ELECTRIC INSPECTION SHEET

UNIVERSITY: Metropolis TU  
CAR NUMBER: E84

| SES PASSED: | ☑ |
| IADR PASSED: | ☑ |
| NUMBER OF DRIVERS: | |
| TALLEST DRIVER: | Height: |

| ESF PASSED: | ☐ |
| TS VOLTAGE: | 380 V |
| GLVS VOLTAGE: | 24.1 V |
| BODY PROTECTION R: | 10kR |

**IMPORTANT** - Present the vehicle for inspection in the following order:
1. Accumulator Check
2. Pre-Scrutineering
3. Electrical Inspection*
4. Mechanical Inspection*
5. Tilt Table Test*
6. Rain Test*
7. Brake Test*
* the car is marked with a sticker if this part has been passed successfully.

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

**PART I: ACCUMULATOR CHECK**

The time limit for this part of the inspection is 45 minutes. Continuation of the inspection is possible after requeueing. During technical inspection all work carried out on the accumulator must be approved by a scrutineer.

### REQUIRED RESOURCES
- All accumulator containers to be used during the event.
- Accumulator Container Hand Cart.
- Tools needed for (dis-)assembly of Accumulator Container.
- Print-out of rule questions, if necessary.
- Charger.
- An ESO must attend.

### BASIC SET OF HV-PROOF TOOLS

1. Insulated cable shear.
2. Insulated screw driver.
3. Insulated spanners (n/a if no screwed connections in TS).
4. Multimeter.
5. Protected probe tips for multimeter.

### SAFETY EQUIPMENT

6. Face shield.
7. Safety glasses (minimum four).
8. HV insulating gloves (minimum two pairs on push bar).
9. HV insulating blankets (two) (min 1 m²).

### HOUSING

10. Check if all parts and the cover/lid of the housing are rigidly fastened.
11. Open container housing, remove maintenance plugs.
12. Check if no voltage is present.

### ASSEMBLY

11. All components and parts of the accumulator container need to be properly fixed.
12. HV potentials are insulated against inner wall of accumulator container if container made from conductive material.
13. Cell tabs must not be mechanically loaded.
14. No soldering in high current path.
15. Every container contains at least one appropriately sized and rated fuse.
16. If the fuse uses a bolt to disconnect there must be sufficient space for the bolt to move into.
17. Every container contains at least two appropriately sized and rated isolation relays.
18. Isolation relays and fuses are separated from cells by barrier according UL94-V0, FAR25 or equivalent.
20. Maintenance plugs removable without tools.
21. Maintenance plugs have positive locking mechanism.
22. Maintenance plugs are located at both poles of each stack.
23. Maintenance plugs must not be able to unintentionally create circuits or short circuits.
24. Stacks separated by Maintenance plugs ≤ 120 VDC.
25. Stacks separated by Maintenance plugs ≤ 6 MJ.
26. Stacks are insulated and separated by a fire resistant barrier according to UL94-V0, FAR25 or equivalent.
27. Internal vertical walls have to be rigidly fastened to the container.
28. Holes in container only for wiring harness, ventilation, cooling or fasteners.
29. If fully closed, equalizing valve implemented.
30. Spare accumulators of same size, weight and type.

### WIRING

31. All HV wires have to be properly fused.
32. No other wires than HV wires are orange.
33. Securely anchored to withstand at least 200N.
34. Located out of the way of possible snagging or damage.
35. TS and GLVS wires separated (not valid for Interlock).
36. Marked with gauge, temperature rating and voltage rating.
37. Suitable wire temperature rating for each wire position.
38. Positive locking mechanism.
39. Insulation is not only insulating tape or rubber-like paint.
40. Every wire used in the Accumulator container (HV AND LV) is rated for the maximum tractive system voltage.

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## TEMPERATURE LOGGING

41 ☐ Sufficient space available for mandated temperature measuring device.
   ► Install iButton for temperature logging.

42 ☐ iButton installed at negative cell tab.

43 ☐ Cooling at iButton position not above-average.

44 ☐ Indicator light or voltmeter installed.
   ► Connect power supply >60 VDC to accumulator HV connector.

45 ☐ Indicator light on or voltmeter showing present TS voltage.

46 ☐ Reasonably bright.

## ACCUMULATOR MANAGEMENT SYSTEM

47 ☐ A minimum of 30% of cells are monitored with temperature sensors.

48 ☐ Every temperature sensor placed on negative terminal of monitored cell or in <10mm distance on busbar.

## INDICATOR LIGHT OR VOLTMETER

49 ☐ Completely closed (no open HV connections).

50 ☐ Interlock integrated.

51 ☐ Emergency shutdown button integrated ≥25 mm diameter.

## CHARGER ASSEMBLY

49 ☐ Completely closed (no open HV connections).

50 ☐ Interlock integrated.

51 ☐ Emergency shutdown button integrated ≥25 mm diameter.

44 ☐ Indicator light or voltmeter installed.
   ► Connect power supply >60 VDC to accumulator HV connector.

45 ☐ Indicator light on or voltmeter showing present TS voltage.

46 ☐ Reasonably bright.

52 ☐ HV wiring orange.

53 ☐ HV wiring temperature rating suitable.

54 ☐ Conductive parts of charging equipment and accumulator are connected to protective earth (PE) while charging.

## CHARGER SHUTDOWN CIRCUIT

55 ☐ IMD is integrated into the charging system.
   ► Connect charger to battery/batteries, start charging process.

56 ☐ Battery indicator shows that HV is present.
   ► Press shutdown button.

57 ☐ AIRs open.

58 ☐ Battery indicator shows voltage <60 V.
   ► Start charging, unplug HV battery connector.

59 ☐ AIRs open.

60 ☐ Charger disabled, no voltage at charger connector.

## SEALING OF COMPONENTS

61 ☐ Accumulator container(s) including spares

62 ☐ Charger

63 ☐ Additional Part:

64 ☐ Additional Part:

## NON-COMPLIANCE / COMMENTS

## APPROVAL

<table>
<thead>
<tr>
<th>Scrutineer Names</th>
<th>Date, Time</th>
<th>Signatures when passed</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

1.

2.

- Additional Part:
PART II: PRE-SCRUTINEERING

☐ TIRES
65 ☐ DRY TIRES - Make:
66 ☐ DRY TIRES - Size:
67 ☐ DRY TIRES - Compound:
68 ☐ RAIN TIRES - Make:
69 ☐ RAIN TIRES - Size:
70 ☐ RAIN TIRES - Compound:
71 ☐ RAIN TIRES - 2.4 mm (3/32 in.) min. tread depth molded by tire manufacturer

☐ DRIVER GEAR & SAFETY
72 ☐ FACE SHIELDS - made of impact resistant material.
73 ☐ UNDERWEAR - certified to SFI 3.3 or FIA 8856-2000
74 ☐ SOCKS - Nomex or equivalent, fire resistant socks. No cotton. No polyester. No bare skin.
75 ☐ GLOVES - Fire resistant material. No holes. Leather allowed only over fire resistant material.
77 ☐ DRIVER SUITS - Single piece FIA 1986 or 2000, or SFI 3-2A/S, FIA 8856-2000 minimum rating, and Labeled AS SUCH
78 ☐ HAIR COVER - Fire resistant (Nomex or equiv.) balaclava of full helmet skirt REQUIRED FOR ALL DRIVERS.
79 ☐ SHOES - SFI 3.3 or FIA 8856-2000
80 ☐ FIRE EXTINGUISHERS - Two (2) hand-held, 0.9 kg (2 lb.) minimum, dry chemical (10BC, 1A10BC, 34B, 5A 34B, 20BE or 1A 10BE), Aqueous Film Forming Foam (AFFF) fire extinguishers are prohibited. 1 WITH CAR securely installed on push-bar, 1 in paddock. (Must see BOTH at Tech.). On-board fire system possible.

APPROVAL
Scrutineer Names Date, Time Signatures when passed
1. ____________________________ ____________________________ ____________________________

PART III: 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 car must be approved by a scrutineer.

☐ REQUIRED RESOURCES
• Printed datasheets for used wiring, insulation materials, and high voltage components.
• Samples of all wire types used inside the battery container.
• Laptop to display data of the AMS.

☐ CAR MOVEMENT
Try to move the car with deactivated TS.
81 ☐ Car movement possible.

☐ SELF DEVELOPED PCBS
Ask for spare PCB of self developed PCBs. Printed photographs are also sufficient if spares are not available.
82 ☐ Sufficient spacing regarding system voltage and implementation.
83 ☐ Sufficient insulation rating of coating if used, datasheet available.
84 ☐ Sufficient temperature rating of coating if used, datasheet available.

☐ MASTER SWITCHES
85 ☐ Two master switches installed.
86 ☐ Master switches on the right side of the vehicle.
87 ☐ GLVMS located approximately at shoulder height of driver.
88 ☐ TSMS located directly next to GLVMS.
89 ☐ Rotary type.
90 ☐ Removable handle.
91 ☐ “ON” position in horizontal.
92 ☐ Rotary axis of both switches nearly horizontal and across car.
93 ☐ Not mounted on removable bodywork.
94 ☐ TSMS with locking mechanism for ‘OFF’ position.
95 ☐ “ON” positions marked.
96 ☐ “OFF” positions marked.
97 ☐ TSMS marked with “HV”.
98 ☐ GLVMS marked with “LV”.

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### MEASURING POINTS

<table>
<thead>
<tr>
<th>Point</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>99</td>
<td>Two TS voltage measuring points and a GLVS ground measuring point installed.</td>
</tr>
<tr>
<td>100</td>
<td>Next to GLVMS.</td>
</tr>
<tr>
<td>101</td>
<td>Approximately shoulder height of the driver.</td>
</tr>
<tr>
<td>102</td>
<td>4 mm shrouded banana jacks.</td>
</tr>
<tr>
<td>103</td>
<td>Voltage rating given.</td>
</tr>
<tr>
<td>104</td>
<td>Non conductive cover.</td>
</tr>
<tr>
<td>105</td>
<td>Cover removable without tools.</td>
</tr>
<tr>
<td>106</td>
<td>Correctly marked (HV+, HV-, GND).</td>
</tr>
</tbody>
</table>

### TS SHUTDOWN DEVICES

<table>
<thead>
<tr>
<th>Point</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>107</td>
<td>Two shutdown buttons installed next to the main hoop.</td>
</tr>
<tr>
<td>108</td>
<td>Right and left on the car.</td>
</tr>
<tr>
<td>109</td>
<td>Push-Pull or Push-Rotate-Pull functionality.</td>
</tr>
<tr>
<td>110</td>
<td>Approx. height of drivers head.</td>
</tr>
<tr>
<td>111</td>
<td>Marked with red sparked sticker.</td>
</tr>
<tr>
<td>112</td>
<td>Diameter ≥ 40 mm.</td>
</tr>
<tr>
<td>113</td>
<td>One cockpit shutdown button installed.</td>
</tr>
<tr>
<td>114</td>
<td>Push-Pull or Push-Rotate-Pull functionality.</td>
</tr>
<tr>
<td>115</td>
<td>Easy actuation by the driver.</td>
</tr>
<tr>
<td>116</td>
<td>Marked with red sparked sticker.</td>
</tr>
<tr>
<td>117</td>
<td>Diameter ≥ 24 mm.</td>
</tr>
<tr>
<td>118</td>
<td>Inertia switch installed.</td>
</tr>
<tr>
<td>119</td>
<td>Mounted to the chassis.</td>
</tr>
<tr>
<td>120</td>
<td>Can be demounted for functionality test.</td>
</tr>
<tr>
<td>121</td>
<td>HV accumulator container(s).</td>
</tr>
<tr>
<td>122</td>
<td>Inverters.</td>
</tr>
<tr>
<td>123</td>
<td>Power distribution boxes.</td>
</tr>
<tr>
<td>124</td>
<td>EM box.</td>
</tr>
</tbody>
</table>

### GLVS VOLTAGE

<table>
<thead>
<tr>
<th>Description</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Voltage given.</td>
<td></td>
</tr>
<tr>
<td>Non conductive cover.</td>
<td></td>
</tr>
<tr>
<td>Cover removable without tools.</td>
<td></td>
</tr>
<tr>
<td>Correctly marked (HV+, HV-, GND).</td>
<td></td>
</tr>
</tbody>
</table>

#### TS VOLTAGE

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

### DIS-CHARGE CIRCUIT AND BODY PROTECTION RESISTORS

- Identify correct body protection resistor value:
  - $R_{BPR} = 10k\Omega$.
- Switch off GLVS. Measure resistance between HV+ and HV-:
  - Resistance is $2 \times BPR + \text{discharge resistor.}$

### HV WIRING

- All HV wiring has to be in the envelope and behind the impact structures.
- All HV wires have to be properly fused.
- Visible HV wiring channels are orange.
- No other wires than HV wires are orange.
- TS wiring outside electrical enclosures in separate non-conductive enclosure or orange shielded cable.
- Securely anchored to withstand at least 200 N.
- Located out of the way of possible snagging or damage.

#### HV WARNING STICKERS

- Check for warning stickers on HV containing enclosures.
- Battery/batteries.
- Inverter(s).

#### TRACTIVE SYSTEM PROTECTIONS

- Check opening in HV enclosures, try to reach HV potentials with insulated test probe.
- Not possible to reach any HV potentials.

#### HIGH VOLTAGE DISCONNECT

- Clearly marked with "HVD".
- Distance to ground greater than 350 mm.
- Easily visible while standing behind the car.
- No remote actuation (e.g. through wires).
- Integrated interlock.
- Stand next to the car, remove HVD.
- Removed within 10 s.
- TS protection still given (insulated test probe).

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1. $U_{\text{max}} \leq 200 \text{ V}_{\text{DC}}$
2. $200 \text{ V}_{\text{DC}} < U_{\text{max}} \leq 400 \text{ V}_{\text{DC}}$
3. $400 \text{ V}_{\text{DC}} < U_{\text{max}} \leq 600 \text{ V}_{\text{DC}}$
| ☐ ENERGY METER | 158 ☐ Energy meter is enclosed in a housing. | 159 ☐ All energy from accumulator flows through the energy meter. |
| ☐ TRACTIVE SYSTEM ACTIVE LIGHT | 160 ☐ Mounted below highest point of the main roll hoop. | 161 ☐ Visible by a person standing 3 m away from TSAL (1.6 m eye height). |
| ☐ FIREWALLS | • Separates driver compartment from any HV component (including HV wiring) . . . | 166 ☐ First layer, facing TS must be made of Aluminum with a thickness between 0.5 and 0.7 mm. |
| | . . . behind the driver's back. | 167 ☐ Second layer, facing driver must be made of electrically insulated material. |
| | . . . at the sides of the driver. | 168 ☐ Material meets UL94-V0, FAR25 or equivalent. |
| | . . . at the front of the car. | 169 ☐ Not made from CFRP. |
| ☐ TORQUE ENCODER | 170 ☐ Returns to original position if not actuated. | (positive stop of pedal). |
| | 171 ☐ At least two sensors are installed. | 174 ☐ Minimum two springs installed to return pedal. |
| | 172 ☐ Sensors do not share supply or signal lines. | 175 ☐ Each spring still returns pedal with the second one disconnected (springs in the torque encoders not counted). |
| | 173 ☐ Sensors are protected from being mechanically overstressed | |
| ☐ BRAKE SYSTEM | 176 ☐ Brake pedal position sensor or brakepressure sensor installed. | 177 ☐ Maximum of 90% of pedal travel without activation of hydraulic brake system. |
| | ➤ Push brake pedal. | |
| ☐ BRAKELIGHT | 178 ☐ Only one brakelight. | 183 ☐ Round, triangle, or rectangular on black background. |
| | 179 ☐ Red color. | 184 ☐ 15 cm² minimum illuminated area OR LED strips with a total length greater than 150 mm with elements closer than 20 mm apart. |
| | 180 ☐ Clearly visible from behind the car. | 185 ☐ Sufficient brightness even in bright sunlight. |
| | 181 ☐ Located on vehicle centerline. | |
| | 182 ☐ Height between wheel centerline and drivers shoulder. | |
| ☐ INSULATION MEASUREMENT TEST | | |
| ➤ Choose test voltage \(^2\). | ➤ Connect insulation tester to HVMP+ and GLVMP. | ➤ Connect insulation tester to HVMP- and GLVMP. |
| ➤ Connect insulation tester to HVMP+ and GLVMP. | ➤ Measure resistance: \(R_{iso} = \) kOhm | ➤ Measure resistance: \(R_{iso} = \) kOhm |
| ➤ Measure resistance: \(R_{iso} = \) kOhm | 187 ☐ Resistance is higher than 500 Ohm/V \(\cdot U_{max}\). | 188 ☐ Resistances are nearly equal. If not, team has explanation. |
| 186 ☐ Resistance is higher than 500 Ohm/V \(\cdot U_{max}\). | | |

\(^2\) \(U_{max} \leq 250 \text{ V}_{\text{DC}}\) \(U_{Test} = 250 \text{ V}_{\text{DC}}\) \(U_{max} > 250 \text{ V}_{\text{DC}}\) \(U_{Test} = 500 \text{ V}_{\text{DC}}\)
### GROUNDING CHECKS

<table>
<thead>
<tr>
<th>Part (if applicable)</th>
<th>Conductive (max. 300 mΩ @ 1 A)</th>
<th>May become conductive (max. 5 Ω @ 0 A)</th>
<th>Value [mΩ]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frame / Monocoque</td>
<td>☐</td>
<td>☐</td>
<td></td>
</tr>
<tr>
<td>Firewall(s)</td>
<td>☐</td>
<td>☐</td>
<td>X</td>
</tr>
<tr>
<td>Accumulator container</td>
<td>☐</td>
<td>☐</td>
<td></td>
</tr>
<tr>
<td>Seat mounting points</td>
<td>☐</td>
<td>☐</td>
<td>X</td>
</tr>
<tr>
<td>Driver harness mounting points</td>
<td>☐</td>
<td>☐</td>
<td>X</td>
</tr>
<tr>
<td>Conductive housings with TS parts inside</td>
<td>☐</td>
<td>☐</td>
<td></td>
</tr>
<tr>
<td>Steering wheel surface</td>
<td>☐</td>
<td>☐</td>
<td></td>
</tr>
<tr>
<td>Pedal box</td>
<td>☐</td>
<td>☐</td>
<td></td>
</tr>
<tr>
<td>Main Roll Hoop</td>
<td>☐</td>
<td>☐</td>
<td></td>
</tr>
<tr>
<td>Suspension Front left</td>
<td>☐</td>
<td>☐</td>
<td></td>
</tr>
<tr>
<td>Suspension Front right</td>
<td>☐</td>
<td>☐</td>
<td></td>
</tr>
<tr>
<td>Suspension Rear left</td>
<td>☐</td>
<td>☐</td>
<td></td>
</tr>
<tr>
<td>Suspension Rear right</td>
<td>☐</td>
<td>☐</td>
<td></td>
</tr>
<tr>
<td>Driver Controls / Switches / Etc.</td>
<td>☐</td>
<td>☐</td>
<td></td>
</tr>
<tr>
<td>External Heat Sink</td>
<td>☐</td>
<td>☐</td>
<td></td>
</tr>
<tr>
<td>Carbon fiber parts typically touched when trying to move the car with TS deactivated</td>
<td>☐</td>
<td>☐</td>
<td></td>
</tr>
<tr>
<td>Accumulator Management System Data Connector</td>
<td>☐</td>
<td>☐</td>
<td></td>
</tr>
<tr>
<td>Radiator</td>
<td>☐</td>
<td>☐</td>
<td></td>
</tr>
<tr>
<td>Additional Part:</td>
<td>☐</td>
<td>☐</td>
<td></td>
</tr>
</tbody>
</table>

### !! TEST AT HIGH VOLTAGE !!

#### TRACTIVE SYSTEM POWER-UP

- All driven wheels are off the ground, driven wheels removed.
- Switch on TSMS with GLVMS deactivated.
- Voltage at HV measurement points less or equal 60 VDC.
- Switch on GLVMS with TSMS deactivated.
- Voltage at HV measurement points less or equal 60 VDC.
- Activate TS, measure TS voltage during TS power-up.
- System is precharged before second AIR closes.
- Switch off GLVMS.
- TS shuts down.

#### TRACTIVE SYSTEM SHUTDOWN

- Connect multimeter between HV+ and HV-.
- For every of the following switches, deactivation leads to TS shutdown, voltage decreases below 60 VDC within 5 s.
- TSMS.
- Shutdown button left.
- Shutdown button right.
- Cockpit shutdown button.
- Inertia switch.
- Break-over-travel-switch.
- Interlocks.

#### TRACTIVE SYSTEM INDICATORS

- Activate TS.
- Deactivate TS, deactivate GLVS, connect power supply >60 VDC to TS.
- Activate GLVS.
- TSAL is activated.
- Disconnect power supply, remove HVD, override HVD interlock (!! cover HV potentials !!), activate TS.
- TSAL is activated.

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3 $25\ V_{rms}$ equal $42.5\ V_{p-p}$ when the signal is sinusoidal.

4 Do not use measuring points. The team needs to provide a method of connection which uses receptacles according to EV4.4.4.
INSULATION MONITORING DEVICE

- $R_{\text{test}} = (\text{max. TS voltage} \cdot 250 \text{ Ohm/V}) - BPR \cdot R_{\text{test}} = k\text{Ohm}$

- IMD indicator light...

- is inside the cockpit.
- is red.
- is marked with IMD.
- is visible in bright sunlight.

- is visible for the driver.
  - Activate TS, connect $R_{\text{test}}$ between HV+ and GLVS GND.

- Shutdown circuits opens within 30 s.

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

- Reactivation of TS is not possible.
  - Push the reset button which is not accessible to the driver, if any.

- Prepare the reset button which is not accessible to the driver, if any.

ACCUMULATOR MANAGEMENT SYSTEM

- AMS indicator light...

- is inside the cockpit.
- is red.
- is marked with AMS or BMS.
- is visible in bright sunlight.

- is visible for the driver.
  - Ask the team to connect their laptop to the AMS.

- Cell voltages can be displayed.
- Cell temperatures can be displayed.

READY TO DRIVE ACTIVATION SEQUENCE

- Activate TS, press torque pedal.

- No turning of motors.
  - Let the team set the car to ready to drive mode.

- Pressing brake pedal during the activation sequence is necessary.
  - Disconnect the brake sensor.

- Get motors turning, disconnect ≥ 50 % of torque encoders while motors turn.

- Motors stop turning.
  - Release brake, while torque pedal still activated.

- Motors do not turn.
  - Release torque pedal slowly.

- Motors turn again when torque pedal position is <5 %.

- Activation of tractive system is not possible.
  - Ready to drive sound duration is 1 s to 3 s.

- Ready to drive sound is min 80 dBA (2 m around the car).
  - Ready to drive sound is easy recognizable.

- Ready to drive sound is no animal sound or song part.

IMPLAUSIBILITY CHECKS

- Press car to ready to drive state. Press torque pedal >25 %.
  - Push brake pedal

- Motors stop turning.
  - Release brake, while torque pedal still activated.

- Motors do not turn.
  - Release torque pedal slowly.

- Motors turn again when torque pedal position is <5 %.

- Get motors turning, disconnect ≥ 50 % of torque encoders while motors turn.

- Motors stop turning.
  - Team simulates 5 kW power, press brake representing hard braking (>0.5 s).

- TS shuts down.
  - Reactivation of TS is not possible.

REGENERATIVE BRAKING

- Ask the team to mount one driven wheel.
  - Activating hydraulic brake system.

- Set car to ready to drive state, press brake slightly without activating hydraulic brake system.

- Turning a driven wheel by hand is possible.

SEALING OF COMPONENTS

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

- Motor Controller housing
- Energy Meter housing
- IMD housing

- TSAL circuitry housing

- Additional Part:

- Additional Part:

ENERGY METER

- Check energy meter connectivity. This may be done after electrical scrutineering.
## APPROVAL

<table>
<thead>
<tr>
<th>Scrutineer Names</th>
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<tbody>
<tr>
<td>1.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
## PART IV: MECHANICAL INSPECTION

The time limit for this part of the inspection is 60 minutes. Continuation of the inspection is possible after requeuing.

During technical inspection all work carried out on the car must be approved by a scrutineer.

### CAR WITH DRIVER READY TO RACE

<table>
<thead>
<tr>
<th>Section</th>
<th>Requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>PUSH BAR</strong></td>
<td>With car, securely attached to car, detachable, push &amp; pull function for 2 people standing erect. The push bar must be located behind the rear axle when the car is moved. FIRE EXTINGUISHERS, 2 pair of HV gloves in protecting case and Multimeter must be installed.</td>
</tr>
<tr>
<td><strong>CAMERAS</strong></td>
<td>If &gt;0.25 kg, must be secured by two points, see T14.15. No cameras mounted to helmet.</td>
</tr>
<tr>
<td><strong>VISIBILITY</strong></td>
<td>Minimum of 100 deg. field either side. Head rotation allowed or mirrors. If mirrors, must be firmly installed and adjusted</td>
</tr>
<tr>
<td><strong>VEHICLE CONTROLS</strong></td>
<td>All controls, including shifter, must be inside cockpit. No arms or elbows outside side impact system to actuate.</td>
</tr>
<tr>
<td><strong>MAIN HOOP &amp; FRONT HOOP HEIGHTS</strong></td>
<td>Helmet of tallest driver to be 50 mm below line between top of front and main hoop AND between top of main hoop to rear attachment point of main hoop bracing.</td>
</tr>
<tr>
<td><strong>ROLL BAR PADDING</strong></td>
<td>Roll bar or bracing that could be hit by driver’s helmet must be covered with 12 mm thick, SFI or FIA (hard) padding. Pipe insulation and foam NOT acceptable.</td>
</tr>
<tr>
<td><strong>OTHER SIDE TUBES</strong></td>
<td>Design prevents driver’s neck hitting bracing or other side tubes</td>
</tr>
<tr>
<td><strong>ARM RESTRAINTS</strong></td>
<td>Must be installed so the driver can release them and exit unassisted regardless of vehicle’s position.</td>
</tr>
<tr>
<td><strong>HEAD RESTRAINT</strong></td>
<td>Near vertical. Must take 890 N load. 38 mm thick, energy absorbing padding. Max. 25.4 mm from helmet. Helmet contact point 50 mm min. from any edge. May be changed for different drivers. Minimum 150x150mm AND height adjustment of 175 mm; OR minimum 150 x 280mm</td>
</tr>
<tr>
<td><strong>GROUND CLEARANCE</strong></td>
<td>Sufficient to prevent any portion of the car from touching the ground during track events 30 mm min.</td>
</tr>
<tr>
<td><strong>EGRESS</strong></td>
<td>5 seconds max. to actuate cockpit master switch and exit to side of vehicle, from fully seated position with all safety equipment; wings must remain fixed in position. ALL DRIVERS.</td>
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### CAR WITHOUT DRIVER

<table>
<thead>
<tr>
<th>Section</th>
<th>Requirement</th>
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<tbody>
<tr>
<td><strong>BODYWORK EDGES</strong></td>
<td>edges that could contact a pedestrian must have a minimum radius of 1.0 mm (safety requirement)</td>
</tr>
<tr>
<td><strong>BODY &amp; STYLING</strong></td>
<td>Open wheeled, open cockpit, formula style body. Vertical keepout zones 75mm in front and behind tires (no aerodynamic exceptions), tires unobstructed from sides.</td>
</tr>
<tr>
<td><strong>BODYWORK</strong></td>
<td>Min. 38 mm radius on nose. No large openings in bodywork into driver compartment in front of or along-side driver, (except cockpit opening).</td>
</tr>
<tr>
<td><strong>SEAT</strong></td>
<td>Insulated against heat conduction, convection and radiation. Lowest point no lower than bottom of side rails OR must have longitudinal, 25.4 x 1.65mm steel tube underneath.</td>
</tr>
<tr>
<td><strong>DRIVER RESTRAINT HARNESS</strong></td>
<td>SFI 16.1, SFI 16.5 or FIA spec 5, 6 or 7 point and be labeled. 50 mm wide shoulder belts OK with HANS. 50 mm lap belts OK for FIA &amp; SFI 16.5, not OK for SFI 16.1. All lap belts must have Quick Adjusters. Reclined drivers must have a 6 or 7 point, and Quick Adjuster sub-belts or 2 sets of sub belts. Must securely attached to prim. structure. Min. 25.4x2.4 or equal.)</td>
</tr>
<tr>
<td><strong>LAP BELT MOUNTING</strong></td>
<td>Must pass over pelvic area between 45 - 65 deg. to horizontal for upright driver, 60-80 deg. for reclined. Pivoting mounting with eye bolts or shoulder bolts attached securely to Primary Structure. Min. tab thickness 1.6 mm.</td>
</tr>
<tr>
<td><strong>SHOULDER HARNESS MOUNTING</strong></td>
<td>Mounting points 178 - 229 mm apart. 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.</td>
</tr>
<tr>
<td><strong>SCHOOL NAME &amp; OTHER DECALS</strong></td>
<td>School Name, or recognized initials - 5.1 cm tall min. on both sides in Roman letters. Must be clearly visible.</td>
</tr>
<tr>
<td><strong>CAR NUMBERS</strong></td>
<td>On front &amp; both sides of car, minimum 15.24 cm tall, 18 mm stroke &amp; spacing, Black on White, White on Black only, specified background shapes. Must be clearly visible.</td>
</tr>
<tr>
<td><strong>TECH STICKER SPACE</strong></td>
<td>7.5cm x 15 cm on centerline of front of car in front of the cockpit opening</td>
</tr>
<tr>
<td><strong>COCKPIT OPENING</strong></td>
<td>Fig. 8 template passes down from above cockpit centre line of top SIS tube or to 350 mm above ground for monocoque. Steering wheel &amp; column, seat &amp; padding can be removed. No removing of firewall.</td>
</tr>
<tr>
<td><strong>SUSPENSION</strong></td>
<td>Fully operational with dampers front and rear; 50mm minimum wheel travel (25 mm jounce and 25 mm re-bound) with driver in vehicle.</td>
</tr>
<tr>
<td><strong>STEERING WHEEL</strong></td>
<td>Continuous perimeter, near round (no concave sections) with driver operable quick disconnect. 25cm max from front hoop.</td>
</tr>
<tr>
<td><strong>WINGS</strong></td>
<td>securely mounted, should not wiggle when gently touched, especially side-to-side. The deflection may not exceed 25 mm when a force of 200 N is applied Not extending further than the rear portion of the head restraint (in rearmost position).(permanent deflection &lt; 5 mm).</td>
</tr>
<tr>
<td><strong>WING EDGES</strong></td>
<td>Horizontal leading edges min 5 mm radius; vertical forward facing edges min 3 mm radius. Edges that could contact a pedestrian must have a minimum radius of 1.0 mm (safety requirement).</td>
</tr>
<tr>
<td><strong>AERODYNAMICS</strong></td>
<td>ALL aero devices, wings, u/trays, splitters, maximum 70 cm forward of front tires, maximum 250 mm rearward of rear tires. Front wings no wider than inside of rear tires. Rear wings no wider than INSIDE of rear tires. Undertrays no wider than line between front and rear tires. No power ground effects.</td>
</tr>
<tr>
<td><strong>AERO VERTICAL HEIGHT</strong></td>
<td>Rear wing max 1.2 m above ground (incl. end plates); Front wing max 250 mm above ground but higher end plates are OK if &lt; 25 mm thick. No bodywork or aero higher than 500 mm between axles (except center 800 mm of car ie: cockpit panels.).</td>
</tr>
</tbody>
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FORMULA STUDENT GERMANY

ELECTRIC INSPECTION SHEET

☐ REMOVE BODY PANELS

278  ○ 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 pedas.

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

280  ○ MONOCOQUE - Must see laminate test specimen. Steel backing plates (>2mm thick) used at attachment points.

281  ○ BOLTED JOINTS in primary structure - Distance hole center-line to the nearest free edge > 2 x hole diameter.

282  ○ MAIN HOOP - MUST BE STEEL. 25.4 x 2.4 mm or 25.0 x 2.5mm. Must be 1 piece & extend to lowest frame member. 380 mm apart (inside dim.) where attaches to the Major Structure. Above Major Structure, must be within 10 deg. of vertical. Smooth bends without wrinkles.

283  ○ MAIN HOOP BRACING - MUST BE STEEL. One straight brace on each side, 25.4mm x 1.65mm or 25.0 mm x 1.75mm or 25.4 mm x 1.60mm min., attached within 160 mm of top. Min. 30 deg. included angle with hoop. If main hoop is not vertical, bracing must not be on same side of vertical as main hoop. No bends. No rod-ends. Proper construction 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)

284  ○ FRONT HOOP - Must be closed section metal tube. Can be multi-piece. Must extend down to lowest frame member. No lower than top of steering wheel. Max. 20 deg. to vertical. 25.4 x 2.4 mm or 25.0 x 2.5 mm wall steel or equiv. Longitudinal distance to steering wheel max. 250 mm

285  ○ FRONT HOOP BRACING - Two 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 brace required if Front Hoop leans backwards more than 10 deg.

286  ○ DRIVER’S LEG PROTECTION - Covers inside cockpit over sharp and moving suspension and steering components.

287  ○ COCKPIT INTERNAL CROSS SECTION - Fig. 9 template passes forward from cockpit to 100 mm rear of pedals (in most forward position). Steering wheel and paddling removeable with no tools & driver-in can be removed.

288  ○ 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 equiv.) in side or front views when touching.

289  ○ SIDE IMPACT PROTECTION - Min. of two (2) tubes + diagonal must connect the main and front hoops in straight line. Upper tube must be between 300 mm and 350 mm above the ground with driver in car. 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. Monocoques require signed SES.

290  ○ FRONT IMPACT PROTECTION - Feet must be completely within Major Structure & rearward of the Front Bulkhead (25.4 x 1.65mm or 25.0 x 1.75 mm or 25.4 x 1.60 mm steel tube or equiv.) 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 car. Standard IAD: Requires diagonal brace if bulkhead >1° from IAD on any side.

291  ○ 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. four screws M8 Grade 8.8. CFRP plate is accepted if SES approved.

292  ○ FRONT BULKHEAD SUPPORT - Support back to front roll hoop; 3 tubes per side, all 25.4 mm x 1.65 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. (25.0 mm x 1.5 mm and 26.0 mm x 1.2 mm metric tubes OK)

293  ○ INSPECTION HOLES - 4.5 mm inspection holes req’d in non-critical areas of front & main hoops. Inspectors may ask for holes in other tube(s)

294  ○ STEERING - All steerable wheels must have positive stops to prevent linkage lock up or tires from contacting any part of the car. 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.

295  ○ JACKING POINT - an exposed tube at the rear perpendicular to the longitudinal axis 30 cm long by 2.5-2.9 cm O.D. Painted orange. Visible to person standing 1 metre behind car. Rear tires must come off the ground least 102 mm

296  ○ 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 behard anodized.

297  ○ FIREWALL - Fire resistant material; must separate driver, fuel, electrical, drive-train, etc. AIA must be securely fastened directly to Firewall approved SES. No fire resistant material for the firewall (i.e. carbonfibre, fibreglass etc) a fire resistant heat protection shield with a metal surface must be fitted. Protect against tractive system components incl. HV wiring. On tractive side 0.5-0.7 mm aluminium plate grounded, on the driver side a rigid insulating layer (no CFRP) 200mm wide x 100mm long x 4.5 mm thick. Inspectors may ask for holes in other tube(s)

DIMENSIONAL INFORMATION

- 405 mm max. between the main and front hoops.
- 180 mm max. between main and front fronts.
- 160 mm max. between main and front roll hoops.
- 300 mm max. between main and front roll bulkhead.

WHEELS

- 203 mm 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.

FIREWALL

- Fire resistant material; must separate driver, fuel, electrical, drive-train, etc.
- AIA must be securely fastened directly to Firewall approved SES.
- No fire resistant material for the firewall (i.e. carbonfibre, fibreglass etc) a fire resistant heat protection shield with a metal surface must be fitted. Protect against tractive system components incl. HV wiring. On tractive side 0.5-0.7 mm aluminium plate grounded, on the driver side a rigid insulating layer (no CFRP) 200mm wide x 100mm long x 4.5 mm thick.

Dimensions for approved SES.

- Front Bulkhead: 25.4 mm x 1.65 mm steel or equivalent
- Firewall: 25.4 mm x 1.60 mm steel or equivalent
- Cockpit: 25.4 mm x 1.65 mm steel or equivalent
- MEV: 25.4 mm x 1.60 mm steel or equivalent

Safety Features

- Anti-intrusion plates: 1.5 mm solid steel metal or 4.0 mm solid aluminium metal sheet (same size as outside dims.)
- Inspection holes: 4.5 mm inspection holes req’d in non-critical areas of front & main hoops.
- Steering: All steerable wheels must have positive stops to prevent linkage lock up or tires from contacting any part of the car.
- Jacking point: an exposed tube at the rear perpendicular to the longitudinal axis 30 cm long by 2.5-2.9 cm O.D. Painted orange. Visible to person standing 1 metre behind car.
- Tires: Must come off the ground least 102 mm.

材料

- Wheel nuts: Aluminum wheel nuts must be hard anodized.
- Firewall: Fire resistant material; must separate driver, fuel, electrical, drive-train, etc.
- AIA: Must be securely fastened directly to Firewall approved SES.
- Fire resistant material for the firewall (i.e. carbonfibre, fibreglass etc) a fire resistant heat protection shield with a metal surface must be fitted. Protect against tractive system components incl. HV wiring. On tractive side 0.5-0.7 mm aluminium plate grounded, on the driver side a rigid insulating layer (no CFRP) 200mm wide x 100mm long x 4.5 mm thick.
298  SUSPENSION PICK-UP POINTS - Inspected thoroughly for integrity.

299  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. 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 >2.

300  FLOOR CLOSEOUT PANEL - Required from foot area to firewall; solid, non-brittle material; multiple panels are OK if gaps less than 3.18 mm.

301  GAS CYLINDERS - Proprietary manufacture & labeled, Non-flammable gas, regulator on tank, securely mounted, axis not pointed at driver, to rear of Main Hoop 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.

302  SCATTERSHIELDS GENERAL - Required for clutches, chains, belts, etc. No holes. 6mm diam. M8.8 diam. or Grade 5 fasteners minimum. End parallel to lowest part of the sprocket/pulley in front and rear.

303  SCATTERSHIELD MATERIALS - For chains, 2.7mm min. thick solid STEEL, 3 x chain width. For belts, 3mm min. thick Al 6061-T6, 1.7 x belt width. Finger guards: cover all drivetrain parts that spin while car is at rest. No holes >12 mm dia.

304  BATTERY - Attached securely to frame or chassis; hot terminal insulated; wet-cells in marine box if inside cockpit; must be identifiable as Pb (not Li batteries,) otherwise show mfr datasheet and mfr protection circuit info. No circuits > 60 VDC. Li battery behind firewall.

305  HIGH PRESS HYDRAULICS - Pumps and lines must have 1 mm thick steel or aluminium shields to protect driver and workers.

306  COOLANT - 100% water. NO ADDITIVES WHATSOEVER or oil for electric motors.

307  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., unless sealed, requires 50 ml catch bottle.

308  FLUID LEAKS - Oil, grease, coolant, Brake fluid -> none permitted

309  ACCUMULATOR CONTAINER POSITION - All accumulator containers must lie within the major structure of the frame. 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 major structure (EV3.4.3, EV 3.4.4) an additional impact structure according to FSAE rules T3.4 must be build to protect the accumulator.

310  ACCUMULATOR CONTAINER ATTACHMENT - All accumulator containers must be attached to the major structure of the chassis with min. M8 grade 8.8 fasteners or stronger: Up to 20kg 4 fasteners 20kg-30kg 6 fasteners 30kg-40kg 8 fasteners over 40kg 10 fasteners 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.

311  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

312  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 T3.4. 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

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

NON-COMPLIANCE / COMMENTS

APPROVAL

Scrutineer Names Date, Time Signatures when passed

1. 

2. 

3. 

website version v2016-06-16
PART V: TILT TABLE TEST

☐ TILT TABLE TEST

314 ○ LIQUID SPILLAGE - No fuel spill permitted when car is tilted to 45 degrees in the direction most likely to create spillage. Tanks must be filled to scribe line.

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

NON-COMPLIANCE / COMMENTS

APPROVAL

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PART VI: RAIN TEST

☐ RAIN TEST

316 ○ RAIN PROOF - The car is lifted off the ground. Tractive system has to be active (TSAL ON). Water like rain will be sprayed at the car for 120 sec.

Passed if the Insulation Monitoring Device does not react and shut down the Tractive System (TSAL ON) during and 120sec after the rain test. No driver is allowed to sit in the car during the test. Total test duration 240sec.

NON-COMPLIANCE / COMMENTS

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PART VII: BRAKE TEST

☐ BRAKE TEST

317 ○ BRAKING PERFORMANCE - Must lock-up all four wheels on dry asphalt at any speed 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 OFF during breaking or shortly after the Car stopped (may take up to 5 sec. after shut down).

NON-COMPLIANCE / COMMENTS

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