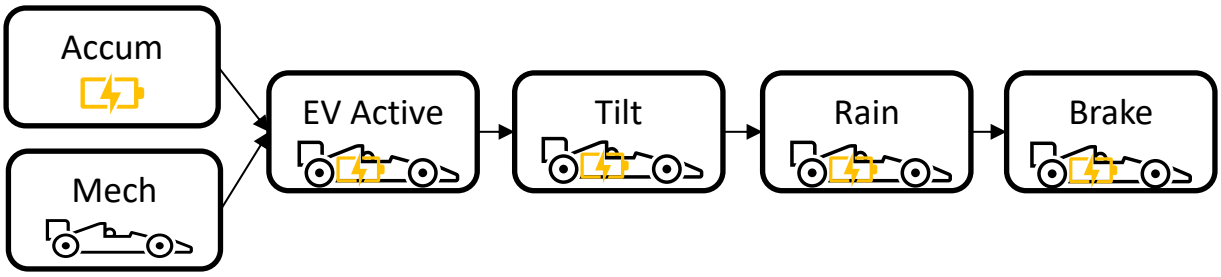
2022 Electrical Inspection Form

IMPORTANT

PRESENT THE VEHICLE FOR INSPECTION IN THE FOLLOWING ORDER:



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

ACCUMULATOR INSPECTION			
UNIVERSITY:		INSPECTOR(s):	
	ESF Accepted		
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 Always Energized" 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 Path	Bolted connections in the high current path must have a positive locking mechanism. **Lock washers and thread locking compound are NOT allowed.**	Visible check	
	Soldering is not allowed in the high current path.	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	
	Branch circuits are fused within 150mm of source.	Visible check	
	Fuse and AIRs must be seperated 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 separated by the use of an electrically insulating and fire resistant 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	
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 an enclosure must include an interlock.	Visible check	
Spare accumulator(s)	Must have the same size, weight and type	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	
	TS+ and TS- shrouded red banana jack available when charging	Visible check	
Energy Meter	Energy Meter Installed (if located in accumulator) Energy Meter provided (if not in accumulator)	Visible check	

!!TEST AT HIGH VOLTAGE!! Pack removed on charging cart			
Accumulator Indicator	Accumulator Indicator indicates if voltage above 60VDC is present outside of the container.	Visible check	
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. Connent IMD test box between TSMP and GLVS Ground. 3. IMD must trip in 30 seconds and TS voltage must decrease below 60VDC is 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.	

DEMONSTRATION

CAR MUST BE JACKED UP WITH DRIVEN WHEELS REMOVED.

UNIVERSITY:		INSPECTOR(s):	
Energy Meter	Energy meter installed in vehicle	Confirm with team	
TS Components	No TS components or wiring below frame.	Visible check	
Measurements			
GLVS ground	Measure GLVS gnd for conductive surface <100mm from a TS component, must be < 300 mOhm.	_____ mΩ	
Discharge Circuit and Body Protection Resistors	1. Measure resistance between TSMP HV- and TSMP HV+ Vmax < 200V => 10k + discharge 200V < Vmax < 400V => 20k + discharge 400V < Vmax < 600V => 30k + discharge	_____ kΩ	
!!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 >= 500 * TS Voltage + BPR	HV+ _____ MΩ	
		HV- _____ MΩ	
Ready-To-Drive Mode	Additional actions required to enter Ready-To-Drive 1. Energize the TS 2. Press Accelerator pedal	Verify motors DO NOT SPIN.	
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. Connent IMD test box between TSMP and GLVS Ground. 3. IMD must trip in 30 seconds and TS voltage must decrease below 60VDC is 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 *Allow team to set pace of tests to prevent overheating precharge / discharge resistors.*	
	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 to set the car to ready-to-drive mode 1. Enable TS 2. Press brake and start button 3. Press Accelerator, **motors SHOULD spin** 4. Press shutdown button 5. Release shutdown button and enable TS 6. Press Accelerator, **motors SHOULD NOT spin** 7. Press brake and start button 8. Press Accelerator, **motors SHOULD spin**	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 demostration per procedure	
APPS Implausibility Check	Torque production must stop if APPS are implausible. 1. Press accelerator to show that axle turns. 2. Unplug all but 1 APPS. 3. Press accelerator, **axle must not turn.**	Team demostration 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	
Energy Meter	Energy Meter functional. Download data from active tests.	Data verified	

!! Test at High Voltages Completed !!
TRACTIVE SYSTEM HAS TO BE SHUT-OFF!

APPROVED BY: **DATE/TIME:**