



UNIVERSITY:		CAR NUMBER:
SES PASSED: <input type="checkbox"/> YES <input type="checkbox"/> NO	IADR PASSED: <input type="checkbox"/> YES <input type="checkbox"/> NO	BODY PROTECTION RESISTOR:
ESF PASSED: <input type="checkbox"/> YES <input type="checkbox"/> NO	FMEA PASSED: <input type="checkbox"/> YES <input type="checkbox"/> NO	NUMBER OF DRIVERS:
TS VOLTAGE:	GLVS VOLTAGE:	TALLEST DRIVER: HEIGHT:

IMPORTANT

PRESENT THE VEHICLE FOR INSPECTION IN THE FOLLOWING ORDER

1. ELECTRICAL INSPECTION
2. TECHNICAL INSPECTION
3. TILT TABLE INSPECTION
4. RAIN TEST
5. BRAKING PERFORMANCE INSPECTION

THIS FORM MUST STAY WITH THE CAR UNTIL THAT SPECIFIC PART OF INSPECTION HAS BEEN COMPLETED
NOTE - IF THERE IS A CONFLICT BETWEEN THIS FORM AND THE RULES, THE RULES PREVAIL

PART 1 ELECTRICAL INSPECTION

Scrutineer name:	Start time:	End time:
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Check that ESF and FMEA are **available printed on paper**:

Available? Check if yes	ESF <input type="checkbox"/>	FMEA <input type="checkbox"/>
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GENERAL

Identify Electrical System Officer	The ESO will be the central team contact during Electrical Inspection	Ask for the ESO	
Separation of TS and GLVS on self-developed PCBs	Check that on self-developed PCBs TS and GLVS are clearly separated. Check spare PCBs or photographs, if available. Otherwise check built-in PCBs, if they are easily accessible.	Visible check	
Tractive System measuring points	Two tractive system voltage measuring points and a GLVS ground point must be installed directly next to the master switches, right side of the vehicle, shoulder height of the driver.	Visible check	
Tractive System measuring points	The measuring points must be protected by a non-conductive housing that can be opened without tools.	Visible check	
Tractive System measuring points	The measuring points must be protected from being touched with the bare hand / fingers, once the housing is opened. 4mm shrouded banana jacks rated to an appropriate voltage level have to be used.	Visible check	
Tractive System measuring points	The TSMPs must be marked with HV+ and HV-	Visible check	
GND measuring point	Must be positioned next to the TSMPs and must be marked with GND.	Visible check	
GLVS Voltage	Measure GLVS Voltage between GLVS battery plus or DC/DC converter plus and chassis.	Must be equal to or less than 40VDC.	
TS Voltage	Measure voltage at TS measurement points.	Must be equal to or less than 40VDC.	
Dis-charge Circuit and Body Protection Resistors	The discharge circuit has to be wired in a way that it is always active whenever the shutdown circuit is open. If a discharge circuit is used a low resistance can be measured between HV+ and HV- whenever the tractive system is de-activated.	Measure resistance between HV+ and HV- with multi-meter. Result must be 2*BPR+ Dis-Charge Resistor (GLVS must be off)	
HV wiring	All visible HV wiring or their cable channels must be orange	Visible check	
	All tractive system wiring that runs outside of electrical enclosures must either be enclosed in separate orange non-conductive conduit or use an orange shielded cable.	Visible check	
	The conduit or shielded cable must be securely anchored at least at each end so that it can withstand a force of 200N without straining the cable and crimp and must be located out of the way of possible snagging or damage.	Visible/Manual check	
	Tractive system wiring must be shielded against damage by rotating and / or moving parts.	Visible check	
	No wires are allowed to run lower than the chassis	Visible check	
	TS wires and GLVS wires are clearly separated / do not run directly next to each other / bounded together by cable rods or in the same cable channel !!! ALLOWED ONLY FOR PILOT CONTACTS OR INTERLOCK SIGNALS !!!	Visible check	
	Wires must be marked with gauge, temperature rating and voltage rating, serial number or norm is also sufficient, if the team shows the datasheet in printed form	Visible check	
	Wire temperature rating must be suitable for position of the wire in the car (e.g. next to hot components)	Visible check	
HV wiring / connections	Using only insulating tape or rubber-like paint for insulation is prohibited .	Visible check	



HV warning stickers	Each housing/enclosure containing HV parts (except motor housings) must be labeled with a HV-sticker.	Visible check	
Tractive System protection	It must not be possible to touch any tractive system connections with a 100 mm long, 6 mm diameter insulated test probe when the tractive system enclosures are in place.	Check with probe	
Tractive System protection	Tractive System components and containers must be protected from moisture in the form of rain or puddles.	Visible check	
High Voltage Disconnect	The HV Disconnect has to be clearly marked with "HVD".	Visible check	
High Voltage Disconnect	It must be possible to disconnect the HVD without removing any bodywork.	Visible check	
High Voltage Disconnect	In ready to race condition it must be possible to disconnect the HVD within 10 seconds.	The team must demonstrate how to operate the HVD within 10s.	
High Voltage Disconnect	If opening the HVD is possible without the use of tools, a pilot contact/interlock line has to be implemented which breaks the current through the AIRs whenever the connector is removed.	Visible check	
Outboard Wheel Motors	Outboard wheel motors are allowed if an interlock is added such that the Shutdown Circuit is opened if the wheel assembly is damaged or knocked off the car.	Visible check	
Energy Meter Wiring	All energy from accumulator containers must flow through a single point, the EnergyMeter connection point for energy measuring.	Visible check	
Tractive System Active Light	Tractive system active light must be mounted under the highest point of the main roll hoop	Visible check	
Tractive System Active Light	The TSAL must be visible by a person standing up to 3m away from the TSAL. The person's minimum eye height is 1.6m.	Visible check	
Shutdown Buttons	One shutdown button, push-pull or push-rotate-pull on each side behind the drivers compartment (height approx. driver's head), one in the cockpit and easily accessible by the driver in any steering wheel position.	Visible check	
Shutdown Buttons	Minimum diameter of shutdown buttons on the side = 40mm. Minimum diameter of shutdown button in the cockpit = 24mm.	Visible check	
Shutdown Buttons	The shutdown buttons are not allowed to be easily removable, e.g. mounted onto a removable body work.	Visible check	
Cockpit Shutdown Button	The international electrical symbol consisting of a red spark on a white-edged blue triangle must be affixed in close proximity to this switch	Visible check	
Brake-over-travel-switch	Brake-over-travel-switch must be positioned behind the brake pedal	Visible check	
TS and GLVS Master switches	TS and GLVS master switch on the right side of the vehicle, approx. At the height of the drivers shoulders,. The ON position must be in horizontal position.	Visible check	
TS and GLVS Master switches	Clearly marked with HV and LV respectively and indicated "ON" position	Visible check	
TS and GLVS Master switches	Both switches must be a rotary type with a removable key / handle	Visible check	
TS Master switch	TSMS must be fitted with a "lockout/tagout" capability to prevent accidental activation of the tractive system.	Visible check	
Inertia switch	The device must be mechanically attached to the vehicle, however it must be possible to demount the device so that its functionality can be tested by shaking it.	Visible check	
Firewall(s)	A firewall must separate the driver compartment from all components of high voltage system (including HV wiring).	Visible check	
Firewall(s)	The firewall must be made from or coated with an electrically insulating material or there must be an electrically insulating barrier between all the tractive system components and the firewall.	Visible check	
Firewall(s)	The firewall must be fire resistant according to UL94-V0, FAR25 or equivalent.	Visible check	
Firewall(s)	The firewall must be puncture and scratch resistant.	Visible check	
Torque Encoder	Torque Encoder must return to original position, if not actuated.	Visible/Manual check	
Torque Encoder	At least two sensors must be fitted as torque encoder not sharing supply or signal lines.	Visible check	
Torque Encoder	The foot pedal must have a positive stop to prevent sensors from being mechanically overstressed	Visible/Manual check	
Torque Encoder	Two springs must be used to return the throttle pedal to the off position and each spring must work with the other disconnected. NOTE: The springs in the torque encoders/sensors are not acceptable return springs.	Visible/Manual check	
Brake System Encoder	A brake pedal position sensor or brake pressure switch must be fitted to check for plausibility.	Visible check	



Brake System Master Cylinder	The brake system master cylinder must be actuated directly or by a mechanical connection. The use of bowden cables or push-pull bowden cables is not allowed. The first 90% of the brake pedal travel may be used to regenerate brake energy without actuating the hydraulic brake system. The remaining brake pedal travel must directly actuate the hydraulic brake system, but brake energy regeneration may remain active.	Visible/Manual check	
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ACCUMULATOR CONTAINER

HV Accumulator(s) must be enclosed in container(s)	The poles of the accumulator stack(s) and/or cells must be insulated against the inner wall of the accumulator container, if the container is made of electrically conductive material.	visible check (photos taken during assembly are acceptable)	
Internals – Cell connection	Contacting / interconnecting the single cells by soldering in the high current path is prohibited . Soldering wires to cells for the voltage monitoring input of the BMS is allowed.	visible check (photos taken during assembly are acceptable)	
Internals – AIR / Fuse	Every accumulator container must contain at least one fuse and at least two accumulator insulation relays	visible check (photos taken during assembly are acceptable)	
Internals - Maintenance plugs	Maintenance plugs or similar measures have to be taken to allow separating the internal cell stacks in a way, that the separated cell stacks carry a voltage of less than 120VDC and a maximum energy of 12MJ . The separation has to affect both poles of the stack.	visible check (photos taken during assembly are acceptable)	
Internals – Cell stacks	Each stack has to be electrically insulated by the use of suitable material towards other stacks in the container and on top of the stack. Air is not considered to be a suitable insulation material in this case.	visible check (photos taken during assembly are acceptable)	
Internals – Cell stack barriers	The contained cell stacks must be separated by an insulating and fire resistant (according to UL94-V0, FAR25 or equivalent) barrier in a way, that no single cell stack contains more than 6MJ energy, if fully charged. These barriers are only needed, if cells are used, which are not LiFePO4.	visible check (photos taken during assembly are acceptable)	
Indicator Light / Voltmeter	Each container must have an indicator light or an analogue voltmeter showing that voltages greater than 40V DC are present outside of the container.	visible check	
Accumulator Container Connectors	If HV-connectors of the accumulator containers can be removed without the use of tools, a pilot contact/interlock line has to be implemented which breaks the current through the AIRs whenever the connector is removed.	visible check	
Openings in container	Breakthroughs or holes in the container are only allowed for the wiring-harness, ventilation, cooling or fasteners. These holes must be sealed against water.	visible check	
Equalizing Valve	If the container is completely sealed, it must have an equalizing valve	visible check	
Spare accumulator(s)	Must have the same size, weight and type Only applicable if spare accumulators are used.	weight, visible check, mark	

ACCUMULATOR MANAGEMENT SYSTEM

Cell Voltage Monitoring	AMS must monitor the cell voltage of each cell	Activate GLVS and show current measurement data of the AMS by connecting a laptop	
Cell Temperature Monitoring	AMS must monitor the temperature of at least 30% of the cells, if a cell chemistry is used, which is not LiFePO		
AMS Indicator Light	A red LED marked "AMS" or "BMS" must be installed in the cockpit that lights up, if the BMS shuts down the car.	Visible check (function must not be demonstrated)	

All electrically conductive parts of the vehicle (e.g. parts made of steel, (anodized) aluminum, any other metal parts, etc.) which are within 100mm of any tractive system or GLV component, and any driver harness mounting points, seat mounting points and driver controls must have a resistance below 300 mOhms (measured with a current of 1A) to GLV system ground.

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

Part (only if applicable)	conductive (max. 300 mOhm)	may become conductive / coated (max 5 Ohm)		
Frame / Monocoque	<input type="checkbox"/>	<input type="checkbox"/>	[mΩ]:	
Firewall(s)	<input type="checkbox"/>	<input type="checkbox"/>	[mΩ]:	
Accumulator container	<input type="checkbox"/>	<input type="checkbox"/>	[mΩ]:	
Seat mounting points	X		[mΩ]:	
Driver harness mounting points	X		[mΩ]:	
Conductive housings with TS parts inside	<input type="checkbox"/>	<input type="checkbox"/>	[mΩ]:	



Steering wheel surface	<input type="checkbox"/>	<input type="checkbox"/>	[mΩ]:	
Pedal box	<input type="checkbox"/>	<input type="checkbox"/>	[mΩ]:	
Main Roll Hoop	<input type="checkbox"/>	<input type="checkbox"/>	[mΩ]:	
Suspension Front left	<input type="checkbox"/>	<input type="checkbox"/>	[mΩ]:	
Suspension Front right	<input type="checkbox"/>	<input type="checkbox"/>	[mΩ]:	
Suspension Rear left	<input type="checkbox"/>	<input type="checkbox"/>	[mΩ]:	
Suspension Rear right	<input type="checkbox"/>	<input type="checkbox"/>	[mΩ]:	
Driver Controls / Switches / Etc.	<input type="checkbox"/>	<input type="checkbox"/>	[mΩ]:	
External Heat Sink	<input type="checkbox"/>	<input type="checkbox"/>	[mΩ]:	
Carbon fiber parts typically touched when trying to move the car with TS deactivated.:	<input type="checkbox"/>	<input type="checkbox"/>	[mΩ]:	
Accumulator Management System Data Connector:	<input type="checkbox"/>	<input type="checkbox"/>	[mΩ]:	
Radiator	<input type="checkbox"/>	<input type="checkbox"/>	[mΩ]:	
Additional Part:	<input type="checkbox"/>	<input type="checkbox"/>	[mΩ]:	

Measure the isolation between HV measuring points and chassis ground, choose next voltage level above the tractive system voltage level, (either 250V or 500V whichever is the next higher value to the tractive-system voltage)

Insulation Measurement Test - IMT	R iso+ [kΩ] (min 0.5 kΩm/Volt + BPR)	HV+ Measured resistance:	
	R iso+ [kΩ] (min 0.5 kΩm/Volt + BPR)	HV- Measured resistance:	

!!TEST AT HIGH VOLTAGE!!

All driven wheels have to be off the ground! Car has to be jacked up with driven wheels removed

TS only allowed to be powered up, when GLVS is powered up	Try to switch on Tractive System with GLVS Master switch in Off-Position	No voltage above 40VDC allowed at measurement points	
TS only allowed to be powered up, when GLVS is powered up	Switch on Tractive System and then switch off GLVS Master switch.	Tractive system must switch off as well	
Tractive System Voltage	Measure HV during following tests. Must be less than or equal to 600VDC	[V]:	
Pre-Charge Circuit	A circuit that is able to pre-charge the intermediate circuit to at least 90% of the current accumulator voltage before closing the second AIR has to be implemented.	Check with multimeter during power up of the tractive system that the system is pre-charged before the second AIR closes.	
Accumulator Indicator Light / Voltmeter	Accumulator Indicator Light or analogue voltmeter has to show if voltage above 40VDC is present outside of the container	Visible check	
Tractive system active light	The TSAL must be switched on whenever outside of accumulator container exceeds 40V DC or 25V AC RMS or when the accumulator insulation relays are closed	Visible check / use multimeter	
Tractive system active light	The TSAL must be clearly visible from every horizontal direction, even in bright sunlight. Small angles of invisibility may be caused by the main roll hoop.	Visible check	
Tractive system active light	The TSAL must be red.	Visible check	
Tractive system active light	The TSAL has to flash continuously with a frequency between 2Hz and 5Hz.	Visible check	
Calculate IMD Test-Resistor Value	R_Test = (max. TS voltage * 250Ω/V) - BPR	R test [kΩ]:	
IMD	IMD indicator light inside the cockpit must be marked with "IMD" and must be RED	visible check	
IMD	IMD status must be shown to the driver (visible in bright sunlight)	visible check	
IMD Test	Activate Tractive System, Connect R_Test between HV+ and GLVS ground	TS voltage must decrease below 40VDC in 5 sec, IMD may take up to 30s to react	
	Activate Tractive System, Connect R_Test between HV- and GLVS ground	TS voltage must decrease below 40VDC in 5 sec, IMD may take up to 30s to react	
IMD or BMS Error disables TS	The tractive system may not automatically return to active state after the IMD test resistor was removed or a BMS error disabled it. The Driver must not be able to reactivate the tractive-system.	Demonstrated by the team.	
Seal all important parts after the IMD test was passed successfully	Accumulator container, Motor Controller Housing, etc.		
Tractive System master switch, shutdown buttons and brake-over-travel-switch and	All switches on --> TS master switch off	TS voltage must decrease below 40VDC in 5 sec	
	All switches on --> CS master switch off		



interlocks	All switches on --> left shutdown button off		
	All switches on --> right shutdown button off		
	All switches on --> Cockpit shutdown button off		
	All switches on --> brake-over-travel-switch off		
	All switches on --> Open Interlock(s) of outboard wheel motor (if applicable)		
Inertia switch	Unmount inertia switch. Activate TS and measure HV voltage. Shake the switch and check if TS is shutdown. TS is not allowed to reactivate without a manual reset e.g. by the driver.	TS voltage must decrease below 40VDC in 5 sec	
Ready-To-Drive-Mode	Only closing the shutdown circuit must not set the car to ready-to-drive mode. The car is ready to drive as soon as the motor(s) will respond to the input of the torque encoder / acceleration pedal.	Check that car is not automatically Ready-To-Drive, when TS is activated	
Ready-To-Drive-Mode	Additional actions are required by the driver to set the car to ready-to-drive-mode e.g. pressing a dedicated start button, after the tractive system has been activated. One of these actions must include the brake pedal being pressed as ready-to-drive-mode is entered.	The team must demonstrate how the car is set to Ready-To-Drive-mode by the driver (pressing the brake pedal is mandatory)	
Ready-To-Drive-Sound-Test	The car must make a characteristic sound, once but not continuous, for at least 1 second and a maximum of 3 seconds when it is ready to drive. The sound level must be a minimum of 70dBA, fast weighting, in a radius of 2m around the car. The used sound must be easily recognizable. No animal voices, song parts or sounds that can be interpreted as offensive will be accepted.	Check/measure during Ready-To-Drive-Mode test	
Torque Encoder / Brake Pedal Plausibility Check	Torque encoder is at more than 25% and brake is actuated simultaneously. The motors have to shut down. The motor power shut down has to remain active until the torque encoder signals less than 5% pedal travel, no matter whether the brake pedal is still actuated or not.	Check that driven axles turn with torque encoder > 25%. Then additionally activate the brake-Motors must stop. Release brake-> motor is still shutdown. Slowly drop torque encoder until it is below 5%. Motors are allowed to move again after torque encoder has gone below 5%	
Torque Encoder Implausibility Check	If an implausibility occurs between the values of two torque encoder sensors the power to the motor(s) has to be immediately shut down completely. It is not necessary to completely deactivate the Tractive System, the motor controller(s) shutting down the power to the motor(s) is sufficient. Implausibility is defined as a deviation of more than 10% pedal travel between the sensors. If three sensors are used at least two sensors have to be within 10% pedal travel, etc.	Check that driven axles turn, then disconnect at least 50% of the sensors and check that the power to the motors is shut down. The sensor should be disconnected while the axles are turning!	
Brake System Plausibility Device	A standalone non-programmable circuit must be used on the car such that when braking hard (without locking the wheels) and when a positive current is delivered from the motor controller (a current to propel the vehicle forward), the AIRs will be opened. The current limit for triggering the circuit must be set at a level where 5kW of electrical power in the DC circuit is delivered to the motors at the nominal battery voltage. The action of opening the AIRs must occur if the implausibility is persistent for more than 0.5sec.	The team must devise a test to prove this required function during Electrical Tech Inspection. However it is suggested that it should be possible to achieve this by sending an appropriate signal to the non-programmable circuit that represents the current to achieve 5kW whilst pressing the brake pedal to a position or with a force that represents hard braking.	
Brake System Plausibility Device	The Brake Plausibility Device may only be reset by power cycling the GLVS Master Switch.	Check that TS is only re-activated, after the GLVS has been cycled.	
Regenerating Energy	Regenerating energy is not allowed below a vehicle speed of 5kph.	Set car to ready-to-drive-mode and actuate the brake pedal slightly without activating the hydraulic brake circuit. Turning a driven wheel/axle by hand must be possible.	
Brake Light	One (!) RED brake light, clearly visible from the rear; on vehicles centerline; height between wheel centerline & driver's shoulders. Round, triangle, or rectangular on black background. 15cm² minimum illuminated area. Sufficient brightness for visible activation in bright sunlight.	Visible check during the tests containing brake pedal actuation.	

!!Test at High voltages completed!!
TRACTIVE SYSTEM HAS TO BE SHUT-OFF!

FORMULA STUDENT GERMANY

ELECTRIC - INSPECTION SHEET 2013



Seal important parts after the TS tests have been passed successfully	Accumulator container(s) including spares	Part sealed:	
	Motor Controller housing	Part sealed:	
	Energy Meter housing	Part sealed:	
	IMD housing	Part sealed:	
	TSAL circuitry housing	Part sealed:	
	Additional Part:	Part sealed:	
	Additional Part:	Part sealed:	
Car movement	Check car movement with all electrical systems deactivated	try to move the car manually with deactivated TS	
Check and mark Charger	Charger needs to be professionally built, e.g. no damaged insulation on cables etc.	visible check and mark	
Basic set of HV-proof tools	Insulated cable shear	visible check	
	Insulated screw drivers	visible check	
	Multimeter with protected probe tips	visible check	
	Insulated spanners, if screwed connections are used in the Tractive System	visible check	
	Face Shield	visible check	
Safety Glasses		Visible check	
HV isolating gloves		visible check	
HV isolating blanket(s)	At least 1m ² (36" x 36")	visible check	
Push Bar	A pair of high-voltage insulating gloves, a multimeter and a fire extinguisher have to be attached to the push bar.	visible check	
	If a tool is needed to open the HVD, this tool has also to be attached to the push bar.	visible check	

NON-COMPLIANCE / COMMENTS:

APPROVED BY:

DATE / TIME:



UNIVERSITY:		CAR NUMBER:	
SES PASSED: <input type="checkbox"/> YES <input type="checkbox"/> NO	IADR PASSED: <input type="checkbox"/> YES <input type="checkbox"/> NO	ABS: <input type="checkbox"/> YES <input type="checkbox"/> NO	
ESF PASSED: <input type="checkbox"/> YES <input type="checkbox"/> NO	FMEA PASSED: <input type="checkbox"/> YES <input type="checkbox"/> NO	NUMBER OF DRIVERS:	
TS Voltage:	GLVS Voltage:	TALLEST DRIVER:	HEIGHT:

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PART 2 TECHNICAL INSPECTION

Scrutineer name:	Start time:	End time:
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TYRES, WHEELS & DRIVER'S EQUIPMENT

DRY TIRES - Make:		RAIN TIRES - Make:	
DRY TIRES - Size:		RAIN TIRES - Size:	
DRY TIRES - Compound:		RAIN TIRES - Compound:	
WHEELS - 20,32 cm min. diam. Wheels with single wheel nut must have positive retainer. No aluminium or hollow wheel bolts		RAIN TIRES - 2,4 mm (3/32 in.) min. tread depth moulded by tire manufacturer.	
1	UNDERWEAR – certified to SFI 3.3 or FIA 8856-2000	8	GOGGLES / FACE SHIELDS - made of impact resistant material.
2	SOCKS – Nomex or equivalent, fire resistant socks. No cotton. No polyester. No bare skin.	9	ARM RESTRAINTS - Must be installed so the driver can release them and exit unassisted regardless of vehicle's position.
3	SHOES – SFI 3.3 or FIA 8856-2000	10	GLOVES – Fire resistant material. No holes. Leather allowed only over fire resistant material.
4	HELMETS - Snell SA2000, SA2005, SA2010, M2000, M2005, M2010, K2000, K2005, K2010, BS 6658-85 Type A/FR (not Type A and B). SFI 31.2A, SFI 31.1/2005, FIA 8860-2004. Closed Face, no Open Face	11	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 installed on push-bar, 1 in paddock. (Must see BOTH at Tech.). On-board fire system possible.
5	DRIVER SUITS - FIA 1986 or 2000, or SFI 3-2A/5, FIA 8856-2000 minimum rating, and LABELED AS SUCH	12	PUSH BAR - With car, detachable, push & pull function for 2 people standing erect. The push bar must be located behind the rear axle when the car is moved. FIRE EXTINGUISHERS must be installed. HV Insulation Gloves and Multimeter must be attached.
6	HAIR COVER - Fire resistant (Nomex or equiv.) balaclava of full helmet skirt REQUIRED FOR ALL DRIVERS.		
7	ACCUMULATOR HAND CART – needed if accumulator will be externally charged, equipped with brake, brake actuation must be designed as dead man's switch (brake unactuated means braking!) The brakes have to be able to stop a fully loaded hand cart. The hand cart must be able to carry the load of the accumulator container(s).		

EXTERIOR, GENERAL

13	DRIVER RESTRAINT HARNESS - 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 & 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.	17	VISIBILITY - Minimum of 100 deg. field either side. Head rotation allowed or mirrors. If mirrors, must be firmly installed and adjusted
14	LAP BELT MOUNTING - 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.	18	VEHICLE CONTROLS - All controls, including shifter, must be inside cockpit. No arms or elbows outside side impact system to actuate.
15	SHOULDER HARNESS MOUNTING - 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. Braces if not straight to main hoop.	19	MAIN HOOP & FRONT HOOP HEIGHTS - Helmet of tallest 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.
16	HEAD RESTRAINT - Near vertical. Must take 890 N load. 38 mm thick, energy absorbing padding. Max. 25.4 mm from helmet. Helmet contact point 50mm min. from any edge. May be changed for different drivers. Minimum 150x150mm AND height adjustment of 175 mm; OR minimum 150 x 280mm	20	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.
		21	EGRESS - 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. Check that driver helmet cannot contact the tractive system active light below the main roll hoop.

FORMULA STUDENT GERMANY

ELECTRIC - INSPECTION SHEET 2013



22	BODY & STYLING - Open wheeled, open cockpit, formula style body. 69mm keep out zone around tires, tires unobstructed from above and from sides.	23	AERODYNAMICS - ALL aero devices, wings, u/trays, splitters, maximum 76 cm. In front of front tires, maximum 305mm rearward of rear tires, no wider than outside of widest track. No power ground effects.
24	BODYWORK - Min. 38 mm radius on nose. No large openings in bodywork into driver compartment in front of or alongside driver, (except cockpit opening).	27	WING EDGES - wing edges including wings, end plates, Gurney flaps, wicker bills and undertrays that could contact a pedestrian must have a minimum radius of 1.5 mm
25	SCHOOL NAME & OTHER DECALS - School Name, or recognised initials - 5.1 cm tall min. on both sides in Roman letters. Must be clearly visible.	28	JACKING POINT - a 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 10.2 cm
26	CAR NUMBERS - On front & both sides of car, minimum 15.24 cm tall, 20 mm stroke & spacing, Black on White, White on Black only, specified background shapes. Must be clearly visible.	29	WHEELBASE - Minimum 1524 mm
		30	TECH STICKER SPACE - 7.5cm x 15 cm on centerline of front of car in front of the cockpit opening
PRIMARY STRUCTURE			
31	COCKPIT OPENING - Fig. 8 template passes down from above cockpit centre line of top SIS tube or to 350 mm above ground for monocoque. Steering wheel& column, seat & padding can be removed. No removing firewall. No fore/aft translation of template.	40	COCKPIT INTERNAL CROSS SECTION - Fig. 9 template passes forward from cockpit to 100 mm rear of pedals. Steering wheel, and padding removable with no tools & driver-in can be removed.
32	ALTERNATIVE TUBING & MATERIALS - If used, team must show an APPROVED SES. If using Alternative Frame Rules, SRCF req'd. No Magnesium tubes in primary structure.		
33	MAIN HOOP - MUST BE STEEL. 25.4 x 2.4mm 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.	41	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. All tubes to be 25.4 x 1.65mm or 25.0 x 1.75mm or 25.4 x 1.6 mm wall steel or equivalent. Monocoques require signed SES.
34	MAIN HOOP BRACING - MUST BE STEEL. One brace 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 thru proper triangulated structure.	42	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, 200 mm 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.
35	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 2.4mm or 25.0 x 2.5 mm wall steel or equiv. Longitudinal distance to steering wheel max. 250 mm.		ANTI INTRUSION PLATE - A 1.5mm solid steel metal or 4.0mm solid aluminium metal sheet (same size as outside dims.) must be welded or min. four screws M8 Grade 8.8
36	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 bracing required if Front Hoop leans backwards more than 10 deg.	43	FRONT BULKHEAD SUPPORT - Support back to front roll hoop; 3 tubes per side; 1 bottom, 1 top within 50 mm of top of bulkhead, with node to node diagonal ((must form a triangle with Front BulkH'd and either top or bottom tube); all 25.4 x 1,25mm wall steel tube or equiv. (25.0 mm x 1.5 mm and 26.0 mm x 1.2 mm tubes OK)
37	ROLL BAR PADDING - 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.	44	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).
38	SEAT - 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.	45	OTHER SIDE TUBES - Design prevents driver's neck hitting bracing or other side tubes
39	MONOCOQUE - Must see laminate test specimen. Steel backing plates (>2mm thick) used at attachment points.		
STEERING, SUSPENSION, BRAKES			
46	VISIBLE ACCESS - To ALL components on Tech form.		
47	SUSPENSION - Fully operational with dampers front and rear; 50mm minimum wheel travel with driver in vehicle.	52	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.
48	SUSPENSION PICK-UP POINTS - Inspected thoroughly for integ.		
49	BRAKES - Dual hydraulic system & reservoirs, operating on all four wheels, (one brake on limited slip 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/tub in side view. Brake pedal capable of 2000N, no failures if official exerts max force (seated normally in vehicle).	53	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.
50	CABLE STEERING - If steering is cable actuated, require approved FMEA (part of SES approval); confirm FMEA is representative of system, and reasonable.		



51	STEERING WHEEL - Continuous perimeter, near round (no concave sections) with driver operable quick disconnect. 25cm max from front hoop.	54	GROUND CLEARANCE - Sufficient clearance so that no part of the car other than the tires will contact the track surface.
INTERIOR			
55	FIREWALL - Fire resistant material; must separate driver compartment from fuel supply, cooling & oil systems. Pass-throughs OK with grommets. Multiple panels OK if gaps sealed. No gaps at sides or bottom. Must protect (line-of-sight up to mid-height of driver's helmet) from cooling, oil and fuel systems. If used a non metal material for the firewall (i.e. carbon fibre, fibreglass etc.) a fire resistant heat protection shield with a metal surface must be fitted. The firewall must be fire resistant according to UL94-V0 or equivalent. Minimum thickness of used metal material is 0.3mm	56	FLOOR CLOSEOUT PANEL - Required from foot area to firewall; solid, non-brittle material; multiple panels are OK if gaps less than 3.18 mm.
		57	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 in side or front views when touching pedals.
		58	DRIVER'S LEG PROTECTION - Covers inside cockpit over sharp and moving suspension & steering components
DRIVETRAIN COMPARTMENT			
59	VISIBLE ACCESS - To ALL components on Tech sheet	64	COOLANT - Only 100% water or oil. NO ADDITIVES WHATSOEVER
60	SCATTERSHIELDS GENERAL - 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	65	CATCH TANKS - Any coolant overflow or lube system vents must have separate catch tanks. One quart (0.9 l) minimum each. 100 deg. C material, behind firewall, below shoulder level. 3 mm min. dia. vent away from driver.
61	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.		
62	FLUID LEAKS - Oil, grease, coolant, Brake fluid -> none permitted	66	BELLYPANS - Must be vented to prevent accumulation of liquids. Must have at least one hole (minimum of 50 mm in diameter). This hole must be positioned in the lowest part of the structure
ACCUMULATOR CONTAINERS and TRACTIVE-SYSTEM PARTS (specific for electric cars)			
89	ACCUMULATOR CONTAINERS - All accumulator containers must be rugged and rigidly mounted to the chassis to prevent the containers from loosening during the dynamic events or possible accidents. The mounting system must be designed to withstand forces from a 20g deceleration in the horizontal plane and 10g vertical deceleration. - Plausibility Check.	92	IMPACT PROTECTION OF TRACTIVE SYSTEM PARTS - If tractive system parts are mounted in a position where damage could occur from a rear or side impact (below 350mm from the ground), for example motors at the rear of the car, 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 – see T3.4.
90	ACCUMULATOR CONTAINER MATERIAL - The container material must be fire resistant according to UL94-V0, FAR25 or equivalent. The data sheet of the used material has to be presented at Scrutineering.	93	IMPACT PROTECTION OF ACCUMULATOR CONTAINERS All accumulator containers must be protected from side or rear impact collisions by structure equivalent to that defined in T3.4. 25.4 mm x 1.65 mm or equivalent.
91	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 and/or an additional envelope of tubing which meets the minimum specification defined in T3.4 or equivalent, such that they are protected against being damaged in case of a crash or roll-over situation.	94	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
		95	LOW VOLTAGE BATTERY - Must be attached securely to the frame.
NON-COMPLIANCE / COMMENTS			
APPROVED BY:		DATE / TIME:	



UNIVERSITY:	CAR NUMBER:
IMPORTANT	
PRESENT THE VEHICLE FOR INSPECTION IN THE FOLLOWING ORDER	
<ol style="list-style-type: none"> 1. ELECTRICAL INSPECTION 2. TECHNICAL INSPECTION 3. TILT TABLE INSPECTION 4. RAIN TEST 5. BRAKING PERFORMANCE INSPECTION 	
THIS FORM MUST STAY WITH THE CAR AT ALL TIMES NOTE - IF THERE IS A CONFLICT BETWEEN THIS FORM AND THE RULES, THE RULES PREVAIL	
PART 3 TILT TABLE INSPECTION	
LIQUID SPILLAGE - No liquid spill permitted when car is tilted to 45 degrees in the direction most likely to create spillage;	VEHICLE STABILITY - All wheels in contact with tilt table when tilted to 60 degrees to the horizontal.
NON-COMPLIANCE / COMMENTS	
APPROVED BY:	DATE / TIME:
PART 4 RAIN TEST	
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 120sec. – 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	
APPROVED BY:	DATE / TIME:
PART 5 BRAKING PERFORMANCE INSPECTION	
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). If adjustments are made to the vehicle after three failed attempts before retest, the car may run on the Practice Track without the final Brake Performance Tech Sticker.	
NON-COMPLIANCE / COMMENTS	
APPROVED BY:	DATE / TIME: