

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

Present the vehicle for inspection in the following order:

- Pre-Inspection
- Accumulator Inspection* Mon 05:30-06:30
- 1. Electrical Inspection* Mon 07:30-09:00
- Mechanical Inspection* Mon 04:00-05:30
- Driver Egress Tue 08:00-08:30
- 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
- △ Check in responsibility of the team
- Check

NOTES:

- This form must stay with the vehicle at all times!
- If there is a conflict between this form and the rules, the rules prevail.

PART I: ACCUMULATOR 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 accumulator must be approved by a technical inspector.

TIS STATUS UPDATE

▶ Set online TIS status to *Present*

▶ Write down current time to manual TIS sheet

Date, Time: _____

REQUIRED RESSOURCES

- 1 ○ 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
- do not wear synthetic clothes
- no cell phone
- wear safety glasses
- no batch / no necklace
- wear safety gloves
- no sources of distraction

BASIC SET OF HV-PROOF TOOLS

- 2 ○ Insulated cable shear.
- 3 ○ Insulated screw driver.
- 4 ○ Insulated spanners (n/a if no screwed connections in TS).
- 5 ○ Multimeter with protected probe tips
- 6 ○ two 4mm banana plug test leads (1000V CAT III)

SAFETY EQUIPMENT

- 7 ○ Face shield.
- 8 ○ Safety glasses (minimum three).
- 9 ○ HV insulating gloves (minimum two pairs).
- 10 ○ HV insulating blankets (two) (min 1 m²) with label or serial number and datasheet.

SELF DEVELOPED PCBs

- ▶ Ask for fully assembled spare PCB of self developed PCBs inside accumulator container.
- 11 ○ Sufficient spacing regarding system voltage and implementation.
- 12 ○ Sufficient insulation and temperature rating of coating if used, datasheet available.
- 13 ○ Coating process according to datasheet

CHARGER ASSEMBLY

- 14 ○ Completely closed. Check opening in HV/TS enclosures, try to reach HV/TS potentials with insulated test probe (100 mm length, 6 mm diameter).
- 15 ○ Interlock integrated.
- 16 ○ TSMP integrated
- 17 ○ Emergency shutdown button integrated.
- 18 △ Emergency shutdown button ≥24 mm diameter.
- 19 ○ TS wiring is orange, marked with gauge, temperature rating

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>85°C and voltage rating.

20 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. 21 Resistance is $30\text{ k}\Omega$ ¹ + discharge resistor
- 22 Body protection resistor power rating is $>6.0\text{ W}$ 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.
- ▶ Measure resistance: $R_{iso+} =$ k Ω
- 23 Resistance is much higher than $315\text{ k}\Omega$ ⁴.
- ▶ Connect insulation tester to TS- and LV ground.
- ▶ Measure resistance: $R_{iso-} =$ k Ω
- 24 Resistance is much higher than $315\text{ k}\Omega$ ⁴.
- 25 Resistances are nearly equal.

HOUSING

- 26 The accumulator must be mechanically fixed to the handcart while on the handcart
- 27 Vehicle number, university name and ESO phone number(s) written on a high contrast background.
- 28 Roman Sans-Serif characters of at least 20 mm high are used.
- 29 Warning stickers with side length of $\geq 100\text{ mm}$ and text "Always Energized" and "High Voltage" (if TS $>60\text{ V}$) installed. (triangle with black lightning bolt on yellow background)
- 30 Check if all parts and the cover/lid of the housing are rigidly fastened.
- ▶ Open container housing, remove maintenance plugs.
- ▶ Check if no voltage is present.

ASSEMBLY

- 31 All components and parts of the accumulator container need to be properly fixed.
- 32 All used fasteners must be secured by the use of positive locking except they are non-conductive and non-structural
- 33 TS potentials are insulated against inner wall of accumulator container if container made from conductive material.
- 34 Cell tabs must not be mechanically loaded.
- 35 No soldering in high current path
- 36 Every container contains at least one appropriately sized and rated fuse.
 - ▶ Check datasheet of fuse, main wire and cells and compare to ESF
- 37 Every container contains at least two appropriately sized and rated isolation relays (current and voltage).
- 38 Isolation relays and fuses are separated from cells by barrier according UL94-V0, FAR25 or equivalent.
- 39 Pre-charge relay is of mechanical type with appropriate voltage rating.
 - ▶ Check datasheet of pre-charge relay and compare to ESF
- 40 Maintenance plugs are located at both poles of each stack (including first and last stack).
- 41 Maintenance plugs removable without tools.
- 42 Maintenance plugs have positive locking mechanism.
- 43 Maintenance plugs must not be able to unintentionally create circuits or short circuits.
- 44 Stacks separated by Maintenance plugs $\leq 120\text{ VDC}$.
- 45 Stacks separated by Maintenance plugs $\leq 6\text{ MJ}$.
- 46 Stacks are insulated and separated by a fire resistant barrier according to UL94-V0 for min. used thickness, FAR25 or equivalent.
- 47 Internal vertical walls have to be rigidly fastened to the container.
- 48 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).
- 49 If fully closed, equalizing valve implemented.
- 50 Spare accumulators of same size, weight and type.

WIRING

- 51 All TS wires have proper overcurrent protection.
- 52 No other wires than TS wires are orange.
- 53 Securely anchored to withstand at least 200 N , if outside of enclosure.
- 54 Located out of the way of possible snagging or damage.
- 55 TS and LV wires separated (not valid for Interlock).
- 56 Every wire used in the Accumulator container (TS and LV) is rated for $\geq 600\text{ V}$ ⁵.
- 57 TS wires are marked with gauge, temperature rating $>85^\circ\text{C}$ and voltage rating.
- 58 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
- 59 Insulation is not only insulating tape or rubber-like paint.

CELL TEMPERATURE MONITORING DEVICE (CTMD)

- ▶ Install CTMD
- 60 CTMD sensor installed at negative cell tab as defined in the ESF or specified by the technical inspector.
- 61 Cooling at CTMD sensor positions not above-average.
 - ▶ Take a picture and upload it to competition server.

+

¹ 2 x Body Protection Resistor (BPR)

² sufficient to short circuit TS+ and TS-

³ $U_{max} \leq 250\text{ V}_{DC}$ $U_{max} > 250\text{ V}_{DC}$
 $U_{Test} = 250\text{ V}_{DC}$ $U_{Test} = 500\text{ V}_{DC}$

⁴ Minimal Resistance = $500\Omega/\text{V} \cdot U_{max} + \text{BPR}$

⁵ max. TS voltage

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INDICATOR LIGHT OR VOLTMETER

- 62 Red indicator light or voltmeter installed
- 63 Marked with "Voltage Indicator"
- 64 Visible while opening the battery connector.
- 65 Hard wired electronics, supplied by TS
- ▶ Connect power supply with 60 VDC⁶ to accumulator TS connector.
- 66 Indicator light on or voltmeter showing present TS voltage.
- 67 Visible in bright sunlight.

ACCUMULATOR MANAGEMENT SYSTEM

- 68 A minimum of 30% of cells are monitored with temperature sensors.
- 69 Every temperature sensor placed on negativ terminal of monitored cell or in <10mm distance on busbar.
 - ▶ Disconnect AMS current sensor connector
- 70 The AMS must open the shutdown circuit within 0.5 s.
 - ▶ Disconnect any other AMS internal connector
- 71 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.
- 72 Cell voltages can be displayed.
- 73 Cell temperatures can be displayed.
- 74 Plausible accumulator current can be displayed.

CHARGER SHUTDOWN CIRCUIT

- 75 IMD is integrated into the charging system
 - ▶ Connect charger to battery/batteries, start charging process
- 76 Voltage indicator shows that HV is present
 - ▶ Press shutdown button
- 77 AIRs open
- 78 Voltage indicator shows voltage <60 V
 - ▶ Start charging, unplug TS accumulator connector
- 79 AIRs open.
- 80 Charger disabled, no voltage at charger connector

INSULATION MONITORING DEVICE

- 81 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
 - ▶ $R_{Test} = 120 \text{ k}\Omega$ ⁷
 - ▶ Activate charger output, connect R_{Test} between TS+ and LV GND.
- 82 Shutdown circuits opens within 30 s.
- 83 TS voltage decreases below 60 VDC within 5 s after shutdown
- ▶ circuit opens.
- 84 Reactivation of charger output is not possible.
 - ▶ Push the reset button, if any.
- 85 Reactivation of charger output is not possible.
 - ▶ Remove R_{Test} . Wait 40 s until IMD resets status output.
- 86 Reactivation of charger output is not possible.
 - ▶ Activate TS, connect R_{Test} between TS- and LV GND.
- 87 Shutdown circuits opens within 30 s.

WEIGHING OF ACCUMULATOR

- ▶ Weight of each used accumulator:

SEALING OF COMPONENTS

- ▶ After all tests have been passed successfully seal the inspected TS housings:
- 88 Accumulator container(s) including spares
- 89 Charger
- 90 Additional Part:
- 91 Additional Part:

TIS STATUS UPDATE

- ▶ Set online TIS status to *Passed* or *Failed*
- ▶ Write down current time and result to manual TIS sheet

⁶60 V or half the nominal tractive system voltage, whichever is lower

⁷ $R_{Test} = (\text{max. TS voltage} \cdot 250 \text{ Ohm/V}) \cdot \text{BPR}$

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NON-COMPLIANCE / COMMENTS

APPROVAL

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

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PART II: PRE-INSPECTION

TIS STATUS UPDATE

▶ Set online TIS status to *Present*

TIRES

92 **DRY TIRES** - Make:

93 **DRY TIRES** - Size:

94 **DRY TIRES** - Compound:

95 **RAIN TIRES** - Make:

96 **RAIN TIRES** - Size:

97 **RAIN TIRES** - Compound:

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

DRIVER GEAR & SAFETY

99 **FACE SHIELDS** - made of impact resistant material.

100 **UNDERWEAR** - certified to SFI 3.3 or FIA 8856-2000

101 **SOCKS** - Nomex or equivalent, fire resistant socks. No cotton. No polyester. No bare skin.

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

103 **ARM RESTRAINTS** - Commercially manufactured according to SFI Standard 3.3 or equivalent.

104 **HELMETS** - Snell K2005, K2010, K2015, M2005, M2010, M2015, SA2005, SA2010, SAH2010, SA2015, EA2016,

SFI 31.1/2005, 31.1/2010, 31.1/2015, 41.1/2005, 41.1/2010, 41.1/2015, FIA 8860-2004, FIA 8860-2010, FIA 8860-2018, FIA 8859-2015. Closed Face, no Open Face, must have integrated shield (no dirtbike helmets). No camera mounts.

105 **DRIVER SUITS** - Single piece FIA 1986 or 2000, or SFI 3-2A/5, FIA 8856-2000/2018 minimum rating, and LABELED AS SUCH

106 **HAIR COVER** - Fire resistant (Nomex or equiv.) balaclava of full helmet skirt **REQUIRED FOR ALL DRIVERS.**

107 **SHOES** - SFI 3.3 or FIA 8856-2000

APPROVAL

Inspector Names

Date, Time

Signatures when passed

1. _____ / _____

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PART III: EGRESS TEST

DRIVER POSITION

- 108 **ARM RESTRAINTS**- Must be installed so the driver can release them and exit unassisted regardless of vehicle's position.
- 109 **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.
- 110 **HEAD RESTRAINT**- Near vertical. Max. 25 mm from helmet.
- 111 **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.
- 112 **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

APPROVAL

	Inspector Name	Driver ID	Date, Time	Signatures when passed
1.	_____	_____	_____	_____
2.	_____	_____	_____	_____
3.	_____	_____	_____	_____
4.	_____	_____	_____	_____
5.	_____	_____	_____	_____
6.	_____	_____	_____	_____

NON-COMPLIANCE / COMMENTS

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PART IV: ELECTRICAL INSPECTION

The time limit for this part of the inspection is 120 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*

REQUIRED RESSOURCES

- 113 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

- 114 Voltage ≤ 60 VDC
- 115 Rigid and sturdy casing
- 116 Only for wet-cell batteries: IPX7 rated and acid resistant casing if inside cockpit
- 117 Behind Firewall
- 118 Short circuit protection (e.g. fused)
- 119 Grounded to the chassis
- 120 Proper insulation of internal electrical connections
- 121 Proper mounting of cells
- 122 Complete battery pack inside rollover protection envelope
- Following checks only for Li-Ion batteries other than LiFePO₄:
 - 123 UL94-V0 for min. used thickness, FAR25 or equivalent casing
 - 124 Overcurrent protection that trips below max. discharge current
 - 125 Overtemperature protection of at least 30 % of the cells (max. 60°C or datasheet, whichever is lower)
 - 126 Voltage protection of all cells
 - 127 Signal failures electrically disconnect the LV battery (SCS)
 - ▶ Ask the team to connect their laptop to the AMS
 - 128 Cell voltages can be displayed
 - 129 Cell temperatures can be displayed

SELF DEVELOPED PCBS

- ▶ Ask for fully assembled spare PCB of self developed PCBs datasheet available
- 130 Sufficient spacing regarding system voltage and implementation
- 131 Sufficient insulation and temperature rating of coating if used,
- 132 Coating process according to datasheet
- 133 BSPD PCB(s) is standalone with only minimum interface

MASTER SWITCHES

- 134 TSMS & LVMS installed easily accessible on the right side of the vehicle and located next to each other
- 135 All master switches are located above 80% of shoulder height of Percy
- 136 Rigidly mounted and no need to be removed during maintenance
- 137 Rotary type with removable handle
- 138 Handle length ≥ 50 mm
- 139 "ON" position in horizontal
- 140 "ON" and "OFF" positions marked
- 141 TSMS with locking mechanism for "OFF" position
- 142 LVMS marked with "LV" and symbol showing a red spark in a white edged blue triangle
- 143 LVMS mounted on an red circular area on high contrast background
- 144 Circular area diameter ≥ 50 mm
- 145 TSMS marked with "TS" and triangle with black lightning bolt on yellow background
- 146 TSMS mounted on an orange circular area on high contrast background
- 147 Circular area diameter ≥ 50 mm

MEASURING POINTS

- 148 Two TS measuring points on exclusive orange background
- 149 A black LV ground measuring point installed
- 150 Next to the master switches
- 151 4 mm shrouded banana jacks
- 152 Non conductive cover
- 153 Cover removable without tools
- 154 Correctly marked ("TS+", "TS-", "GND")

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TS SHUTDOWN DEVICES

- 155 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
- 156 Marked with red sparked sticker
- 157 Diameter >39 mm
- 158 One cockpit shutdown button installed. Push-Pull or Push-Rotate-Pull functionality
- 159 Marked with red sparked sticker
- 160 Easy actuation by the driver
- 161 Diameter ≥ 24 mm
- 162 Inertia switch rigidly mounted to the chassis and can be demounted for functionality test
 - ▶ Check interlocks on ...
- 163 TS accumulator container(s)
- 164 Inverters
- 165 HVD
- 166 Power distribution boxes
- 167 Data Logger box
- 168 Outboard wheel motors. (Interlocks must act before a TS wiring failure.)

TS VOLTAGE

- ▶ Measure voltage at TS measuring points
- 169 Equal or less than 60 VDC

DIS-CHARGE CIRCUIT AND BODY PROTECTION RESISTORS

- ▶ Switch off LV. Measure resistance between TS+ and TS- measuring points
- 170 Resistance is $30 \text{ k}\Omega$ ⁸ + discharge resistor
- 171 Body protection resistor power rating is $>6.0 \text{ W}$ ⁹
- 172 Dis-charge power rating is sufficient for continuous dis-charge

TS WIRING

- 173 All TS wiring and components have to be in the envelope and behind the impact structures
- 174 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.
- 175 All TS wires and connectors have proper overcurrent protection
- 176 TS wiring channels are orange
- 177 No other wires than TS wires are orange
- 178 TS wiring outside electrical enclosures in separate non-conductive enclosure or orange shielded cable
- 179 Securely anchored to withstand at least 200 N, if outside of enclosure
- 180 Located out of the way of possible snagging or damage
- 181 Shielded against rotating/moving parts
- 182 No wire lower than the chassis
- 183 TS and LV wires separated (n/a for interlock)
- 184 Marked with gauge, temperature rating $>85^\circ\text{C}$ and voltage rating $\geq 600 \text{ V}$ ¹⁰
- 185 Suitable temperature rating for used position
- 186 Positive locking mechanism on every screwed connection. (Photographs for all inaccessible TS connections)
- 187 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)
- 188 Inverter(s)
- 189 Motor(s)
- 190 Power Distribution box(es)
- 191 Energy meter box
- 192 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)
- 193 Not possible to reach any TS potentials
- 194 TS components and containers protected from moisture

HIGH VOLTAGE DISCONNECT

- 195 Clearly marked with "HVD"
- 196 Distance to ground greater than 350 mm
- 197 Inside roll-over protected envelope
- 198 Easily visible while standing behind the vehicle
- 199 No remote actuation (e.g. through wires)
- 200 Integrated interlock
 - ▶ Stand next to the vehicle, remove HVD
- 201 Removed within 10 s without tools
- 202 TS protection still given (insulated test probe). If dummy connector is used, it must be stored at the push-bar.

TRACTIVE SYSTEM ACTIVE LIGHT

- 203 Mounted below highest point of the main roll hoop and within the roll-over protected envelope (including mounting)
- 204 Full illuminated surface visible by a person standing 3 m away from TSAL (1.6 m eye height)
- 205 A device logically replacing an accumulator container is available
 - Cockpit indicator light ...
- 206 ... is inside the cockpit and marked with "TS off"
- 207 ... is green and visible in bright sunlight
- 208 ... is visible for the driver

⁸2 x Body Protection Resistor (BPR)

⁹sufficient to short circuit TS+ and TS-

¹⁰max. TS voltage

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DATA LOGGER

- 209 data logger is enclosed in a housing 210 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) ...
- 211 ... behind the driver's back
- 212 ... at the sides of the driver
- 213 ... at the front of the vehicle
- 214 First layer, facing TS must be made of Aluminum with a thickness of at least 0.5 mm
- 215 Second layer, facing driver must be made of electrically insulated material (no CFRP)
- 216 Material meets UL94-V0 for min. used thickness, FAR25 or equivalent

ACCELERATOR PEDAL POSITION SENSOR (APPS)

- 217 Returns to original position if not actuated
- 218 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)
- 219 Sensors do not share supply or signal lines
- 220 Sensors are protected from being mechanically overstressed (positive stop of pedal)
- 221 Minimum two springs installed to return pedal
- 222 Each spring still returns pedal with the second one disconnected (springs in the torque encoders not counted)

BRAKE LIGHT

- 223 Only one brakelight in red color
- 224 Located on vehicle centerline, height between wheel centerline and drivers shoulder
- 225 Round, triangle, or rectangular on black background
- 226 15 cm^2 minimum illuminated area OR LED strips with a total length greater than 150 mm with elements <20 mm apart

INSULATION MEASUREMENT TEST

- ▶ Choose test voltage to 500 V. ¹¹
- ▶ Connect insulation tester to TS+ and LVMP
- ▶ Measure resistance: $R_{iso+} =$ k Ω
- ▶ Connect insulation tester to TS- and LVMP
- ▶ Measure resistance: $R_{iso-} =$ k Ω
- 227 Resistance is much higher than 315 k Ω ¹²
- 228 Resistance is much higher than 315 k Ω ¹²
- 229 Resistances are nearly equal

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 m Ω @ 1 A)	May become conductive (max. 5 Ω @ 0 A)
Main Roll Hoop	<input type="checkbox"/>	
Frame / Monocoque	<input type="checkbox"/>	<input type="checkbox"/>
Driver harness mounting points	<input type="checkbox"/>	
Seat mounting points	<input type="checkbox"/>	
Firewall(s)	<input type="checkbox"/>	
Carbon fiber part within 10 cm around TS parts:		<input type="checkbox"/>
Suspension Front left or right	<input type="checkbox"/>	<input type="checkbox"/>
Suspension Rear left or right	<input type="checkbox"/>	<input type="checkbox"/>
Accumulator container	<input type="checkbox"/>	<input type="checkbox"/>
Accumulator Management System Data Connector	<input type="checkbox"/>	<input type="checkbox"/>
Conductive housings with TS parts inside	<input type="checkbox"/>	<input type="checkbox"/>
Radiator	<input type="checkbox"/>	<input type="checkbox"/>
Additional Part:	<input type="checkbox"/>	<input type="checkbox"/>

¹¹ $\frac{U_{max} \leq 250 V_{DC}}{U_{Test} = 250 V_{DC}}$ $\frac{U_{max} > 250 V_{DC}}{U_{Test} = 500 V_{DC}}$

¹² Minimal Resistance = 500 Ω /V · U_{max} + BPR

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!! 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
- 230 Voltage at TS measurement points less or equal 60 VDC
- ▶ Switch on LVMS with TSMS deactivated
- 231 IMD and AMS and TS Cockpit indicator light illuminate for 1 s to 3 s for visible check
- 232 Voltage at TS measurement points less or equal 60 VDC
- ▶ Switch on TSMS and all shutdown buttons
- ▶ Reset any IMD or AMS errors
- 233 TS still deactivated
- ▶ Activate TS, measure TS voltage during TS power-up
- 234 System is precharged before second AIR closes
- ▶ Switch off TSMS
- 235 TS voltage decreases below 60 VDC within 5 s
- ▶ Try to power-up TS with switched off TSMS
- 236 TS still deactivated
- ▶ Switch on TSMS
- 237 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
- 238 LVMS
- 239 Shutdown button left
- 240 Shutdown button right
- 241 Cockpit shutdown button
- 242 Inertia switch
- 243 Break-over-travel-switch
- ▶ Show schematic of TS with all interlocks (ESF)
- 244 Interlocks

TRACTIVE SYSTEM ACTIVE LIGHT

- ▶ Activate LV system
- 245 TSAL and Cockpit Indicator (CI) is green only
- ▶ Activate TS
- 246 TSAL flashes red with freq 2 Hz - 5 Hz, and CI is off
- 247 TSAL is clearly visible (horizontal position, entire illuminated surface)
- ▶ Disconnect AIR state detection circuitry (disconnect data connection to accumulator container), activate LV
- 248 TSAL is off (red must be explained) and CI is off
- ▶ Deactivate TS, deactivate LV, connect power supply >60 VDC¹³ to TS¹⁴
- ▶ Activate LV system
- 249 TSAL is off and CI is off
- ▶ Disconnect power supply, remove HVD, override HVD interlock (!! cover TS potentials !!), activate TS
- 250 TSAL and CI is off

INSULATION MONITORING DEVICE

- 251 One IMD ground line is connected to the accumulator container and one ground line is connected to the main hoop by a separate wired connection
- ▶ $R_{Test} = 120 \text{ k}\Omega$ ¹⁵
- IMD indicator light ...
- 252 ... is inside the cockpit and marked with "IMD"
- 253 ... is red and visible in bright sunlight, even from outside
- 254 ... is visible for the driver
- ▶ Activate TS, connect R_{Test} between TS+ and LV GND
- 255 Shutdown circuits opens within 30 s
- 256 IMD indicator light illuminates
- 257 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)
- 258 Reactivation of TS is not possible
- ▶ Push the reset button which is not accessible to the driver, if any and/or restart LVMS
- 259 Reactivation of TS is not possible
- ▶ Remove R_{Test} . Wait 40 s until IMD resets status output
- 260 Reactivation of TS is not possible
- ▶ Push all reset buttons in the cockpit, if any
- 261 Reactivation of TS is not possible
- ▶ Push the IMD reset button which is not accessible to the driver, if any
- 262 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
- 263 Shutdown circuits opens within 30 s
- 264 IMD indicator light illuminates

ACCUMULATOR MANAGEMENT SYSTEM

- AMS indicator light ...
- 265 ... is inside the cockpit and marked with "AMS"
- ▶ Disconnect TS accumulator
- 266 ... is illuminated red and visible in bright sunlight, even from outside
- 267 ... is visible for the driver

¹³ V_{AC} equal 42.5 VDC when the signal is sinusoidal

¹⁴ Do not use measuring points. The team needs to provide a method of connection which

uses same receptacles as used for TSMP

¹⁵ $R_{Test} = (\text{max. TS voltage} \cdot 250 \text{ Ohm/V}) \cdot \text{BPR}$

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READY TO DRIVE ACTIVATION SEQUENCE

- ▶ Activate TS, press torque pedal
- ▶ Disconnect the brake sensor
- 268 No turning of motors
- ▶ Let the team set the vehicle to ready to drive mode
- 271 No ready to drive mode possible
- ▶ Pressing brake pedal WHILE activating is necessary
- 272 Ready to drive sound duration is 1 s to 3 s continuously
- ▶ Repeat the activation sequence, but push the brake pedal only once before finally pushing the activation button
- 273 Ready to drive sound is min 80 dBA (2 m around the vehicle)
- 274 Ready to drive sound is easy recognizable and no animal sound or song part
- 270 No ready to drive mode possible

APPS AND BSPD

- ▶ Set vehicle to ready to drive state
- ▶ Disconnect $\geq 50\%$ of APPS
- ▶ be used), press brake representing hard braking (>0.5 s)
- 275 Motors do not turn
- ▶ Disconnect all APPS
- 277 TS shuts down
- ▶ Reactivate TS. Disconnect current sensor, press brake representing hard braking (>0.5 s)
- 276 Motors do not turn
- ▶ Team simulates 5 kW power (complete BSPD circuitry must be used)
- 278 TS shuts down
- 279 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:
- 283 TSAL circuitry housing
- 280 Motor Controller housing
- 284 BSPD casing /BSPD calibration
- 281 Energy Meter housing
- 285 Additional Part:
- 282 IMD housing
- 286 Additional Part:

DATA LOGGER

- 287 Check data logger functionality and connectivity

TIS STATUS UPDATE

- ▶ Set online TIS status to *Passed* or *Failed*
- ▶ Write down current time and result to manual TIS sheet

NON-COMPLIANCE / COMMENTS

APPROVAL

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

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PART V: 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*

VEHICLE WITH TALLEST DRIVER READY TO RACE

- 288 ○ **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.). On-board fire system possible.
- 289 ○ **PUSH BAR (red color)** - With vehicle, securely attached to vehicle, detachable, push & pull function for 2 people standing erect. The push bar must be attached to the rear of the vehicle for moving it. Two pair of HV gloves in protecting case and Multimeter must be installed.
- 290 △ **GROUND CLEARANCE** - At least 30 mm min. with driver.
- 291 △ **CAMERAS** - Must be secured by two points, see T13.5. No cameras mounted to helmet.
- 292 ○ **VISIBILITY** - Minimum of 100 deg. field either side. Head rotation allowed or mirrors. If mirrors, must be firmly installed and adjusted
- 293 △ **VEHICLE CONTROLS** - All controls, including shifter, must be inside cockpit. No arms or elbows outside the SIS plane.
- 294 ○ **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.
- 295 ○ **ROLL BAR PADDING** - Roll bar or bracing that could be hit by driver's helmet must be covered with 12 mm thick, SFI spec 45.1 or FIA 8857-2001 padding.
- 296 △ **OTHER SIDE TUBES** - Design prevents driver's neck hitting bracing or other side tubes
- 297 ○ **HEAD RESTRAINT**- Near vertical. Must take 890 N load. 40 mm thick, SFI 45.2 standard. Max. 25 mm from helmet. Helmet contact point 50 mm min. from any edge. May be changed for different drivers. Minimum 150x150mm.
- 298 ○ **DRIVER RESTRAINT HARNESS** - SFI 16.1, SFI 16.5, 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 50 mm). (7-point system must have three anti-submarine straps). Must be securely attached to prim. structure (25,4x2,4 or equal.)
- 299 ○ **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. Pivoting mounting with eye bolts or shoulder bolts attached securely to Primary Structure. Min. tab thickness 1,6 mm. Attachment brackets to the monocoque must be steel, see T5.3.2.
- 300 ○ **SHOULDER HARNESS MOUNTING** - Mounting points 180 - 230 mm 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 2.4 mm or 25.0 mm x 2.5 mm 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.
- 301 ○ **SUSPENSION** - Fully operational with dampers front and rear; 50mm minimum wheel travel (minimum jounce of 25mm) with driver in vehicle.

VEHICLE WITHOUT DRIVER

- 302 △ **TECH STICKER SPACE** - 45 mm x 175 mm on centerline of front of vehicle in front of the cockpit opening
- 303 △ **SCHOOL NAME & OTHER DECALS** - School Name, or recognized initials - 50 mm tall min (all letters). on both sides in Roman letters. Must be clearly visible.
- 304 △ **VEHICLE NUMBERS** - On front & both sides of vehicle, minimum 150 mm tall, 20 mm stroke & spacing, 25 mm min. between number and background edge, Black on White, White on Black only, specified background shapes. Must be clearly visible.
- 305 △ **BODYWORK EDGES** - edges that could contact a pedestrian must have a minimum radius of 1.0 mm (safety requirement)
- 306 △ **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.
- 307 ○ **BODYWORK** - Min. 38 mm radius on nose. No large openings in bodywork into driver compartment in front of or alongside driver, (except cockpit opening).
- 308 ○ **AERODYNAMIC DEVICES** - Securely mounted. The deflection may not exceed 10 mm when a force of 200 N is applied over a surface of 225 cm² and not more than 25 mm with a point force of 50 N is applied.
- 309 △ **AERODYNAMICS** - ALL aerodynamic devices maximum 250 mm rearward of rear tires, maximum 700 mm forward of front tires. Devices lower than 500 mm 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 500 mm behind the front axle must not be wider than the inside of the rear tires. No power ground effects.
- 310 △ **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 500 mm from the ground. Rear device max 1.2 m above ground (incl. end plates); Front device max 250 mm above ground outside of the inside plane of the front tires inside this plane max 500 mm.
- 311 ○ **EDGES/RADII** - Edges that could contact a pedestrian must have a minimum radius of: horizontal leading edges min 5 mm; vertical forward facing edges min 3 mm. All other edges must have a minimum radius of 1.0 mm
- 312 △ **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.
- 313 ○ **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.
- 314 ○ **COCKPIT INTERNAL CROSS SECTION** - Fig. 11 (right) template passes from the cockpit opening to 100 mm rear of rearmost pedal contact area (in most forward position). Steering wheel and paddings can be removed (without tools).
- 315 △ **STEERING WHEEL** - Continuous perimeter, near round (no concave sections) with driver operable quick disconnect. 250mm max from front hoop.

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REMOVE BODY PANELS

- 316 ○ **DRIVER'S LEG PROTECTION** - Covers inside of cockpit over any sharp edges or moving suspension / steering components.
- 317 ○ **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.
- 318 ○ **PERCY** - Helmet of 95th percentile male (PERCY) to be 50 mm 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 915 mm from pedals.
- 319 ○ **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).
- 320 △ **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.
- 321 ○ **TUBING & MATERIALS** - Team must show an APPROVED SES. No Magnesium tubes in primary structure.
- 322 ○ **MONOCOQUE** - Must see laminate test specimen. Steel backing plates (≥ 2 mm thick) used at attachment points.
- 323 ○ **BOLTED JOINTS** in primary structure - Distance hole centerline to the nearest free edge $> 1.5 \times$ hole diameter.
- 324 ○ **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.
- 325 ○ **MAIN HOOP BRACING** - MUST BE STEEL. One straight brace on each side. Dimension as shown in the approved SES. Attached within 160 mm 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 mm x 1.2 mm or equivalent)
- 326 ○ **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.
- 327 ○ **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 50 mm of top. Extra rearward bracing required if Front Hoop leans backwards more than 10 deg.
- 328 ○ **SIDE IMPACT PROTECTION** - Min. of 2 tubes + diagonal must connect the main and front hoops in straight line. Upper tube must be between 240 mm and 320 mm above lowest inside chassis point between FH and MH. Lower tube can be lower frame member. At least one diagonal per side must connect the upper and lower members between the main and front hoops. Dimension as shown in approved SES.
- 329 ○ **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 $> 1"$ from IA on any side.
- 330 ○ **ANTI INTRUSION PLATE** - A 1.5 mm solid steel metal or 4.0 mm solid aluminium metal sheet (same size as outside dims.) must be welded or min. 8 screws M8 Grade 8.8 (critical fasteners T10). CFRP plate is accepted if SES approved.
- 331 ○ **FRONT BULKHEAD SUPPORT** - Support back to front roll hoop; 3 tubes per side, all 25 mm x 1.5 mm wall steel tube or equiv. 1 bottom; 1 top within 50 mm of top of bulkhead, and connecting within 100 mm above and 50 mm below upper SIS tube; 1 or more node-to-node diagonal to completely triangulate connections to upper and lower SIS tubes.
- 332 ○ **INSPECTION HOLES** - 4.5 mm inspection holes required in non-critical areas of front & main hoops. Inspectors may ask for holes in other tube(s).
- 333 ○ **QUICK JACK (red color)** - One device must be available to lift up all driven wheels min. 100 mm 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.
- 334 ○ **WHEELS** - 203.2 mm (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.
- 335 ○ **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

- 336 ○ **SUSPENSION PICK-UP POINTS** - Inspected thoroughly for integrity.
- 337 ○ **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 $e/D > 1.5$.
- 338 ○ **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.
- 339 △ **FLOOR CLOSEOUT PANEL** - Required from foot area to fire-wall; solid, non-brittle material; multiple panels are OK if gaps less than 3 mm.
- 340 ○ **GAS CYLINDERS** - Proprietary manufacture & labeled, Non-flammable gas, regulator on tank, securely mounted, axis not pointed at driver, within the frame envelope, or in structural side pod, but not in cockpit, insulated from exhaust, appropriate lines & fittings. Positively retained, i.e. no tie-wraps.
- 341 ○ **SCATTERSHIELDS GENERAL** - Required for clutches, chains, belts, etc. No holes. 6 mm diam. Grade 8.8 minimum. End parallel to lowest part of the sprocket/pulley in front and rear.
- 342 △ **SCATTERSHIELD MATERIALS** - For chains, 2 mm min. thick solid STEEL, 3 x chain width. For belts, 3 mm min. thick Al 6061-T6, 3 x belt width. Finger guards: cover all drivetrain parts that spin while vehicle is stationary. No holes > 12 mm dia.
- 343 ○ **LV BATTERY** - Attached securely to frame or chassis.

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- 344 ○ **HIGH PRESS HYDRAULICS** - Pumps and lines must have 1 mm steel or aluminium shields protecting driver and workers.
- 345 △ **COOLANT** - 100% water. NO ADDITIVES WHATSOEVER or oil for electric motors.
- 346 ○ **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. 3 mm min. dia. vent away from driver down to the bottom level of frame. Trans or diff., cooling systems using plain water, unless sealed, requires 100 ml catch bottle.
- 347 △ **FLUID LEAKS** - Oil, grease, coolant, Brake fluid -> none permitted
- 348 ○ **BELLYPANS** - Enclosed chassis structures and structures between the chassis and the ground must have two venting holes of at least 25mm diameter in the lowest part of the structure to prevent accumulation of liquids. Additional holes are required when multiple local lowest parts exist in the structure.
- 349 ○ **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 T2.3.1 must be built to protect the accumulator.
- 350 ○ **ACCUMULATOR CONTAINER ATTACHMENT** - Accumulator container must be attached to the primary structure with fasteners min. Grade 8.8. Fasteners have to follow T9. Mounting as designed in SES. Brackets 1.6 mm steel or 4 mm aluminium with gussets to withstand bending loads. Monocoque needs 2 mm steel backing plates or equivalent, mentioned in SES.
- 351 ○ **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
- 352 ○ **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 T2.3. 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
- 353 ○ **MOTOR CASING** - 3 mm Aluminium 6061-T6 or 2 mm steel. If rotating around the stator or the motor case is perforated a scatter shield around the motor should be installed of 1 mm 6061-T6 aluminium or steel.

TIS STATUS UPDATE

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

▶ Write down current time and result to manual TIS sheet

NON-COMPLIANCE / COMMENTS

APPROVAL

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

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PART VI: TILT TEST

TIS STATUS UPDATE

▶ Set online TIS status to *Present*

TILT TEST

- 354 **FLUID LEAKAGE** - No fuel spill permitted when vehicle is tilted to 60 degrees in the direction most likely to create spillage. Tanks must be filled to scribe line.
- 355 **VEHICLE STABILITY** - All wheels in contact with tilt table when tilted to 60 degrees to the horizontal.

TIS STATUS UPDATE

▶ Set online TIS status to *Passed or Failed*

▶ Write down current time and result to manual TIS sheet

NON-COMPLIANCE / COMMENTS

APPROVAL

Inspector Names

Date, Time

Signatures when passed

1. _____ / _____

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PART VII: RAIN TEST

TIS STATUS UPDATE

▶ Set online TIS status to *Present*

▶ Write down current time to manual TIS sheet
Date, Time: _____

RAIN TEST

- ▶ The vehicle is lifted off the ground. Tractive system has to be active (TSAL ON)
- 356 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 spary.
- 357 The Insulation Monitoring Device does not react and not shut down the tractive system.
 - ▶ Connect R_{Test} between any TSMP and LVS GND.
- 358 Shutdown circuits opens within 30 s.

TIS STATUS UPDATE

▶ Set online TIS status to *Passed or Failed*

▶ Write down current time and result to manual TIS sheet

NON-COMPLIANCE / COMMENTS

APPROVAL

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

PART VIII: BRAKE TEST

TIS STATUS UPDATE

▶ Set online TIS status to *Present*

BRAKE TEST

- 359 **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).
- 360 **BRAKE LIGHT** - has to be clearly visible even in bright sunlight.

TIS STATUS UPDATE

▶ Set online TIS status to *Passed or Failed*

▶ Write down current time and result to manual TIS sheet

NON-COMPLIANCE / COMMENTS

APPROVAL

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