent, fire resistant underwear (no cotton, no polyester, no bare skin). No holes.

9 ◯ **SOCKS** - Nomex or equivalent, fire resistant socks (no cotton, no polyester, no bare skin). No holes.

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

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

12 ◯ **HELMETS** - Snell K2010, K2015, K2020, M2010, M2015, M2020, SA2010, SAH2010, SA2015, SA2020, EA2016 or newer.SFI 31.1/2010, 31.1/2015, 31.1/2020, 41.1/2010, 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.

13 ◯ **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.

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

15 ◯ **SHOES** - SFI 3.3 or FIA 8856-2000/2018

☐ TIS STATUS UPDATE

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

NON-COMPLIANCE / COMMENTS

APPROVAL

	Inspector Names	Date, Time	Signatures when passed
1.	_____/_____	_____	_____

PART III: EGRESS TEST

☐ DRIVER POSITION

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

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

18 ◯ **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.

19 ◯ **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.

20 ◯ **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.

☐ 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 DOCUMENTATION

	Driver Name Name	Wristband ID	Signatures when passed	Acc	Skid Pad	AutoX	Endurance
1.				☐☐	☐☐	☐☐	☐
2.				☐☐	☐☐	☐☐	☐
3.				☐☐	☐☐	☐☐	☐
4.				☐☐	☐☐	☐☐	☐
5.				☐☐	☐☐	☐☐	☐
6.				☐☐	☐☐	☐☐	☐

PART IV: ACCUMULATOR INSPECTION

The time limit for this part of the inspection is 105 minutes. Continuation of the inspection is possible after requeueing.
During technical inspection all work carried out on the accumulator must be approved by a technical inspector.

☐ TIS STATUS UPDATE

► Set online TIS status to *Present*

☐ COMMENTS

► Check comments from first page

☐ REQUIRED RESSOURCES

21 ○ An ESO must attend.
- All accumulator containers to be used during the event.
- 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 jewellery, 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

22 ○ Insulated cable shear.
23 ○ Insulated screw driver.
24 ○ Insulated spanners (n/a if no screwed connections in TS).
25 ○ Multimeter with protected probe tips
26 ○ two 4mm banana plug test leads (1000V CAT III)

☐ SAFETY EQUIPMENT

27 ○ Face shield.
28 ○ Safety glasses (minimum three).
29 ○ HV insulating gloves (minimum two pairs).
30 ○ HV insulating blankets (two) (min $1\,m^2$) with label or serial number and datasheet.

☐ SELF DEVELOPED PCBS

► Ask for fully assembled spare PCB of self developed PCBs inside accumulator container.
31 ○ Sufficient spacing regarding system voltage and implementation.
32 ○ Sufficient insulation and temperature rating of coating if used, datasheet available.
33 ○ Coating process according to datasheet

☐ CHARGER ASSEMBLY

34 ○ Completely closed. Check opening in HV/TS enclosures, try to reach HV/TS potentials with insulated test probe (100 mm length, 6 mm diameter).
35 ○ Interlock integrated.
36 ○ TSMP integrated
37 ○ Emergency shutdown button integrated.
38 △ Emergency shutdown button ≥24 mm diameter.
39 ○ TS wiring is orange, marked with gauge, temperature rating >85°C and voltage rating.
40 ○ Conductive parts of charging equipment and accumulator are connected to protective earth (PE) while charging.

☐ DIS-CHARGE CIRCUIT AND BODY PROTECTION RESISTORS

► Switch off Charger. Measure resistance between TS+ and TS- measuring points.
41 ○ Resistance is 30 kΩ [1] + discharge resistor
42 ○ Body protection resistor power rating is >6.0 W [2]

☐ INSULATION MEASUREMENT TEST

► Check low resistance connection between LV ground MP and PE/casing
► Choose test voltage to 500 V. [3]
► Connect insulation tester to charger TS+ and LV ground.
► Connect charger (do not activate charger) to accumulator, keep AIRs opened.

[1] 2 x Body Protection Resistor (BPR)
[2] sufficient to short circuit TS+ and TS-
[3] $U_{max} \leq 250\,V_{DC}$ $U_{Test} = 250\,V_{DC}$ $U_{max} > 250\,V_{DC}$ $U_{Test} = 500\,V_{DC}$
[4] Minimal Resistance = 500 Ω/V · U_{max} + BPR

► Measure resistance: R_{iso+} = kΩ

43 ◯ Resistance is much higher than 315 kΩ [4].

► Connect insulation tester to TS- and LV ground.

► Measure resistance: R_{iso-} = kΩ

44 ◯ Resistance is much higher than 315 kΩ[4].

45 ◯ Resistances are nearly equal.

► Open container housing, remove maintenance plugs.

► Check if no voltage is present.

☐ ASSEMBLY

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

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

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

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

50 ◯ No soldering in high current path

51 ◯ Every container contains at least one appropriately sized and rated fuse.

► Check datasheet of fuse, main wire and cells and compare to ESF.

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

53 ◯ Isolation relays and fuses are separated from cells by barrier according UL94-V0or equivalent.

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

► Check datasheet of pre-charge relay and compare to ESF

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

56 ◯ Maintenance plugs removable without tools.

57 ◯ Maintenance plugs have positive locking mechanism.

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

59 ◯ Stacks separated by Maintenance plugs $\leq$ 120 VDC.

60 ◯ Stacks separated by Maintenance plugs $\leq$ 6 MJ.

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

62 ◯ Holes in container only for wiring harness, ventilation, cooling or fasteners, if mechanical properties are not influenced.

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

63 ◯ If fully closed, equalizing valve implemented.

64 ◯ Spare accumulators of same size, weight and type.

☐ WIRING

65 ◯ All TS wires have proper overcurrent protection.

66 ◯ No other wires than TS wires are orange.

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

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

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

70 ◯ Every wire used in the Accumulator container (TS and LV) is rated for $\geq$600 V [5].

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

72 ◯ 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

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

☐ CELL TEMPERATURE MONITORING DEVICE (CTMD)

► Install CTMD

74 ◯ CTMD sensor installed at negative cell tab as defined in the ESF or specified by the technical inspector.

75 ◯ Cooling at CTMD sensor positions not above-average.

► Take a picture and upload it to competition server.

☐ INDICATOR LIGHT OR VOLTMETER

76 ◯ Red indicator light or voltmeter installed

77 ◯ Marked with “Voltage Indicator”

78 ◯ Visible while opening the battery connector.

79 ◯ Hard wired electronics, supplied by TS

► Connect power supply with 60 VDC[6] to accumulator TS connector.

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

81 ◯ Visible in bright sunlight.

☐ ACCUMULATOR MANAGEMENT SYSTEM

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

83 ◯ Every temperature sensor placed on negativ terminal of monitored cell or in <10mm distance on busbar.

► Disconnect AMS current sensor connector

84 ◯ The AMS must open the shutdown circuit within 0.5 s.

► Disconnect any other AMS internal connector

85 ◯ The AMS must open the shutdown circuit within 1 s.

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

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

86 ◯ Cell voltages can be displayed.

87 ◯ Cell temperatures can be displayed.

88 ◯ Plausible accumulator current can be displayed.

► Disconnect one SINGLE voltage sense wire, if any wires used.

89 ◯ The AMS must open the shutdown circuit within 0.5 s.

► Disconnect one SINGLE temperature sense wire, if any wires used.

90 ◯ The AMS must open the shutdown circuit within 1 s.

☐ CHARGER SHUTDOWN CIRCUIT

91 ◯ IMD is integrated into the charging system

► Connect charger to battery/batteries, start charging process

92 ◯ Voltage indicator shows that HV is present

► Press shutdown button

93 ◯ AIRs open

94 ◯ Voltage indicator shows voltage <60 V

► Start charging, unplug TS accumulator connector

95 ◯ AIRs open.

96 ◯ Charger disabled, no voltage at charger connector

[5] max. TS voltage

[6] 60 V or half the nominal tractive system voltage, whichever is lower

☐ INSULATION MONITORING DEVICE

97 ◯ 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

► R_{Test} = 120 kΩ[7]

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

98 ◯ Shutdown circuits opens within 30 s.

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

100 ◯ Reactivation of charger output is not possible.

► Push the reset button, if any.

101 ◯ Reactivation of charger output is not possible.

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

102 ◯ Reactivation of charger output is not possible.

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

103 ◯ Shutdown circuits opens within 30 s.

[7] R_{Test} = (max. TS voltage · 250 Ohm/V) - BPR

☐ ACCUMULATOR CONTAINER

► Team must show approved SES for accumulator container.

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

104 ◯ Accumulator container manufactured according to SES.

105 ◯ Internal vertical walls have to be rigidly fastened to the container. Minimum 75% of the height of the external walls. Divide the accumulator in sections of max. 12 kg.

106 ◯ Cells securely fastened towards all 3 directions.

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

108 △ Roman Sans-Serif characters of at least 20 mm high are used.

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

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

☐ HANDCART

111 ◯ Handcart present with four wheels. Max. dimensions 1200 mm x 800 mm.

112 ◯ Handcart has always on type brake system.

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

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

115 ◯ Label according to EV5.3.8 still visible while on handcart.

☐ WEIGHING OF ACCUMULATOR

► Weight of each used accumulator:

☐ SEALING OF COMPONENTS

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

116 ◯ Accumulator container(s) including spares

117 ◯ Charger

118 ◯ Additional Part:

119 ◯ Additional Part:

☐ TIS STATUS UPDATE

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

NON-COMPLIANCE / COMMENTS

APPROVAL

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

PART V: ELECTRICAL INSPECTION

The time limit for this part of the inspection is 90 minutes. Continuation of the inspection is possible after requeueing.
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*

☐ COMMENTS

► Check comments from first page

☐ REQUIRED RESSOURCES

120 ◯ 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
- 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
- Photographs of all inaccessible TS connections

☐ LV BATTERY

121 ◯ Voltage $\leq$60 VDC
122 ◯ Rigid and sturdy casing
123 ◯ Only for wet-cell batteries: IPX7 rated and acid resistant casing if inside cockpit
124 ◯ Behind Firewall
125 ◯ Short circuit protection (e.g. fused)
126 ◯ Grounded to the chassis
127 ◯ Proper insulation of internal electrical connections
128 ◯ Proper mounting of cells
129 ◯ Complete battery pack inside rollover protection envelope
- Following checks only for Li-Ion batteries other than $LiFePO_4$:

130 ◯ UL94-V0 for min. used thickness or equivalent casing
131 ◯ Overcurrent protection that trips below max. discharge current
132 ◯ Overtemperature protection of at least 30 % of the cells (max. 60°C or datasheet, whichever is lower)
133 ◯ Voltage protection of all cells
134 ◯ Signal failures electrically disconnect the LV battery (SCS)
► Ask the team to connect their laptop to the AMS
135 ◯ Cell voltages can be displayed
136 ◯ Cell temperatures can be displayed

☐ SELF DEVELOPED PCBS

► Ask for fully assembled spare PCB of self developed PCBs
137 ◯ Sufficient spacing regarding system voltage and implementation
138 ◯ Sufficient insulation and temperature rating of coating if used, datasheet available
139 ◯ Coating process according to datasheet
140 ◯ BSPD PCB(s) is standalone with only minimum interface
141 ◯ BSPD PCB(s) are directly suppled from the LVMS

☐ MASTER SWITCHES

142 ◯ TSMS & LVMS installed easily accessible on the right side of the vehicle and located next to each other
143 △ All master switches are located above 80% of shoulder height of percy
144 ◯ Rigidly mounted and no need to be removed during maintenance
145 ◯ Rotary type with removable handle
146 △ Handle length $\geq$50 mm
147 ◯ "ON" position in horizontal
148 ◯ "ON" and "OFF" positions marked
149 ◯ TSMS with locking mechanism for “OFF” position
150 ◯ LVMS marked with “LV” and symbol showing a red spark in a white edged blue triangle
151 ◯ LVMS mounted on an red circular area on high contrast background
152 △ Circular area diameter $\geq$ 50 mm
153 ◯ TSMS marked with “TS” and triangle with black lightning bolt on yellow background
154 ◯ TSMS mounted on an orange circular area on high contrast background
155 △ Circular area diameter $\geq$ 50 mm

☐ MEASURING POINTS

156 ◯ Two TS measuring points on exclusive orange background
157 ◯ A black LV ground measuring point installed
158 ◯ Next to the master switches
159 ◯ 4 mm shrouded banana jacks
160 ◯ Non conductive cover
161 ◯ Cover removable without tools
162 ◯ Correctly marked (“TS+”, “TS-”, “GND”)

☐ TS SHUTDOWN DEVICES

163 ○ Two shutdown buttons installed next to the main hoop, right and left on the vehicle at approx. height of drivers head. Push-Pull or Push-Rotate-Pull functionality

164 ○ Marked with red sparked sticker

165 △ Diameter >39 mm

166 ○ One cockpit shutdown button installed. Push-Pull or Push-Rotate-Pull functionality

167 ○ Marked with red sparked sticker

168 ○ Easy actuation by the driver

169 △ Diameter ≥24 mm

170 ○ Inertia switch rigidly mounted to the chassis and can be de-mounted for functionality test

► Check interlocks on ...

171 ○ TS accumulator container(s)

172 ○ Inverters

173 ○ HVD

174 ○ Power distribution boxes

175 ○ Data Logger box

176 ○ Outboard wheel motors. (Interlocks must act before a TS wiring failure.)

☐ TS VOLTAGE

► Measure voltage at TS measuring points

177 ○ Equal or less than 60 VDC

☐ DIS-CHARGE CIRCUIT AND BODY PROTECTION RESISTORS

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

178 ○ Resistance is 30 kΩ [8] + discharge resistor

179 ○ Body protection resistor power rating is >6.0 W [9]

180 ○ Dis-charge power rating is sufficient for continuous dis-charge

☐ TS WIRING

181 ○ All TS wiring and components have to be in the envelope and behind the impact structures

182 ○ TS connectors outside of enclosures cannot be physically connected other than the design intent configuration

183 ○ 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.

184 ○ All TS wires and connectors have proper overcurrent protection

185 ○ TS wiring channels are orange

186 ○ No other wires than TS wires are orange

187 ○ TS wiring outside electrical enclosures in seperate non-conductive conduit or orange shielded cable

188 ○ Securely anchored to withstand at least 200 N, if outside of enclosure

189 ○ Located out of the way of possible snagging or damage

190 ○ Shielded against rotating/moving parts

191 ○ No wire lower than the chassis

192 ○ TS and LV wires separated (n/a for interlock)

193 ○ Possible to clearly assign and prove gauge, temperature and voltage rating of TS wires

194 ○ Suitable temperature rating for used position

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

196 ○ Insulation is not insulating tape or rubber-like paint

☐ HV WARNING STICKERS

► Check for warning stickers on TS containing enclosures. (triangle with black lightning bolt on yellow background)

197 ○ Inverter(s)

198 ○ Motor(s)

199 ○ Power Distribution box(es)

200 ○ Energy meter box

201 ○ Other TS containing enclosures

☐ TRACTIVE SYSTEM PROTECTIONS

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

202 ○ Not possible to reach any TS potentials

203 ○ TS components and containers protected from moisture

☐ HIGH VOLTAGE DISCONNECT

204 ○ Clearly marked with "HVD"

205 △ Distance to ground greater than 350 mm

206 ○ Inside roll-over protected envelope

207 ○ Easily visible while standing behind the vehicle

208 ○ No remote actuation (e.g. through wires)

209 ○ Integrated interlock

► Stand next to the vehicle, remove HVD

210 ○ Removed within 10 s without tools

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

☐ TRACTIVE SYSTEM ACTIVE LIGHT

212 ○ Mounted below highest point of the main roll hoop and within the roll-over protected envelope (including mounting)

213 △ Full illuminated surface visible by a person standing 3 m away from TSAL (1.6 m eye height)

● Cockpit indicator light ...

214 ○ ... is inside the cockpit and marked with “TS off”

215 ○ ... is green and visible in bright sunlight

216 ○ ... is visible for the driver

[8] 2 x Body Protection Resistor (BPR)

[9] sufficient to short circuit TS+ and TS-

☐ DATA LOGGER

217 ◯ data logger is enclosed in a housing

218 ◯ All energy from accumulator flows through the data logger

☐ FIREWALLS

- Separates any point of the driver (less than 100 mm above the bottom of the helmet of the tallest driver) from any TS component (including TS wiring) . . .

219 ◯ . . . behind the driver's back

220 ◯ . . . at the sides of the driver

221 ◯ . . . at the front of the vehicle

222 ◯ First layer, facing TS must be made of Aluminum with a thickness of at least 0.5 mm

223 ◯ Second layer, facing driver must be made of electrically insulated material (no CFRP)

224 ◯ Material meets UL94-V0 for min. used thickness or equivalent

☐ ACCELERATOR PEDAL POSITION SENSOR (APPS)

225 ◯ Returns to original position if not actuated

226 ◯ At least two sensors with different transfer functions, each having a positive slope sense with either different gradients and/or offsets to the other(s) are installed. (For digital sensors, a checksum is necessary)

227 ◯ Sensors do not share supply or signal lines

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

229 ◯ Minimum two springs installed to return pedal

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

☐ BRAKE LIGHT

231 ◯ Only one brakelight in red color

232 ◯ Located on vehicle centerline, height between wheel centerline and drivers shoulder

233 ◯ Round, triangle, or rectangular on black background

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

☐ GROUNDING CHECKS

Measure resistance between any conductive parts of the vehicle within 100 mm around any TS component, the seat mounting points and the harness attachment points and the LV GND measuring point:

Part (if applicable)	**Conductive** (max. 300 mΩ @ 1 A)	**May become conductive** (max. 5 Ω @ 0 A)
Main Roll Hoop	☐	
Frame / Monocoque	☐	☐
Driver harness mounting points	☐	
Seat mounting points	☐	
Firewall(s)	☐	
Carbon fiber part within 10 cm around TS parts:		☐
Suspension Front left or right if applicable	☐	☐
Suspension Rear left or right if applicable	☐	☐
Accumulator container	☐	☐
Accumulator Management System Data Connector	☐	☐
Conductive housings with TS parts inside	☐	☐
Additional Part:	☐	☐

☐ INSULATION MEASUREMENT TEST

- ▶ Choose test voltage to 500 V. [10]
- ▶ Connect insulation tester to TS+ and LVMP
- ▶ Measure resistance: R_{iso+} = kΩ

235 ◯ Resistance is much higher than 315 kΩ[11]

- ▶ Connect insulation tester to TS- and LVMP
- ▶ Measure resistance: R_{iso-} = kΩ

236 ◯ Resistance is much higher than 315 kΩ[11]

237 ◯ Resistances are nearly equal

[10] $U_{max} \leq 250\,V_{DC}$ U_{Test} = 250 V_{DC} $U_{max} > 250\,V_{DC}$ U_{Test} = 500 V_{DC}

[11] Minimal Resistance = 500 Ω/V · U_{max} + BPR

!! 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

238 ◯ Voltage at TS measurement points less or equal 60 VDC

- ▶ Switch on LVMS with TSMS deactivated

239 ◯ IMD and AMS and TS Cockpit indicator light illuminate for 1 s to 3 s for visible check

240 ◯ Voltage at TS measurement points less or equal 60 VDC

- ▶ Switch on TSMS and all shutdown buttons
- ▶ Reset any IMD or AMS errors

241 ◯ TS still deactivated

- ▶ Activate TS, measure TS voltage during TS power-up

242 ◯ System is precharged before second AIR closes

- ▶ Switch off TSMS

243 ◯ TS voltage decreases below 60 VDC within 5 s

- ▶ Try to power-up TS with switched off TSMS

244 ◯ TS still deactivated

- ▶ Switch on TSMS

245 ◯ TS still deactivated

☐ TRACTIVE SYSTEM SHUTDOWN

- ▶ Connect multimeter between TS+ and TS-
- ▶ For every of the following switches, deactivation leads to TS shutdown, voltage decreases below 60 VDC within 5 s

246 ◯ LVMS

247 ◯ Shutdown button left

248 ◯ Shutdown button right

249 ◯ Cockpit shutdown button

250 ◯ Inertia switch

251 ◯ Break-over-travel-switch

- ▶ Show schematic of TS with all interlocks (ESF)

252 ◯ Interlocks

☐ TRACTIVE SYSTEM ACTIVE LIGHT

- ▶ Activate LVS

253 ◯ TSAL and Cockpit Indicator (CI) is green only

- ▶ Activate TS

254 ◯ TSAL flashes red with freq 2 Hz - 5 Hz, and CI is off

255 ◯ TSAL is clearly visible (horizontal position, entire illuminated surface)

- ▶ Disconnect TSAC state detection circuitry (disconnect data connection to accumulator container), activate LVS and TS

256 ◯ TSAL flashes red and CI is off

- ▶ Deactivate TS, connect power supply >60 VDC[12] to TS[13], activate LVS

257 ◯ TSAL is both green and read flasching simultaniously and CI is on

- ▶ Disconnect power supply, remove HVD, override HVD interlock (!! cover TS potentials !!), activate LVS and TS

258 ◯ TSAL and CI is off

☐ INSULATION MONITORING DEVICE

259 ◯ One IMD ground line is connected to the accumulator container[14] and one ground line is connected to the main hoop by a separate wired connection

- ▶ R_{Test} = 120 kΩ[15]
- ● IMD indicator light ...

260 ◯ ... is inside the cockpit and marked with “IMD”

261 ◯ ... is red and visible in bright sunlight, even from outside

262 ◯ ... is visible for the driver

- ▶ Activate TS, connect R_{Test} between TS+ and LV GND

263 ◯ Shutdown circuits opens within 30 s

264 ◯ IMD indicator light illuminates

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

- ▶ Try to activate the TS by the required additional action (EV5.11.2)

266 ◯ Reactivation of TS is not possible

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

267 ◯ Reactivation of TS is not possible

- ▶ Remove R_{Test}. Wait 40 s until IMD resets status output

268 ◯ Reactivation of TS is not possible

- ▶ Push all reset buttons in the cockpit, if any

269 ◯ Reactivation of TS is not possible

- ▶ Push the IMD reset button which is not accessible to the driver, if any

270 ◯ 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

271 ◯ Shutdown circuits opens within 30 s

272 ◯ IMD indicator light illuminates

☐ ACCUMULATOR MANAGEMENT SYSTEM

- ● AMS indicator light ...

273 ◯ ... is inside the cockpit and marked with “AMS”

- ▶ Disconnect TS accumulator

274 ◯ ... is illuminated red and visible in bright sunlight, even from outside

275 ◯ ... is visible for the driver

[12] 25 V_{AC} equal 42.5 V_{DC} when the signal is sinusoidal

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

[14] or the IMD's enclosure

[15] R_{Test} = (max. TS voltage · 250 Ohm/V) - BPR

☐ READY TO DRIVE ACTIVATION SEQUENCE

► Activate TS, press torque pedal

276 ○ No turning of motors

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

277 ○ Pressing brake pedal WHILE activating is necessary

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

278 ○ No ready to drive mode possible

► Disconnect the brake sensor

279 ○ No ready to drive mode possible

280 ○ Ready to drive sound duration is 1 s to 3 s continuously

281 △ Ready to drive sound is min 80 dBA (2 m around the vehicle)

282 ○ Ready to drive sound is easy recognizable and no animal sound or song part

☐ APPS AND BSPD

► Set vehicle to ready to drive state

► Disconnect $\geq$ 50 % of APPS

283 ○ Motors do not turn

► Disconnect all APPS

284 ○ Motors do not turn

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

285 ○ TS shuts down

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

286 ○ TS shuts down

287 ○ Reactivation of TS is only possible after 10 s without implausibility

☐ SEALING OF COMPONENTS

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

288 ○ Motor Controller housing

289 ○ Energy Meter housing

290 ○ IMD housing

291 ○ TSAL circuitry housing

292 ○ BSPD casing /BSPD calibration

293 ○ Additional Part:

294 ○ Additional Part:

☐ DATA LOGGER

295 △ Check data logger functionality and connectivity

☐ TIS STATUS UPDATE

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

NON-COMPLIANCE / COMMENTS

APPROVAL

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

PART VI: MECHANICAL INSPECTION

The time limit for this part of the inspection is 75 minutes. Continuation of the inspection is possible after requeueing.
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*

☐ COMMENTS

► Check comments from first page

☐ VEHICLE WITH TALLEST DRIVER READY TO RACE

296 ○ **FIRE EXTINGUISHERS** - Two (2) hand-held, 0.9 kg (2 lb.) minimum, dry chemical (10BC, 1A10BC, 34B, 5A 34B, 20BE or 1A 10BE), 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 Tech.).

297 ○ **PUSH BAR (red color)** - With vehicle, 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.

298 △ **CAMERAS** - Must be secured by two points, see T13.5. No cameras mounted to helmet.

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

300 △ **VEHICLE CONTROLS** - All controls, including shifter, must be inside cockpit. No arms or elbows outside the SIS plane.

301 ○ **DRIVER FLUID PROTECTION** - A firewall (rigidly mounted cover plate for cooling systems using plain water) must extend sufficiently far upwards and/or rearwards such that any point, less than 100mm above the bottom of the helmet of the tallest driver, is not in direct line of sight with any of the following parts: cooling system and low voltage battery.

302 ○ **ROLL BAR PADDING** - Roll bar or bracing that could be hit by driver's helmet must be covered with 12mm thick, SFI spec 45.1 or FIA 8857-2001 padding.

303 △ **OTHER SIDE TUBES** - Design prevents driver's neck hitting bracing or other side tubes

304 ○ **HEAD RESTRAINT**- Near vertical. Must take 890N load. 40mm thick, SFI 45.2 standard. Max. 25mm from helmet. Helmet contact point 50mm min. from any edge. May be changed for different drivers. Minimum 150x150mm.

305 ○ **DRIVER RESTRAINT HARNESS** - SFI 16.1, SFI 16.5, SFI 16.6, FIA 8853/98 or 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 (25.4 x 2.4mm or equal.)

306 ○ **LAP BELT MOUNTING** - Pivoting mounting with eye bolts or shoulder bolts attached securely to Primary Structure. Min. tab thickness 1.6mm. Attachment brackets to the monocoque must be steel, see T5.3.2.

307 ○ **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.

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

☐ VEHICLE WITHOUT DRIVER

309 △ **TECH STICKER SPACE** - 45 mm x 175 mm on centerline of front of vehicle in front of the cockpit opening

310 △ **SCHOOL NAME & OTHER DECALS** - School Name, or recognized initials - min. 50mm tall (all letters). on both sides in Roman letters. Must be clearly visible.

311 △ **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.

312 △ **BODYWORK EDGES** - edges that could contact a pedestrian must have a minimum radius of 1.0mm (safety requirement)

313 △ **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.

314 ○ **BODYWORK** - Min. 38mm radius on nose. No large openings in bodywork into driver compartment in front of or alongside driver, (except cockpit opening).

315 ○ **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.

316 △ **AERODYNAMICS** - ALL aerodynamic devices maximum 250mm rearward of rear tires, maximum 700mm forward of front tires. Devices lower than 500mm from the ground rearward 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.

317 △ **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 1.2 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.

318 ○ **EDGES/RADII** - Edges that could contact a pedestrian must have a minimum radius of: horizontal leading edges min 5mm; vertical forward facing edges min 3mm. All other edges must have a minimum radius of 1.0mm

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

320 ○ **COCKPIT OPENING** - Fig. 11 (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.

321 ○ **COCKPIT INTERNAL CROSS SECTION** - Fig. 11 (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).

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

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

☐ REMOVE BODY PANELS

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

325 ○ **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.

326 ○ **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.

327 ○ **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).

328 △ **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.

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

330 ○ **MONOCOQUE** - Must see laminate test specimen. Steel backing plates ($\geq$2 mm thick) used at attachment points (must be fully supported).

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

332 ○ **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.

333 ○ **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)

334 ○ **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.

335 ○ **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. Extra rearward bracing required if Front Hoop leans backwards more than 10 deg.

336 ○ **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.

337 ○ **FRONT IMPACT PROTECTION** - No non-crushable objects forward of bulkhead. IMPACT ATTENUATOR forward of bulkhead, 200mm long x 200mm wide x 100mm high. 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.

338 ○ **ANTI INTRUSION PLATE** - A 1.5mm solid steel or 4.0mm solid aluminium sheet. Must be welded (size: min. to centerlines) or min. 8 screws M8 Grade 8.8 (critical fasteners T10) (size: min. outside dimensions). CFRP plate is accepted if SES approved.

339 ○ **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.

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

341 ○ **QUICK JACK (red color)** - One device must be available to lift up all driven wheels min. 100mm above the ground. Lifting the car must be possible by one person. In lifted position the quick jack must be locked/secured and function without the support of a person or additional weights. University name must be written on.

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

343 ○ **FIREWALL** - Fire resistant material; must separate driver compartment from cooling, oil system & LV battery. Pass-throughs OK with grommets. Multiple panels OK if gaps sealed. No gaps at sides or bottom. Must be rigidly mounted to the chassis. Material must meet UL94-V0, FAR25 or equivalent. 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 250N 4mm screwdriver penetrating test.

☐ VEHICLE LIFTED AND WHEELS REMOVED

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

345 ○ **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. 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.

346 ○ **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. NO STEER-BY-WIRE on front wheels. Rear wheel steering, max. 6 deg. and mechanical stops installed. No bonded joints in steering column.

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

348 ○ **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 aluminum with a minimum thickness of 1 mm.

349 ○ **GAS CYLINDERS** - Proprietary manufacture & labeled, Non-flammable gas, regulator on tank, securely mounted, appropriate lines & fittings. Positively retained, i.e. no tie-wraps. Maximum of 10bar allowed, except cylinders/tanks with directly mounted pressure regulator (-> 10bar).

350 ○ **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.

351 △ **SCATTERSHIELD MATERIALS** - For chains, 2mm min. thick solid STEEL, 3 x chain width. For belts, 3mm min. thick Al 6061-T6, 3 x belt width. Finger guards: cover all drivetrain parts that spin while vehicle is stationary. No holes >12mm dia.

352 ◯ **LV BATTERY** - Attached securely to frame or chassis.

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

354 △ **COOLANT** - 100% water. NO ADDITIVES WHATSOEVER or oil for electric motors.

355 ◯ **CATCH TANKS** - Any coolant overflow or lube system vents must have separate catch tanks. 0.9 l minimum each, 100 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.

356 △ **FLUID LEAKS** - Oil, grease, coolant,Brake fluid -> none permitted

357 ◯ **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.

358 ◯ **ACCUMULATOR CONTAINER POSITION** - All accumulator containers must lie within the primary structure of the frame lower than the top of the SIS. All accumulator containers must be protected from side or rear impact collisions. If an accumulator container or parts of it are mounted outside of the primary structure (EV.3.5.1, EV 3.5.3) an additional impact structure according to T3.2 must be build to protect the accumulator.

359 ◯ **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.

360 ◯ **PROTECTION OF TRACTIVE SYSTEM PARTS** - In side view no part of the tractive-system can project below the lower surface of the frame or the monocoque, whichever is applicable

361 ◯ **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

362 ◯ **MOTOR CASING** - 3mm Aluminium 6061-T6 or 2mm steel. If rotating around the stator or the motor case is perforated a scatter shield around the motor should be installed of 1mm 6061-T6 aluminium or steel.

☐ TIS STATUS UPDATE

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

NON-COMPLIANCE / COMMENTS

APPROVAL

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

PART VII: TILT TEST

☐ TIS STATUS UPDATE

► Set online TIS status to *Present*

☐ COMMENTS

► Check comments from first page

☐ TILT TEST

363 ○ **FLUID LEAKAGE** - No fluid spill permitted when vehicle is tilted to 60 degrees in the direction most likely to create spillage. Tanks must be filled to scribe line.

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

365 △ **GROUND CLEARANCE** - At least 30 mm min. with driver.

☐ TIS STATUS UPDATE

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

NON-COMPLIANCE / COMMENTS

APPROVAL

	Inspector Names	Date, Time	Signatures when passed
1.	_____/_____	_____	_____

PART VIII: RAIN TEST

☐ TIS STATUS UPDATE

► Set online TIS status to *Present*

☐ COMMENTS

► Check comments from first page

☐ RAIN TEST

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

366 ◯ 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 waitng without water spary.

367 ◯ The Insulation Monitoring Device does not react and not shut down the tractive system.

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

368 ◯ Shutdown circuits opens within 30 s.

☐ TIS STATUS UPDATE

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

NON-COMPLIANCE / COMMENTS

APPROVAL

	Inspector Names	Date, Time	Signatures when passed
1.	_____/_____	_____	_____

PART IX: BRAKE TEST

☐ TIS STATUS UPDATE

► Set online TIS status to *Present*

☐ COMMENTS

► Check comments from first page

☐ BRAKE TEST

369 ◯ **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).

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

☐ TIS STATUS UPDATE

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

NON-COMPLIANCE / COMMENTS

APPROVAL

	Inspector Names	Date, Time	Signatures when passed
1.	_____/_____	_____	_____