



Car Number

University Name

Please Note

All teams must submit the SES (Structural Equivalency Sheet), ASES (Accumulator SES) and SE3D (3D-CAD model) in the team area on the **FSAE Italy** website by the official deadline. The (A)SES must be checked and approved by a third party or another competition following the same rules. If changes to the (A)SES are required during the approval process, the updated (A)SES must be re-uploaded in the team area as soon as the FSG officials mark the previous upload as "Fail." A detailed changelog from the "Version History" tab of the (A)SES must accompany the SES Approval (SESA).

Reviewing an SES and ASES, together, requires at least 3-4 hours of the (A)SES reviewer's time. If issues are found, the reviewer should use the changelog to provide comments. The team must address these issues, and the reviewer should recheck them before submitting the SESA. The complete changelog of the SESA process must be included with the submission.

Please note: **[NEW]** the Accumulator/most of the EV5 section, has been separated from the SES and is reviewed independently in the ASES. If the reviewer, at own discretion, feels qualified to assess the structural integrity of the accumulator, it is required to indicate that this review has been completed.

(A)SES reviewer

Title, Name, Surname

Company

Street

City, Zip

Country

Phone Number

E-mail address

URL

I hereby declare that I have reviewed the SES (and at own discretion, ASES) and SE3D and can conclude that the final SES and SE3D have passed all requirements listed on the following pages.

City, Date, Signature, Stamp

#	SES Tab / Rule	Content	OK
1	Read Me	Template check, is the template used, the most recent one?	☐
2		Revisions Check for the Revisions in relation to new Rules!	☐
3	Version History	Version History If remarks by SESA Reviewer are incorporated in the SES, this Tab must be filled out as well!	☐
4	Rules Clarifications	Rules Clarifications Ask Team if they have sent Rules Questions, relevant to the Chassis/Primary Structure/TSAC (Tractive System Accumulator Container) & check that answers to Rules Questions are correctly implemented in SES	☐
5	Cover Sheet	Cover Sheet duly completed (team name, contact details, international material-nr. or material name, number of layers, layer orientation, core thickness, type of resin)	☐
6		Receipt for used materials, proof for non-steel materials on TAB "Additional Info"	☐
7		Attachment Checklist filled out, see cells T51-56	☐
8	Chassis Pictures	Chassis Pictures colour code for different materials or different composite layups (if asymmetrical layups present, check orientation inner and outer skin in all subsequent TABs)	☐
9		Proof of materials = used materials for different areas?	☐
10		3 different views and an isometric view is shown	☐
11		angle of main and front hoops, angle between main hoop bracing and main hoop, distance from top of main hoop to main hoop bracing attachment, distance from top of front hoop to front hoop bracing attachment, outer diameter and wall thickness of all tubes / mono-coque layup? (cross-check with SE3D)	☐
12		[EV ONLY] HV components included, coloured orange	☐
13		[CV ONLY] Fuel tank and filler neck included, coloured red	☐
14		Holes in members of the primary structure with a cross sectional $>60mm^2$ must be marked with purple (e.g. holes for cooling, service hatch etc.)	☐
15		"Compliance Shown?" Checklist filled out, see cells R12-20	☐
16	Tab A2.2 First year vehicle	Did the team truthfully provide sufficient proof of manufacturing a new chassis (side-by-side pictures of old vs. new build, alternatively clarification of changes if any)? If re-using existing chassis, does the team comply with Rule A2.2.3 (cell B6 filled out and additional comment given)?	☐
17 1	Material Data	Material data and values for each different laminate must be provided. Also, if applicable, are values for used aluminium (also as in welded condition) provided? And is the used welding method documented and suitable?	☐
18	Tab T3.6 Laminate Tests Tab T3.6.10 Shear Tests Rules T3.5 + T3.6	3 point bending test (3-PBT) test sample 275x500 mm / load applicator Ø100 mm / support span >400 mm (test specimen with closed flanges are NOT accepted)	☐
19		Proof for SIS with 2 baseline tubes (T3.2.1), other different laminate structures require additional tests with baseline materials (T3.2.1)	☐
20		Check rig compliance value (if below >85%, additional test with baseline material required)	☐
21		If same lay-up used in structures with different core thicknesses, check that laminate with thickest core is tested.	☐
22		Calculated absorbed energy from start up to max. 12.7 mm, and within reasonable load carrying capability of the laminate.	☐
23		SIS - Absorbed energy must be equal or bigger than that of the two baseline tubes and must be at least 65 Joules!	☐
24		Perimeter shear test sample 100x100 mm on a plate with Ø32 mm hole and with a punch of Ø25 mm	☐
25		Compare values from diagram with values from the TAB	☐
26		Check the evidence of the used material values! If asymmetrical lay-up is used, the thinner skin must face the punch.	☐

¹ If the ply layup (number of plies, orientation used material) is the same but the core thickness is different, it is still acceptable to use the derived properties from one laminate panel test. If the core thickness is the same but

the number of plies or the orientation or the used material is different than additional test are required (T3.5.3).

27	Tab T3.9 Main Hoop Tubing Rules T3.8 + T3.9	Main Hoop [MH] must be a single piece of uncut, continuous, closed section steel tube	☐
28		MH angle- (shown in TAB "Chassis Pics") above the top of the major structure must be inclined less than 10deg from vertical.	☐
29		MH angle - below the top of the major structure can be inclined in forward direction at any angle to the vertical, in the rearward direction, maximal 10deg to the vertical	☐
30	Tab T3.10 Front Hoop Tubing Rules T3.8 + 3.10	Front Hoop [FH] angle between the FH and the vertical is inclined less than 20deg	☐
31		FH - If FH is of welded construction, check data input for suitable welding and heat treatment method	☐
32		FH - Check the evidence of the used values! (Material Data for Aluminium and physical test sample "in welded condition" and dimension in SE3D)	☐
33	Tab T3.11 Main Hoop Bracing Rules T3.11	Main Hoop Bracing [MHB] must be made of a straight tube, on both sides of the MH; directed in inclination from the main hoop	☐
34		MHB - must be attached to the main hoop no lower than 160 mm below the top-most surface of the main hoop. The included angle formed by MH and the MHB must be at least 30deg.	☐
35		MHB - support made of steel tubes must be properly triangulated to the bottom of the main hoop and upper member of the SIS	☐
36		MHB - Check the evidence of the used values in SE3D!	☐
37	Tab T3.11.5 T3.6 MH Bracing Spt Rules T3.11 + T3.5-7 + T3.16	Monocoque Main Hoop Bracing Support [MHBS] (T3.15 must be applied) 30 kN for each attachment point, for each support 2 M8 Grade 8.8 bolt or 1 M10 Grade 8.8 bolt.	☐
38		MHBS - Check laminate 3-PBT!	☐
39		MHBS - Check the shear strength of the laminate!	☐
40		MHBS attachment - Check the calculation of the welding seam + backing plate perimeter	☐
41		MHBS - Check the evidence of the used values for the weakest cross sectional area, check for the correct measurement (if alternative proof of equivalence is provided) of the cross sectional inertia (measurement must be verifiable in SE3D, T3.7.3)!	☐
42		MHBS - Check that the laminate's orientation is corresponding with given proof and laminate test!	☐
43	Tab T3.12 T3.6 FH Bracing Rules T3.12 + T3.5-7	Front Hoop Bracing [FHB] extended to the drivers feet in front direction; attached on both sides, max. 50.0 mm below top of front hoop	☐
44		FHB - If FH > 10 degree inclined to the rear, additional support to the rear is required	☐
45		FHB - Check laminate 3-PBT!	☐
46		FHB - Check the shear strength of the laminate!	☐
47		FHB - Check the evidence of the used values for the weakest cross sectional area, check for the correct measurement (if alternative proof of equivalence is provided) of the cross sectional inertia (measurement must be verifiable in SE3D, T3.7.3)!	☐
48	Tab T3.14 T3.6 FBH Spt Structure Rules T3.14 + T3.5-7	Front bulkhead support [FBHS] check the drivers leg protection	☐
49		FBHS - In side view max. 50 mm from top of front bulkhead and from front bulkhead back to the front hoop	☐
50		FBHS - EI of the FBHS must be equivalent to the sum of the EI of the six (6) baseline steel tubes	☐
51		FBHS - EI of vertical side of the FBHS (T3.14.3) = EI from one baseline tube	☐
52		FBHS - Check laminate 3-PBT!	☐
53		FBHS - Shear strength (T3.14.4) min. 4kN	☐
54		FBHS - Check the evidence of the used values for the weakest cross sectional area, check for the correct measurement (if alternative proof of equivalence is provided) of the cross sectional inertia (measurement must be verifiable in SE3D, T3.7.3)!	☐

55	Tab T3.13 T3.6 Ft. Bulkhead Rules T3.13 + T3.5 + T3.6	Front Bulkhead [FBH] if L-shaped, the EI of the vertical and horizontal axis must be equivalent to steel	☐
56		FBH - L maximum 25.0 mm towards to the inside	☐
57		FBH - Check dimensions of cut out in SE3D!	☐
58		FBH - Shear strength of bulkhead equivalent to a 1.5 mm thick steel plate (T3.13.1)	☐
59		FBH - Check laminate 3-PBT and laminate perimeter shear test (check for correct orientation of inner and outer skin)!	☐
60		FBH - Check the evidence of the used values (actual geometry calculations are not permitted for the FBH)!	☐
61	Tab T3.17.3 IA AI Plate Rules T3.17.3 - T3.17.7 + T3.16.6	Anti-Intrusion Plate [AIP] 1.5 mm steel or 4 mm aluminium or composite material if approval given	☐
62		Attached with min. 8 x 8 mm Grade 8.8 bolts (proof in longitudinal and transversal direction for alternative attachments), or per T3.16.6 proof of equivalence must be provided in Tab T3.16.6 + 3.17.5 Prim. Struct. Att.	☐
63		If blind inserts are used, proof of compliance with T3.16.7 (physical tests withstands min. 15 kN in the two weakest directions) must be provided in Tab T3.16.7 Prim. Struct. Att. Blind	☐
64		If composite material check laminate test or results of composite IAD test. Failure of FBH is not allowed!	☐
65	Tab T3.15 T3.6 SIS Rules T3.15 + T3.5 + T3.6	Side impact structure [SIS] SIS incl. bottom until 320mm above the lowest inside chassis point <i>geq</i> EI of 3 baseline tubes	☐
66		SIS (up to 320mm above the lowest inside chassis point) $\geq$ EI of 2 baseline tubes	☐
67		Horizontal floor to the middle of the car (on the weakest area) $\geq$ EI of 1 baseline tube	☐
68		SIS between the upper surface of the bottom up to 320mm above the lowest inside chassis point must have an absorbed energy equivalent to two baseline steel tubes -> see Figure 9	☐
69		Shear strength (T3.15.2) min. 7.5kN	☐
70		Check laminate 3-PBT (see also: energy absorption value must be greater than the absorbed energy of the baseline test)!	☐
71		Check the evidence of the used values for the weakest cross sectional area (actual geometry calculations are not permitted for the SIS). Check for the correct measurement (panel height)!	☐
72	Tab T4.5 T5.5 SHB Rules T5.5 + T4.5	Shoulder Harness Bar [SHB] Stiffness must be equivalent to 1 baseline tube	☐
73		SHB - Check measurement of used panel height, see T4.5 Guidance Notes	☐
74		SHB - Check laminate 3-PBT!	☐
75		SHB - Check that max. deflection and maximum bending stress values are feasible	☐
76		SHB - Check the evidence of the used values for the weakest cross sectional area, check for the correct measurement (if alternative proof of equivalence is provided) of the cross sectional inertia!	☐
77	[EV only] Tab EV5.5.1-2 & EV4.4 ACPS TSPS Side & Rear Rules EV5.5.1-2 + T3.15 + EV4.4	TSAC & TSPS (Tractive System Protection Structure) All components below 350 mm above the ground must be protected against side & rear impact with a structure. Analogue to Tab T3.15 T3.6 SIS!	☐
78		Horizontal floor of the SIS (on the weakest area) $\geq$ EI of 1 baseline tube	☐
79		SIS between the upper surface of the bottom up to 320mm above the lowest inside chassis point must have an absorbed energy equivalent to two baseline steel tubes (T3.14)	☐
80		Shear strength (T3.15.4)	☐
81		Check laminate 3-PBT!	☐
82		Check the evidence of all dimensions and material values used!	☐
83	Tab T3.16 MH & MH B'ing Attachments Rule T3.5.5-6 + T3.6.11 + T3.16	Main Hoop Attachment Analogue to rule T3.16	☐

84		Check the evidence of all dimensions and material values used!	☐
85	Tab T4.5 Harness Attachments Rules T4.5 + T5.3	Harness Attachments Shoulder and lap belt attachments must be tested (harness attachment bracket incl.)	☐
86		Distance from the test specimen to the load application point must be at least 125 mm away	☐
87		Test specimens must reflect the design of the car used in competition	☐
88		Check the panel height in SES with test specimen dimension!	☐
89		Shoulder and lap attachment must support a load of 13 kN, anti-submarine attachment 6.5 kN; lap and anti-submarine at the same attachment point 19.5 kN	☐
90	Tab T3.16 FH & FH B'ing Attachments Rule T3.5.5-6 + T3.6.11 T3.10.5-6 + T3.16	Front Hoop Attachment Analogue to rule T3.16, no lower than 50 mm from top of FH	☐
91		Fully laminated in is accepted if a calculation of the equivalence to four attachment points is shown (min. 6 x 30kN)!	☐
92		Check the evidence of all dimensions and material values used!	☐
93	Tab 3.16.6-7 & 3.17.5 Prim. Struct. Att. Rule T3.16.6-7	Primary Structure Attachment of Plates/Panels (e.g. AIP to Bulk-head, Rear TSPS) Equivalency to a minimum number of 8 mm Metric Grade 8.8 bolts, as follows from attached panel/plate outer perimeter	☐
94		Distribution of required number of bolts according to good engineering practises	☐
95		If blind inserts are used, proof of compliance with T3.16.7 (physical tests withstands min. 15 kN in the two weakest directions) must be provided in Tab T3.16.7 Prim. Struct. Att. Blind	☐
96		Check the evidence of all dimensions and material values used!	☐
97	In General - all Tab's T3.16 Rule T3.5.5-6 + T3.16	Hoop Attachment Points each must carry a load of min. 30 kN in each direction	☐
98		Mounting plates, backing plates and inserts must have sufficient shear area, weld area and strength (check shear strength rule T3.15)	☐
99		Mounting plates, backing plates 2 mm steel (NO alternative, NO cut-outs in backing plate, must be near circular or near oval)	☐
100		Each attachment point must have 2 bolts, 8mm Grade 8.8 or equivalent	☐
101		Front and main hoop bracing attachment 1 bolt M10 Grade 8.8 is acceptable	☐
102		No crushing of the core is permitted rule T3.16.5	☐
103	Tab T1.2.1 T4.8 Firewall Rules T4.8	Datasheet of fire resistant material provided	☐
104		Heat insulation conditions all filled out? And is the firewall concept described? (Concept cannot be solely dependent on tape to be able to pass a rain test)	☐
105		Check the evidence of the used thickness values!	☐

[EV ONLY]

#	SES Tab / Rule	Content	OK
106	Tab EV5.5. Acc. Attachments Rules EV5.5 + EV5.5.9	Accumulator Attachment 20 g in vertical direction, 40 g in longitudinal and lateral direction. Calculation, simulation (not stand-alone) and/or physical test required	☐
107		TSAC Attachments Brackets / backing plates 1.6 mm steel or 4 mm aluminium	☐
108		Check the evidence of all dimensions and material values used!	☐

Assessment at own discretion, ASES [EV ONLY]

#	ASES Tab / Rule	Content	OK
109	Tab Accumulator Pics	Accumulator Pics For each part of the accumulator a clear illustration is provided. Tables are duly completed.	☐
110	Tab EV5.5.4 Alt. Matl - 3pt Bending - Shear, Matls Summary Rules EV5.5, EV5.5.4 + EV5.5.6	3 point bending test test sample 275x500 OR 150x275 mm / load applicator Ø100 OR min. Ø10mm if smaller panel is used / support span >400 mm OR >200 if smaller panel is used	☐
111		If same lay-up used in structures with different core thicknesses, check that laminate with thickest core is tested.	☐
112		Perimeter shear test sample 100x100 mm on a plate with Ø32 mm hole and with a punch of Ø25 mm	☐
113		Compare values from diagram with values from the TAB	☐
114		Material per rule EV5.5.5 or equivalent, if equivalence is shown	☐
115		Check the evidence of all dimensions and material values used!	☐
116		Datasheets of fiber, other materials and glue duly completed. Materials overview complete?	☐
117		Check used material is fire resistant according to UL94 V-0 or FAR 25.853(a)(1)(i).	☐
118	Tab EV5.5.9 Segment, TSAC Attachments, Cell-fixation and Fasteners Rules EV5.5.7-13	In all Tabs structural compliance for 20 g in vertical direction, 40 g in longitudinal and lateral direction. Calculation, simulation (not stand-alone) and/or physical test required.	☐
119		Cell fixation compliance with EV5.5.9 and if cell fixation relies on friction: physical testing required.	☐
120		Fasteners Tables duly completed, proof for T10 (if needed) must be shown and/or explained.	☐
121	Tab EV5.5.14-17 Openings & Separation	Table duly completed.	☐
122		For each table entry, proof per illustration provided?	☐



Changelog / Comments

SES Tab / Rule	Comments