Formula Student Netherlands			Dashboard	Responsible Scrutineers		
2022 Inspection Sheet					First Scrutineer	Second Scrutineer
Accumulator Inspection				First try:		
Car Number				Second try:		
University				Third try:		
				Fourth try:		
	REQUIRED RESOURCES			Fifth try:		
No.	Checkpoint	Checkbox	Comment	Sixth try:		
-	All accumulator containers to be used during the event					
-	Accumulator Container Hand Cart					
-	Tools needed for (dis-)assembly of Accumulator Container					
-	Laptop and cables to display data of the AMS					
-	Print-out of Rule Request (if applicable)					
-	Charger					
-	An ESO must attend					
-	Pictures of accumulator internals, if necessary					
-	Datasheets for used wiring, insulation materials, tractive system components and container material with needed values highlighted.					
-	Samples of all wire types used inside the accumulator container.					
-	Power Supply for AIL test					
-	Samples of all used accumulator container material.					
	SAFETY BRIEFING					
No.	Checkpoint	Checkbox	Comment			
-	no jewellery, no rings					
-	no cell phone					
-	no batch / no necklace					
-	no sources of distraction					
-	do not wear synthetic clothes					
-	wear safety glasses					
-	wear safety gloves (if necessary)					
	BASIC SET OF HV-PROOF TOOLS					
No.	Checkpoint	Checkbox	Comment			
1	Insulated cable shear	☐				
2	Insulated screw drivers	☐				
3	Insulated spanners, if applicable	☐				
4	Multimeter with protected probe tips	☐				
5	two 4mm banana plug test leads (1000V CAT III)	☐				
	SAFETY EQUIPMENT					
No.	Checkpoint	Checkbox	Comment			
6	Face shield	☐				
7	Safety glasses (minimum three)	☐				
8	HV Insulating gloves (minimum two pairs)	☐				
9	HV insulating blankets (two) (min 1m²) with label or serial number and datasheet.	☐				

	SELF DEVELOPED PCBS		
No.	Checkpoint	Checkbox	Comment
►	Ask for fully assembled spare PCB of self developed PCBs inside accumulator container.		
10	Sufficient spacing regarding system voltage and implementation.	☐	
11	Sufficient insulation and temperature rating of coating if used, datasheet available.	☐	
12	Coating process according to datasheet	☐	
	CHARGER ASSEMBLY		
No.	Checkpoint	Checkbox	Comment
13	Completely closed (no open TS connections).	☐	
14	Interlock integrated	☐	
15	TSMP integrated	☐	
16	Emergency shutdown button integrated ≥24mm diameter	☐	
17	TS wiring is orange, marked with gauge, temperature rating >85°C and voltage rating.	☐	
18	Conductive parts of charging equipment and accumulator are connected to protective earth (PE) while charging.(1A measurement)	☐	
	DIS-CHARGE CIRCUIT AND BODY PROTECTION RESISTORS		
No.	Checkpoint	Checkbox	Comment
►	Switch off Charger. Measure resistance between HV+ and HV- measuring points.		
19	Resistance is 30 kΩ + discharge resistor	☐	
20	Body protection resistor power and voltage rating is sufficient	☐	
	INSULATION MEASUREMENT TEST		
No.	Checkpoint	Checkbox	Comment
►	Check low resistance connection between LVMP and PE/casing		
►	Choose test voltage to 500V.		
►	Connect insulation tester to charger TS+ and GLV ground.		
►	Connect charger (do not activate charger) to accumulator, keep AIRs opened.		
►	Measure resistance: Riso+ = MΩ		
21	Resistance is much higher than (min. 500Ω/V*Umax)	☐	
►	Connect insulation tester to TS- and GLV ground.		
►	Measure resistance: Riso- = MΩ		
22	Resistance is much higher than (min. 500Ω/V*Umax)	☐	
23	Resistances are nearly equal.	☐	
	HOUSING		
No.	Checkpoint	Checkbox	Comment
24	The accumulator must be mechanically fixed to the handcart	☐	
25	Vehicle number, university name and ESO phone number(s) written on a high contrast background.	☐	
26	Roman Sans-Serif characters of at least 20mm high are used.	☐	
27	Warning stickers with side length of 100mm and text "Always Energized" and "High Voltage" (if TS >60 V) installed. (triangle with black lightning bolt on yellow background)	☐	
28	Check if all parts and the cover/lid of the housing are rigidly fastened.	☐	
►	Open container housing, remove maintenance plugs.		
►	Check if no voltage is present.		
	Accumulator Container Materials and Cell Stack		

No.	Checkpoint	Checkbox	Comment
►	Remove a random stack from the accumulator		
►	Compare SES/ESF documentation with the stack on the table		
29	Stack and SES/ESF documentation are the same	☐	
30	Stacks are robust and rigidly fastened to the container	☐	
31	Stacks seperated by maintenance plugs <120VDC and <6MJ	☐	
32	Stacks are insulated and seperated by barrier according to UL94-V0, FAR25 or equivalent	☐	
33	Cell tabs must not be mechanically loaded	☐	
34	No potential damage to the Cell by sharp edges of the stack	☐	
35	Every temperature sensor placed on negative terminal of monitored cell or in <10mm distance on busbar.	☐	
36	Galvanic Seperation included inside the Accumulator Management System	☐	
37	Maintenance plugs are located at both poles of each stack (including first and last stack).	☐	
38	Maintenance plugs removable without tools.	☐	
39	Maintenance plugs have positive locking mechanism.	☐	
40	Maintenance plugs must not be able to unintentionally create circuits or short circuits	☐	
41	Internal vertical walls have to be rigidly fastened to the container.	☐	
►	Present all Accumulator container materials		
►	Compare samples with Accumulator container		
42	Samples and Accumulator container are of equal quality	☐	
	ASSEMBLY		
No.	Checkpoint	Checkbox	Comment
43	All components and parts of the AC need to be properly fixed	☐	
44	All used fasteners must be secured by the use of positive locking except they are non-conductive and non-structural. (Use of automotive rated components with the manufacturer's indicated torque)	☐	
45	TS potentials are insulated against inner wall of accumulator container if container made from conductive material.	☐	
46	No soldering in high current path	☐	
47	Every container contains at least one appropriately sized and rated fuse	☐	
►	Check datasheet of fuse and compare to ESF		
48	If the fuse uses a bolt to disconnect there must be sufficient space for the bolt to move into.	☐	
49	Every container contains at least two appropriately sized and rated isolation relays	☐	
50	Isolation relays and fuses are seperated from all other components by a barrier according UL94-V0, FAR25 or equivalent	☐	
51	Holes in container only for wiring harness, ventilation, cooling or fasteners.	☐	
52	Check opening in TS enclosures, try to reach TS potentials with insulated test probe (100mm length, 6mm diameter).	☐	
53	If fully closed, an equalizing valve must be implemented	☐	
54	Spare accumulators of same size, weight and type	☐	
	WIRING		
No.	Checkpoint	Checkbox	Comment
55	All TS wires have proper overcurrent protection.	☐	
56	No other wires than HV wires are orange.	☐	
57	Securely anchored to withstand at least 200N, if outside of enclosure.	☐	

58	Located out of the way of possible snagging or damage.	☐				
59	TS and LV wires separated (not valid for Interlock).	☐				
60	Every wire used in the Accumulator container (TS and GLVS) is rated for maximum TS voltage	☐				
61	TS wires are marked with gauge, temperature rating >85°C and voltage rating.	☐				
62	Positive locking mechanism or if no positive locking possible, automotive certified components.	☐				
►	Check if insulated tools needed for the assembly of certified components are available	[redacted]				
63	Insulation is not only insulating tape or rubber-like paint.	☐				
	INDICATOR LIGHT OR VOLTMETER					
No.	Checkpoint	Checkbox	Comment			
64	RED Indicator light or voltmeter installed	☐				
65	Marked with “Voltage Indicator	☐				
66	Visible while opening the battery connector	☐				
67	Hard wired electronics, supplied by TS	☐				
►	Connect power supply with 60VDC to accumulator HV connector.	[redacted]				
68	Indicator light on or voltmeter showing present TS voltage.	☐				
69	Visible in bright sunlight.	☐				
	ACCUMULATOR MANAGEMENT SYSTEM					
No.	Checkpoint	Checkbox	Comment			
70	A minimum of 30% of cells are monitored with temperature sensors	☐				
►	Disconnect any AMS internal connector	[redacted]				
71	The AMS must open the shutdown circuit within 1s.	☐				
►	disconnect AMS current sensor	[redacted]				
72	The AMS must open the shutdown circuit within 0.5s	☐				
►	Ask the team to connect their laptop to the AMS.	[redacted]				
►	Connect charger to battery/batteries, start charging process					
73	Cell voltages can be displayed	☐				
74	Cell temperatures can be displayed.	☐				
75	Temperature and voltage limit according to ESF	☐				
76	Plausible accumulator current can be displayed.	☐				
	CHARGER SHUTDOWN CIRCUIT					
No.	Checkpoint	Checkbox	Comment			
77	IMD is integrated into the charging system.	☐				
►	Connect charger to battery/batteries, start charging process.	[redacted]				
78	Voltage indicator shows that HV is present.	☐				
►	Press shutdown button.	[redacted]				
79	AIRs open.	☐				
80	Battery indicator shows voltage <60V.	☐				
►	Start charging, unplug HV battery connector.	[redacted]				
81	AIRs open.	☐				
82	Charger disabled, no voltage at charger connector.	☐				
	INSULATION MONITORING DEVICE					
No.	Checkpoint	Checkbox	Comment			

83	IMD connected to vehicle side of the AIRs	☐				
►	Determine Rtest = (max TS voltage * 250 Ω/V) - BPR					
►	Activate charger output, connect RTest between TS+ and GLVS GND.					
84	Shutdown circuits opens within 30 s.	☐				
85	TS voltage decreases below 60VDC within 5 s after shutdown circuit opens.	☐				
86	Reactivation of charger output is not possible	☐				
87	Push the reset button, if any.	☐				
►	Reactivation of charger output is not possible.					
88	Remove RTest. Wait 40 s until IMD resets status output.	☐				
►	Reactivation of charger output is not possible.					
►	Activate TS, connect RTest between HV- and GLVS GND.					
89	Shutdown circuits opens within 30 s.	☐				
90	chassis ground measurement line connected to chrager housing?	☐				
-	IMD indicator light . . .					
91	. . . is available during charging	☐				
92	. . . is red and visible in bright sunlight.	☐				
93	. . . is visible for the ESO	☐				
	SEALING OF COMPONENTS					
No.	Checkpoint	Checkbox	Comment			
94	Seal accumulator container(s)	☐				
95	Seal charger	☐				
96	Additional part:	☐				
97	Additional part:	☐				
	OTHER COMMENTS					
	APPROVAL STATUS		Dashboard			
	Approval (Control box) (DON'T CHANGE MANUALLY)	FALSE				