


IMPORTANT

PRESENT THE VEHICLE FOR INSPECTION IN THE FOLLOWING ORDER:

1. SAFETY GEAR CHECK (Bring all items, plus rain tires)
2. ACCUMULATOR INSPECTION
3. ELECTRIC VEHICLE INSPECTION
4. MECHANICAL TECHNICAL INSPECTION (Can be started prior to completing Electric Vehicle Inspection if accumulator is removed)
5. TILT TABLE INSPECTION
6. RAIN TEST
7. BRAKING PERFORMANCE INSPECTION

THIS FORM MUST STAY WITH THE CAR UNTIL THAT SPECIFIC PART OF INSPECTION HAS BEEN COMPLETED

ACCUMULATOR INSPECTION			
UNIVERSITY:		INSPECTOR(s):	
Identify team/design information	The ESO will be the central team contact during Electrical Inspection	Name:	
	The designed maximum TS voltage.	_____ [V]	
	ESF Accepted	<input type="checkbox"/> YES <input type="checkbox"/> NO	
DESIGN			
TSMP	TSMP body protection resistor value.	_____ [kΩ]	
TS Fusing	All wiring protected by overcurrent protection with current rating <= ampacity of wire.	Visible check of documentation	
	All overcurrent protection in TS must have DC voltage rating >= max TS voltage	Visible check of documentation	
	Precharge and discharge circuits must not be fused.	Visible check of documentation	
Accumulator	Maintenance plugs must separate the internal cell stacks. Cell stacks must have a voltage less than 120VDC and a maximum energy of 6MJ. The separation has to affect both poles of the stack.	Per Stack: Max Voltage: _____ [V] Max Energy: _____ [MJ]	
	AMS must monitor the temperature of at least 20% of the cells	Visible check	
	Temperature sensor must be in direct contact with negative terminal or <10mm away on the bus bar	Visible check	
Shutdown/Safety Circuits	Shutdown buttons directly carry current of AIRs and precharge relay	Visible check of documentation	
	IMD, BMS, and BSPD have independent relays or transistors to open the shutdown circuit.	Visible check of documentation	
	An interlock line opens the AIRs whenever the HVD is removed.	Visible check	
APPS	Must have at least two sensors not sharing supply or signal lines.	Visible check	
	The transfer functions of the two sensors must not cross.	Visible check	
ACCUMULATOR			
HV warning stickers	Accumulator housing must be labeled with "High Voltage" and 	Visible check	
Separation on self-developed PCBs	GLV and TS circuits have at least the spacing specified in EV.7.5.7.	Visible check	
HV Wiring	Wiring to professional standards: terminals correct size, intentional current path on bolted connections	Visible check	
	Bolted connections in the high current path must have a positive locking mechanism. Lock washers, nyloc's and thread locking compound are NOT allowed.	Visible check	
	Soldering is not allowed in the high current path. It is acceptable to solder sense wires.	Visible check	
	TS wires and GLVS wires are clearly separated: not run directly next to each other, in the same conduit or connector. Does not apply to interlock wires.	Visible check	

TS Fusing	All wiring has overcurrent protection with current rating \leq ampacity of wire.	Visible check	
	AMS cell voltage sense leads have overcurrent protection. Distributed AMS with leads $<25\text{mm}$ are exempt. Voltage rating \geq cell voltage and must occur in conductor attached to cell.	Visible check	
	Parallel cells or strings of cells must be individually fused to protect all the components on that string. Fusible links acceptable if EV.7.6.5 met.	Visible check	
Internals	The poles of the accumulator stack(s) and cells must be insulated against the inner wall of the accumulator container if the container is made of electrically conductive material.	Visible check	
	Every accumulator container must contain at least one fuse in the high current path.	Visible check	
	No always energized TS wires leaving accumulator container (All TS wires leaving accumulator disconnected by an AIR).	Visible check	
	Fuse and AIRs must be separated from the rest of the enclosure by an electrically insulating fireproof material.	Visible check	
Maintenance Plugs	Maintenance plugs can be removed without tools.	Visible check	
	Surfaces of the maintenance plugs must be non-conductive except as required to make the electrical connection.	Visible check	
	Maintenance plugs cannot be incorrectly installed.	Visible check	
Internals - Cell stacks	Each stack has to be electrically insulated by the use of suitable materials towards other stacks in the container and on top of the stack. Air is not a suitable insulation material in this case.	Visible check	
	The contained cell stacks must be separated by an insulating and fire resistant (according to UL94-V0, FAR25 or equivalent) barrier.	Visible check	
Indicator Light	Each container must have an indicator showing that voltages greater than 60V DC are present outside of the container. Indicator must function with accumulator removed from vehicle.	Visible check	
Accumulator Container Connectors	All Tractive System connectors outside of a housing must include an interlock which activates the shutdown circuit.	Visible check	
AMS	AMS must monitor the voltage of every cell.	Visible check	
Spare accumulator(s)	Must have the same size, weight and type	Visible check	
Accumulator Removal	Accumulator can be removed while rules compliant	Visible check	
Hand Cart	Accumulator is removable while remaining rules compliant.	Visible check	
	Hand cart has dead man's switch capable of stopping fully loaded cart.	Visible check	
Chargers	Charger connector must incorporate an interlock such that the connectors only become live if is correctly connected.	Visible check	
	HV charging leads must be orange.	Visible check	

!!TEST AT HIGH VOLTAGE!!**Pack removed on charging cart**

Charging	Emergency stop button on charger stops charging	TS voltage must decrease below 60VDC in 5 sec	
	IMD must open shutdown circuit in 30 seconds when isolation fault is present.		
	1. Activate Tractive System 2. Connect IMD test box between TSMP and GLVS Ground. 3. IMD must trip in 30 seconds and TS voltage must decrease below 60VDC in 5 sec.	Perform Test	
	When charging, the AMS must be live and must be able to turn off the charger in the event that a fault is detected.	Set vehicle to charge. Team must demonstrate AMS is active.	


ELECTRIC VEHICLE INSPECTION



UNIVERSITY: _____

INSPECTOR(s): _____

CHECK THAT HVD IS REMOVED FROM VEHICLE.

GENERAL

Required Safety Equipment	Insulated cable cutter	Visible check	
	Insulated screw drivers/wrenches for accumulator	Visible check	
	Multimeter with protected probe tips	Visible check	
	Face Shield	Visible check	
	Safety Glasses	Visible check	
	HV isolating gloves. Test date within last 12 months	Visible check	
	Electrically insulating blanket at least 1m ² (36" x 36")	Visible check	
	Push bar has 2 pairs of high-voltage insulating gloves, a multimeter and a fire extinguisher attached.	Visible check	
HV wiring	All HV wiring or their conduit must be orange. GLV wiring must not be orange.	Visible check	
	TS wiring outside of electrical enclosures must either be enclosed in non-conductive conduit or use a shielded cable with the shield grounded.	Visible check	
	The conduit or shielded cable must be securely anchored at least at each end to withstand a force of 200N without straining the cable and crimp.	Visible check / Manual Check	
	TS wiring protected against damage. No TS wires or components are allowed to be lower than the chassis.	Visible check	
	TS wires and GLVS wires are clearly separated: not run directly next to each other, in the same conduit or connector. Does not apply to interlock wires.	Visible check	
HV wiring / Connections	Wiring to professional standards: terminals correct size, intentional current path on bolted connections	Visible check	
	Bolted connections in the high current path must have a positive locking mechanism. Lock washers, nyloc's and thread locking compound are NOT allowed.	Visible check	
GLV Fusing	All wiring protected by overcurrent protection with current rating <= ampacity of wire.	Visible check	
Energy Meter wiring	All energy from accumulator containers must flow through the Energy Meter for energy measuring.	Visible check	
Traction System protection	It must not be possible to touch any TS connections with a 100 mm long, 6 mm diameter insulated test probe when the TS enclosures are in place.	Check with probe	
	Using only 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 "High Voltage" and 	Visible check	
High Voltage Disconnect	The HVD must be actuated by removing/disconnecting an element.	Visible check	
	The HVD is clearly labeled with "HVD"	Visible check	
	The HVD must be accessible without removing bodywork and located >350mm from the ground.	Visible check	
	In ready to race condition it must be possible to disconnect the HVD within 10 seconds.	Team Demonstration	
	HVD must remain fingerproof when disconnected. A dummy connector may be used to restore to fingerproof.	Visible check	
Traction System Active Light	TSAL must be controlled by >60V voltage present in TS, not shutdown circuit voltage.	Visible check of documentation / team explanation	
	The TSAL must be mounted under highest point of main roll hoop and visible from every horizontal direction by a person standing up to 3m away from the TSAL. The person's minimum eye height is 1.6m.	Visible check	
AMS Indicator	A red light marked "AMS" or "BMS" must be installed in the cockpit that lights up, if the AMS shuts down the car.	Visible check	

Measurement Points	TS+, TS- and GLVS ground shrouded banana jack must be installed on the right side of the vehicle at the shoulder height of the driver.	Visible check	
	The TSMPs must be protected by a non-conductive housing that can be opened without tools.	Visible check	
	The TSMPs must be protected from being touched with the bare hand/fingers, once the housing is opened.	Visible check	
	The measurement points must be marked with HV+, HV-, and GND.	Visible check	
Master Switches	TS and GLVS master switch on the right side of the vehicle at the height of the drivers shoulders.	Visible check	
	GLVMS labeled "LV" and in center of red circle TSMS labeled "HV", in the center of orange circle, and 	Visible check	
	On and Off position of each switch is labeled.		
	Both switches must be a rotary type with a removable handle. The ON position must be in horizontal position.	Visible check	
Shutdown Buttons	One shutdown button on each side of drivers compartment (height of drivers head). Minimum diameter = 40mm. Push pull or push-rotate style.	Visible check	
	One shutdown button in cockpit. Minimum diameter = 24mm. Push pull or push-rotate style.	Visible check	
	Three switches labeled with 	Visible check	
Outboard Wheel Motors	Outboard wheel motors require an interlock such that the shutdown circuit is opened if the wheel assembly is damaged or knocked off the car.	Visible check	
Brake-over-travel-switch	Brake-over-travel-switch must actuate if brake pedal overtravels and not be damaged.	Visible check	
APPS	The foot pedal must have a positive stop to prevent sensors from being mechanically overstressed.	Visible check / Manual check	
	Two springs must be used to return the accelerator pedal to the off position and each spring must work with the other disconnected. The springs in the APPS are not acceptable return springs.	Visible check / Manual check	
Firewall(s)	A firewall must separate the driver compartment from all components of high voltage system (including HV wiring).	Visible check	
	The firewall must be coated with an electrically insulating material on the driver side	Visible check	
	The insulating material must be puncture and scratch resistant.	Visible check	

DEMONSTRATION

CAR MUST BE JACKED UP WITH DRIVEN WHEELS REMOVED.

UNIVERSITY:		INSPECTOR(s):	
Measurements			
Discharge Circuit and Body Protection Resistors	If used, the discharge circuit must always be active when the shutdown circuit is open. 1. Measure resistance between TSMP HV- and TSMP HV+ Measurement must be $2 \times \text{body protection resistor} + \text{Discharge}$.	_____ k Ω	
GLVS voltage	Measure GLVS voltage, must be $\leq 60\text{VDC}$	_____ V	
GLVS ground	Measure GLVS gnd for conductive surface $< 100\text{mm}$ from a TS component, must be $< 300 \text{ m}\Omega$.	_____ m Ω	
!!TEST AT HIGH VOLTAGE!!			
Insulation Measurement Test	Measure isolation between TSMP and chassis ground. Choose next voltage level above TS voltage (250V or 500V) $R_{iso} \geq 500 \times \text{TS Voltage} + \text{BPR}$	HV+ _____ M Ω	
		HV- _____ M Ω	
TS only on when GLVS powers up	Try to switch on TS with GLVS Master Switch in off position	No voltage above 60VDC allowed at measurement points	
Tractive System Voltage	Measure HV during following tests. Must be less than or equal to 600VDC	_____ V	
Pre-Charge Circuit	Intermediate circuit must be precharged to $\geq 90\%$ of the current accumulator voltage before closing the second AIR.	Observe precharge with multimeter.	
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 accelerator pedal.	Check that car is not automatically Ready-To-Drive, when shutdown ckt is activated.	
Accumulator Indicator	Accumulator Indicator indicates if voltage above 60VDC is present outside of the container.	Visible check	
Tractive System Active Light	The TSAL must be solid green when GLV turned on and the voltage outside of accumulator container is less than 60V DC.	Visible check	
	The TSAL must be flashing red when GLV turned on and the voltage outside of accumulator container exceeds 60V DC.	Visible check	
	The TSAL must be red and clearly visible even in bright sunlight.	Visible check	
IMD Test	IMD must open shutdown circuit in 30 seconds when isolation fault is present. 1. Activate Tractive System 2. Connect IMD test box between TSMP and GLVS Ground. 3. IMD must trip in 30 seconds and TS voltage must decrease below 60VDC in 5 sec.	Test HV+	
		Test HV-	
IMD	IMD indicator light inside the cockpit must be marked with "IMD", must be RED, and must be visible in bright sunlight.	Visible check	
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 reactive the tractive-system.	Demonstrated by the team	
master switches, shutdown buttons and brake-over-travel-switch and interlocks	All switches on --> TS Master switch off	TS voltage must decrease below 60VDC in 5 sec <i>Allow team to set pace of tests to prevent overheating precharge / discharge resistors.</i>	
	All switches on --> GLV Master switch off		
	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 voltage must decrease below 60VDC in 5 sec	
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 80dBA, fast weighting, in a radius of 2m around the car. The used sound must be easily recognizable.	Check for Ready-To-Drive sound when team starts vehicle.	
APPS / Brake Pedal Plausibility Check	Torque production must stop when accelerator and brake pedal are pressed simultaneously 1. Press accelerator to show that axle turns. 2. With accelerator > 25%, press brake pedal. Axle must stop 3. Keeping accelerator >25%, release brake pedal. Axle must remain stopped. 4. Slowly release accelerator, axle may turn again once < 5% pedal position.	Team demonstration per procedure	
APPS Implausibility Check	Torque production must stop if >= 50% of APPS are implausible. 1. Press accelerator to show that axle turns. 2. Unplug >= 50% of APPS. 3. Press accelerator, axle must not turn.	Team demonstration per procedure	
Brake System Plausibility Device	A standalone non-programmable circuit must open the AIRs when braking hard and a positive current is delivered from the motor controller. The current limit must be set at a 5kW at the nominal battery voltage. The action of opening the AIRs must occur if the implausibility is persistent for more than 0.5 sec.	The team must provide a test. The sensor must be included in the test.	
	The BSPD may not be reset by a driver accessible control.	Check that the driver controls do not reset the BSPD	

!! Test at High Voltages Completed !!

TRACTIVE SYSTEM HAS TO BE SHUT-OFF!

Seal important parts after the TS tests have been passed successfully	Accumulator container(s) including spares	Part sealed:	
	Energy Meter housing	Part sealed:	
	IMD housing	Part sealed:	
	TSAL circuitry housing	Part sealed:	
	Additional Part:	Part sealed:	
	Additional Part:	Part sealed:	
	Additional Part:	Part sealed:	

APPROVED BY:

DATE/TIME: