

Formula Student Netherlands			
2025 Inspection Sheet			
Accumulator Inspection			
Car Number			
University			
	Failed items	Comments	
ESF			
Progress	0.00%		
	REQUIRED RESOURCES		
No.	Checkpoint	Checkbox	Comment
	- Accumulator container to be used during the event		
	- Accumulator Container Hand Cart		
	- Charger		
	- Tools needed for (dis-)assembly of Accumulator Container		
	- Laptop and cables to display data of the AMS		
	- Print-out of Rule Request (if applicable)		
	- 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 NOT ON A CELL PHONE		
	- Samples of all wire types used inside the accumulator container		
	- Samples of all used accumulator container material		
	- Power Supply for AIL/TSAL test		
	SAFETY BRIEFING		
No.	Checkpoint	Checkbox	Comment
	- No jewelry, 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	<input type="checkbox"/>	
	2 Insulated screw drivers	<input type="checkbox"/>	
	3 Insulated spanners, if applicable	<input type="checkbox"/>	
	4 Multimeter with protected probe tips	<input type="checkbox"/>	
	5 Two 4mm banana plug test leads (600V CAT III)	<input type="checkbox"/>	
	SAFETY EQUIPMENT		
No.	Checkpoint	Checkbox	Comment
	6 Face shield	<input type="checkbox"/>	
	7 Safety glasses (minimum three)	<input type="checkbox"/>	
	8 HV Insulating gloves (minimum two pairs)	<input type="checkbox"/>	
	9 HV insulating blankets (two) (min 1m²) with label or serial number and datasheet	<input type="checkbox"/>	
	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	<input type="checkbox"/>	
	11 Sufficient insulation and temperature rating of coating if used, datasheet available	<input type="checkbox"/>	
	12 Coating process according to datasheet	<input type="checkbox"/>	
	13 The 1 min AC RMS isolation test voltage is ≥ 3x max. TS voltage	<input type="checkbox"/>	
	14 The working voltage of the isolation barrier, if specified in the datasheet, is higher than the maximum TS voltage	<input type="checkbox"/>	
	HAND CART		
No.	Checkpoint	Checkbox	Comment
	15 Hand cart has four wheels	<input type="checkbox"/>	
	16 Hand cart has maximal dimensions of 1200mm x 800mm	<input type="checkbox"/>	
	17 Hand cart has always on type brake system	<input type="checkbox"/>	
	18 Hand cart can easily be moved if brake is released	<input type="checkbox"/>	
	19 The accumulator must be mechanically fixed to the handcart while on the handcart	<input type="checkbox"/>	
	20 The accumulator must be protected from vibrations and shocks	<input type="checkbox"/>	
	21 Firewall made from rigid fire retardant material	<input type="checkbox"/>	
	22 Firewall (same width as hand cart, from lowest point to 30 cm above TSAC/handle, transparent above 1.3m from the ground) must protect the operator	<input type="checkbox"/>	

	23	Label according to EV5.3.8 on the firewall below 1.3m from the ground	<input type="checkbox"/>	
CHARGER ASSEMBLY				
No.		Checkpoint	Checkbox	Comment
	24	Completely closed (no open TS connections), test with probe (100mm length, 6mm diameter)	<input type="checkbox"/>	
	25	Interlock integrated	<input type="checkbox"/>	
	26	TSMP integrated	<input type="checkbox"/>	
	27	Red emergency shutdown button integrated ≥24mm diameter	<input type="checkbox"/>	
	28	TSAL indicator integrated. Must be hard-wired electronics	<input type="checkbox"/>	
	29	Switches, plugs and indicators must be labeled	<input type="checkbox"/>	
	30	TS wiring is orange, marked with gauge, temperature rating >85°C and voltage rating	<input type="checkbox"/>	
	31	Conductive parts of charging equipment and accumulator are connected to protective earth (PE) while charging	<input type="checkbox"/>	
	32	Conductive parts are grounded according to EV 3.1	<input type="checkbox"/>	
	33	Charger and accumulator casing made of at least 0.5 mm thick electrically conductive material or electrically insulated material	<input type="checkbox"/>	
		▶ Connect the accumulator to the charger. Check if no voltage is present		
	34	Check the grounding according to EV 3.1	<input type="checkbox"/>	
DIS-CHARGE CIRCUIT AND BODY PROTECTION RESISTORS				
No.		Checkpoint	Checkbox	Comment
		▶ Switch off Charger. Measure resistance between TS+ and TS- measuring points		
	35	Resistance is 30 kΩ + discharge resistor	<input type="checkbox"/>	
	36	Body protection resistor power and voltage rating is sufficient	<input type="checkbox"/>	
	37	Resistor derating was considered for Power Rating	<input type="checkbox"/>	
ACCUMULATOR HOUSING				
No.		Checkpoint	Checkbox	Comment
	38	Vehicle number, university name and ESO phone number(s) written on a high contrast background	<input type="checkbox"/>	
		○ Roman Sans-Serif characters of at least 20mm high are used		
	39	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)	<input type="checkbox"/>	
	40	Check if all parts and the cover/lid of the housing are rigidly fastened	<input type="checkbox"/>	
		▶ 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 cell stack from the accumulator		
		▶ Compare ASES/ESF documentation with the stack on the card		
	41	Stack construction and ASES/ESF documentation are the same	<input type="checkbox"/>	
	42	Stacks are robust and rigidly fastened to the container	<input type="checkbox"/>	
	43	Stacks are insulated and separated by barrier according to UL94-V0, FAR25 or equivalent	<input type="checkbox"/>	
	44	Cell tabs must not be mechanically loaded	<input type="checkbox"/>	
		▶ If the cells are fixed using friction		
	45	Friction design is the same as in the ASES and was approved	<input type="checkbox"/>	
	46	Mockups for testing are representative with actual implementation	<input type="checkbox"/>	
		▶ If the cells are fixed otherwise		
	47	At least 80% of the large surface area is used for fixing the cells	<input type="checkbox"/>	
	48	No cells are damaged or can be damaged by the segment structures	<input type="checkbox"/>	
	49	Cells securely fastened towards all 3 directions	<input type="checkbox"/>	
	50	All parts carrying cells and loads are made of UL94-V0 or equivalent certified materials	<input type="checkbox"/>	
		▶ For all cell stacks		
	51	A minimum of 30% of cells are monitored with temperature sensors	<input type="checkbox"/>	
	52	Every temperature sensor placed directly on negative terminal of monitored cell or in <10mm distance on busbar	<input type="checkbox"/>	
	53	All connections from a TS component to external devices, such as laptops must include galvanic isolation	<input type="checkbox"/>	
	54	Internal vertical walls have to be rigidly fastened to the container	<input type="checkbox"/>	
	55	Internal vertical walls go up to the lid	<input type="checkbox"/>	
	56	Internal vertical walls divide the accumulator in sections of maximum 12 kg	<input type="checkbox"/>	
		▶ Present all Accumulator container materials		
		▶ Compare samples with Accumulator container		
	57	Samples and accumulator container are of equal quality	<input type="checkbox"/>	
ASSEMBLY				
No.		Checkpoint	Checkbox	Comment
	58	All components and parts of the TSAC need to be properly fixed	<input type="checkbox"/>	
	59	All used fasteners must be secured by the use of positive locking except they are non-conductive and non-structural	<input type="checkbox"/>	
	60	TS potentials are insulated against inner wall of accumulator container if container made from conductive material	<input type="checkbox"/>	
	61	No soldering in high current path	<input type="checkbox"/>	
	62	Every container contains at least one appropriately sized and rated fuse	<input type="checkbox"/>	

63	Every container contains at least two appropriately sized and rated isolation relays	<input type="checkbox"/>	
64	Pre-charge relay is of mechanical type with appropriate voltage rating	<input type="checkbox"/>	
65	Isolation relays and fuses are separated from the cells by a barrier without holes according UL94-V0, FAR25 or equivalent	<input type="checkbox"/>	
66	Holes in container only for wiring harness, ventilation, cooling or fasteners if mechanical properties are not influenced	<input type="checkbox"/>	
67	Holes in the accumulator must not cover more than 25% of the surface of the wall	<input type="checkbox"/>	
68	Any covers over the holes must be fire retardant	<input type="checkbox"/>	
69	External openings not pointing towards hand cart operator	<input type="checkbox"/>	
70	Maintenance plugs are located at both poles of each stack (including first and last stack)	<input type="checkbox"/>	
71	Maintenance plugs removable without tools	<input type="checkbox"/>	
72	Maintenance plugs have positive locking mechanism	<input type="checkbox"/>	
73	Maintenance plugs must not be able to unintentionally create circuits or short circuits	<input type="checkbox"/>	
74	Stacks separated by maintenance plugs <120VDC and <6MJ	<input type="checkbox"/>	
75	Check opening in TS enclosures, try to reach TS potentials with insulated test probe (100mm length, 6mm diameter)	<input type="checkbox"/>	
76	If fully closed, an equalizing valve must be implemented	<input type="checkbox"/>	
WIRING			
No.	Checkpoint	Checkbox	Comment
77	All TS wires have proper overcurrent protection	<input type="checkbox"/>	
78	No other wires than TS wires are orange	<input type="checkbox"/>	
79	Securely anchored to withstand at least 200N, if outside of enclosure	<input type="checkbox"/>	
80	Located out of the way of possible snagging or damage	<input type="checkbox"/>	
81	TS and LV wires separated (not valid for Interlock)	<input type="checkbox"/>	
82	Every wire used in the Accumulator container (TS and LV) is rated for maximum TS voltage	<input type="checkbox"/>	
83	TS wires are marked with gauge, temperature rating >85°C and voltage rating	<input type="checkbox"/>	
84	Positive locking mechanism or if no positive locking possible, automotive certified components	<input type="checkbox"/>	
	► Check if insulated tools needed for the assembly of certified components are available		
85	Insulation is not only insulating tape or rubber-like paint	<input type="checkbox"/>	
86	One IMD ground line is connected to the accumulator container	<input type="checkbox"/>	
87	One IMD ground line is connected to the charger casing by a separate wired connection	<input type="checkbox"/>	
88	IMD connected to vehicle side of the AIRs	<input type="checkbox"/>	
INDICATOR LIGHT OR VOLTMETER			
No.	Checkpoint	Checkbox	Comment
89	Red Indicator light or voltmeter installed	<input type="checkbox"/>	
90	Marked with "Voltage Indicator"	<input type="checkbox"/>	
91	Visible while disconnecting the battery connector	<input type="checkbox"/>	
92	Hard wired electronics, supplied by TS on the vehicle side of the AIRs	<input type="checkbox"/>	
	► Activate LVS		
93	TSAL green light indicator on	<input type="checkbox"/>	
94	Green and easily visible in bright sunlight	<input type="checkbox"/>	
	► Connect power supply with 60VDC to accumulator TS connector with proper plugs, no measuring probes		
95	Indicator light on or voltmeter shows TS voltage present on the system	<input type="checkbox"/>	
96	Indicator light continuously on with same brightness	<input type="checkbox"/>	
97	Visible in bright sunlight	<input type="checkbox"/>	
98	TSAL green light indicator off	<input type="checkbox"/>	
ACCUMULATOR MANAGEMENT SYSTEM			
No.	Checkpoint	Checkbox	Comment
99	AMS is located in the TSAC	<input type="checkbox"/>	
	► Disconnect any AMS internal connector		
100	The AMS must open the shutdown circuit within 1s	<input type="checkbox"/>	
	► Disconnect AMS current sensor		
101	The AMS must open the shutdown circuit within 0.5s	<input type="checkbox"/>	
	► Ask the team to connect their laptop to the AMS		
	► Connect charger to battery/batteries. Ask the team to close AIRs.		
102	Cell voltages can be displayed in one overview	<input type="checkbox"/>	
103	Cell temperatures can be displayed	<input type="checkbox"/>	
104	Temperature and voltage limit according to ESF	<input type="checkbox"/>	
	► Confirm later under normal charging conditions		
105	Plausible accumulator current can be displayed	<input type="checkbox"/>	
	► Disconnect one SINGLE voltage sense wire, if any wires used		
106	The AMS must open the shutdown circuit within 0.5 s	<input type="checkbox"/>	
	► Disconnect one SINGLE temperature sense wire, if any wires used		
107	The AMS must open the shutdown circuit within 1 s	<input type="checkbox"/>	
INSULATION MEASUREMENT TEST			
No.	Checkpoint	Checkbox	Comment
	► Install maintenance plugs, close container housing		
108	Seal accumulator container	<input type="checkbox"/>	

	▶ Check low resistance connection between LVMP and PE/casing		
	▶ Choose test voltage to 500V		
	▶ Connect insulation tester to charger TS+ and LV ground		
	▶ Connect charger (do not activate charger) to accumulator, keep AIRs opened		
	▶ Measure resistance: Riso+ = MΩ		
109	Resistance is much higher than (min. 500Ω/V*Umax)	<input type="checkbox"/>	
	▶ Connect insulation tester to TS- and GLV ground		
	▶ Measure resistance: Riso+ = MΩ		
110	Resistance is much higher than (min. 500Ω/V*Umax)	<input type="checkbox"/>	
111	Resistances are nearly equal.	<input type="checkbox"/>	
CHARGER SHUTDOWN CIRCUIT			
No.	Checkpoint	Checkbox	Comment
112	IMD is integrated into the charging system	<input type="checkbox"/>	
	▶ Connect charger to accumulator, start charging process		
113	Voltage indicator shows that HV is present	<input type="checkbox"/>	
	▶ Press shutdown button		
114	AIRs open	<input type="checkbox"/>	
115	Voltage indicator shows voltage <60V	<input type="checkbox"/>	
	▶ Start charging, unplug TSAC connector		
116	AIRs open	<input type="checkbox"/>	
117	Charger disabled, no voltage at charger connector, measure on TSMP	<input type="checkbox"/>	
	▶ Reconnect TSAC connector		
118	Charger stays off	<input type="checkbox"/>	
INSULATION MONITORING DEVICE			
No.	Checkpoint	Checkbox	Comment
	▶ Determine Rtest = (max TS voltage * 250 Ω/V) - BPR		
	▶ Activate charger output, connect RTest between TS+ and LV GND		
119	Shutdown circuits opens within 30s	<input type="checkbox"/>	
120	TS voltage decreases below 60VDC within 5 s after shutdown circuit opens	<input type="checkbox"/>	
121	Reactivation of charger output is not possible	<input type="checkbox"/>	
	▶ Push the reset button, if any		
122	Reactivation of charger output is not possible	<input type="checkbox"/>	
	▶ Remove RTest. Wait 40s until IMD resets status output		
123	Reactivation of charger output is not possible	<input type="checkbox"/>	
	▶ Activate TS, connect RTest between TS- and LV GND		
124	Shutdown circuits opens within 30s	<input type="checkbox"/>	
	▶ IMD indicator light . . .		
125	. . . is available during charging	<input type="checkbox"/>	
126	. . . is red and visible in bright sunlight	<input type="checkbox"/>	
OTHER COMMENTS			
APPROVAL STATUS			
Approval (Control box) (DON'T CHANGE MANUALLY)		FALSE	
	Num True	0	
	Num False	126	