How to create a good SES with less mistakes?

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FS PIT TALKS

27/02/25

TALK CONTENTS

- ➔ WHAT'S NEW?
- ➔ SES COMMON MISTAKES
  - ◆ GENERAL
  - ◆ TUBULAR CHASSIS
  - ◆ MONOCOQUE CHASSIS
- ➔ ASES COMMON MISTAKES
- ➔ SES/ASES DURING TECH. INSPECTION
- ➔ DOUBTS & QUESTIONS

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WHAT'S NEW?

CHANGES FOR 2025

Dropped requirement for significant changes (*A2.2.2*) - **New manufactured chassis is required.**

AIP is now considered **primary structure** (*T1.1.12*).

Added **fire retardant standard for foams**: UL94HF-1 and UL94 VTM-0 (*T1.2.1*).

Introduced **malus for low property steels** (*T3.2.4*) - Use the standard values or the ones present in the datasheet, **whichever is lower.**

Limited usage of alternative **proof of equivalence per actual EI** (*T3.4.1*) - Only applicable if the flat panel EI exceeds **60% of the minimum requirements** .

WHAT'S NEW?

CHANGES FOR 2025

Relaxed requirement for asymmetrical laminates (*T3.4.4*) - Thk ≥ 40% thicker skin or 1 mm, whichever is lower.

New requirement for asymmetrical laminates shear tests (*T3.5.10*) - The thinner skin must face the punch.

Extended requirements within the **SE3D** (*T3.6.3*).

Stricter requirement on harness attachment brackets/tabs (*T4.5.5*) - All except steel must be physically tested.

Enforced backing plate also in AIP to FBH attachment and bolted panels or plates of the primary structure (*T3.15.6*).

Introduced **physical testing requirement for usage of blind inserts** in primary structure attachments (*T3.15.7*).

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WHAT'S NEW?

CHANGES FOR 2025

New document - ASES (*T3.6.1, EV5.5.4*).

Changed minimum wall height (*EV5.5.7*) - Accumulator internal walls must extend upwards until the lid.

Defined minimum number of attachment points (2) for TSAC mounting (*EV5.5.13*).

Removed redundant force (20 kN at any direction) **requirement for TSAC mounting points** (*EV5.5.13*).

TSAC walls holes can extend to the edge of a wall (*EV5.5.14*)

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SES COMMON MISTAKES

General

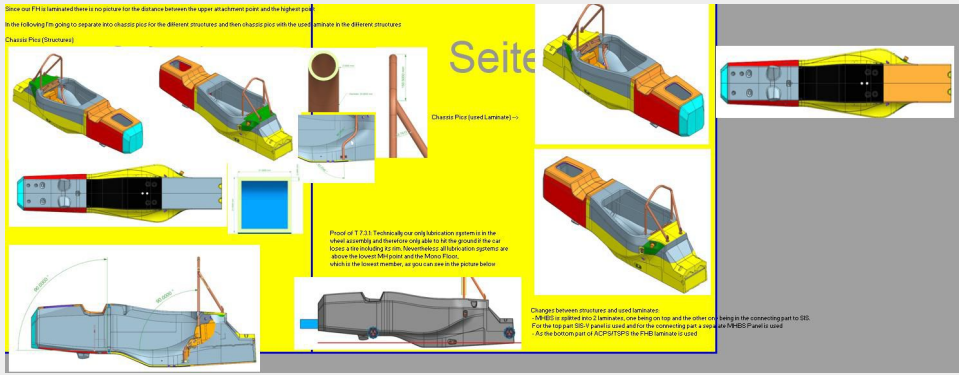
Missing images and required dimensions on tabs:

- ➔ *Chassis pics*
- ➔ *FBH, FHB, FBHS, AIP…*
- ➔ *Firewall, SHB.*

University Name _____ Car No.(s) & Event(s) _____

Please attach pictures of the frame and/or monocoque in the table below for review during the SES process. **All tubes/lay-ups must be colour coded to show outer diameter and wall thickness.** Three view drawings and isometric views of the structure (CAD, FEA models, etc) are acceptable. **Note: Identical composite layups need the identical colour code beyond borders of their specific laminate structure! Maybe you need to work with two picture sets (Structures & your design)**

Images must include dimensions/labels indicating the following:	Compliance shown?
Angle of main and front hoops, including angle of main hoop below upper side impact tube.	Yes
Angle between main hoop bracing and main hoop	Yes
Distance from top of main hoop to main hoop brace attachment	Yes
Distance from top of front hoop to front hoop brace attachment	No
Outer diameter and wall thickness of all tubes / monocoque lay-up	Yes
Compliance to T 7.3.1 - Protection of lubrication systems	Yes
Teams entering cars with IC Powertrains must show the location of the fuel tank and complete filler neck inside rollover protection structure (CV¥2.2.2) in all images and highlight them in the colour red.	N/A
Teams entering cars with EV Powertrains must show the location of all HV components in these images and highlight them by colouring them orange.	Yes
Teams with breakthroughs/cutouts/holes in the laminated primary structure greater 60 mm² must show their location in these images and highlight them by colouring them purple. These breakthroughs/cutouts/holes must also be shown in the SE3D-	Yes

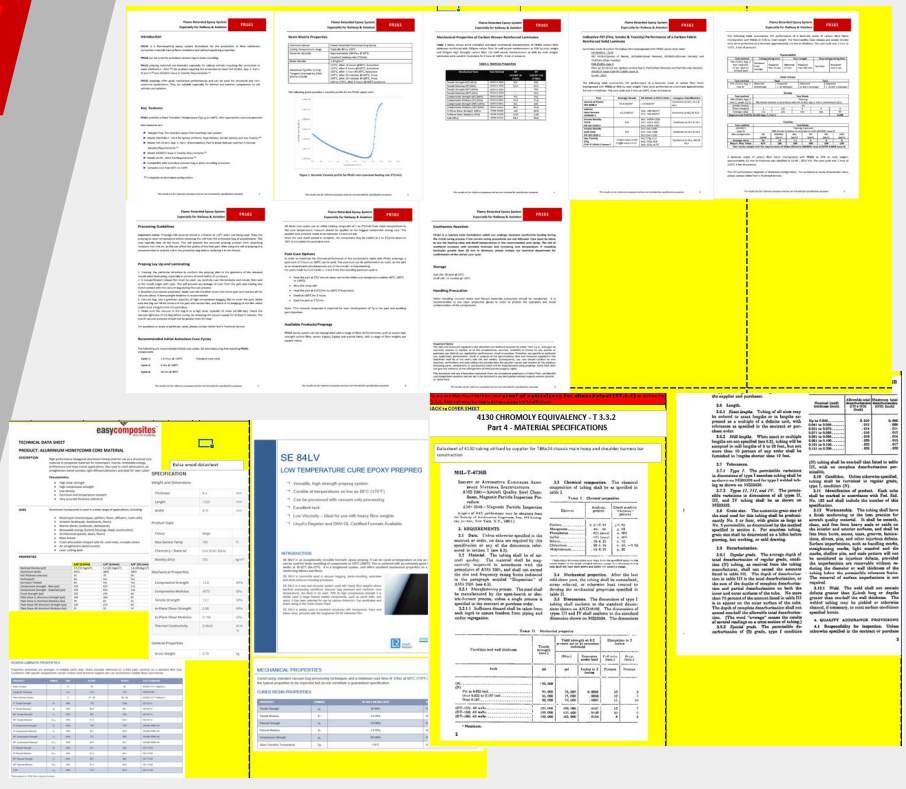


SES COMMON MISTAKES

General

Missing datasheets and/or proof of purchase for relevant materials.

- Steel.
- FRP.
- Resins and adhesives.
- Foams and other cores.



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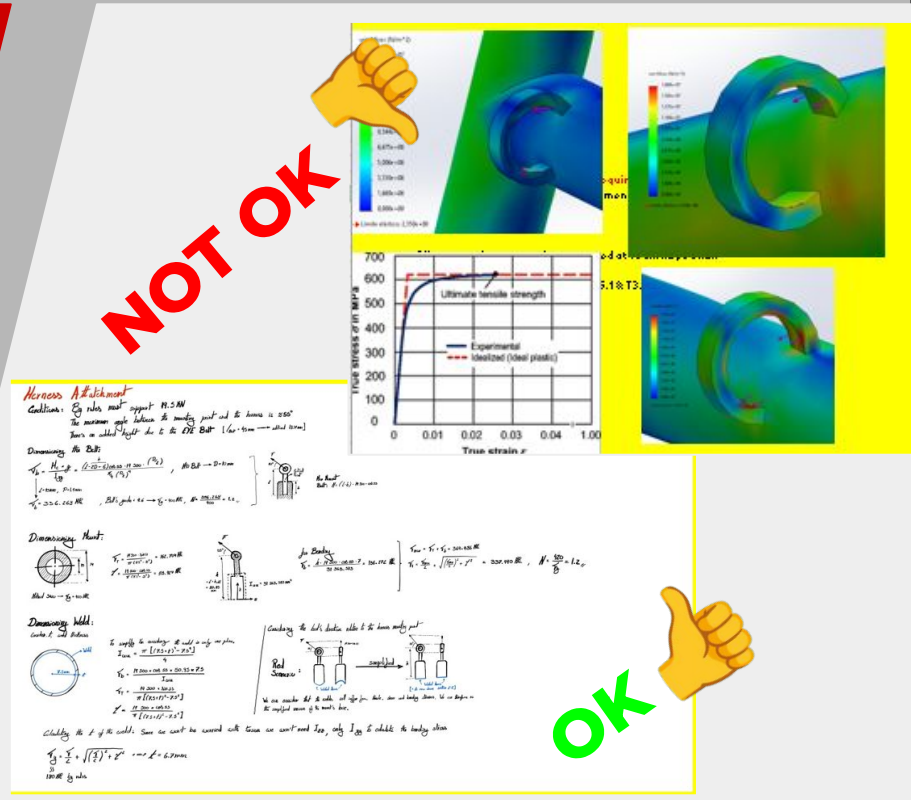
SES COMMON MISTAKES

General

Strength justification by means of FEM images without proper model description.

TIP! Try to use analytical calculations whenever possible.

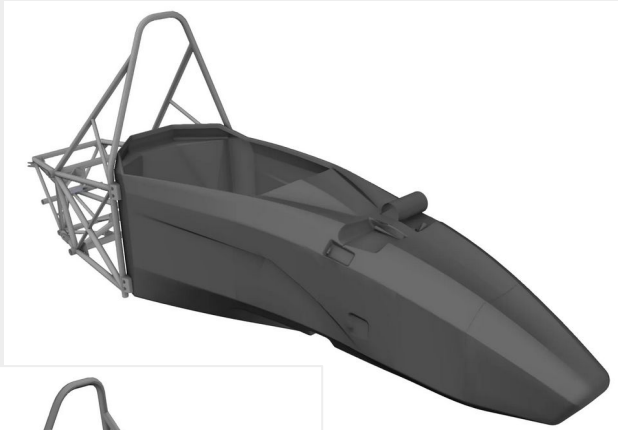


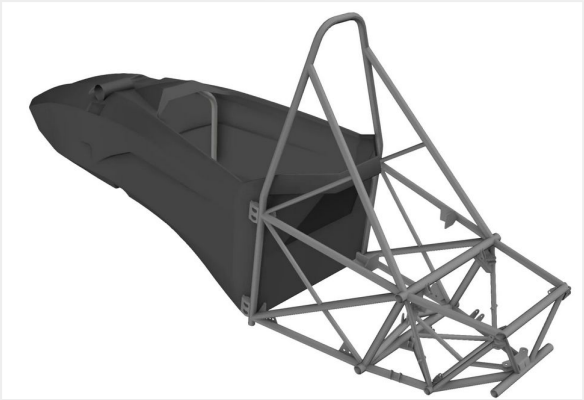
SES COMMON MISTAKES

General

SES and SE3D do not reflect the same version of the car.

Different tabs of SES reflect different versions of the car.





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SES COMMON MISTAKES

General

Poor visibility of values in CAD captures and other required photographies.

NOT OK

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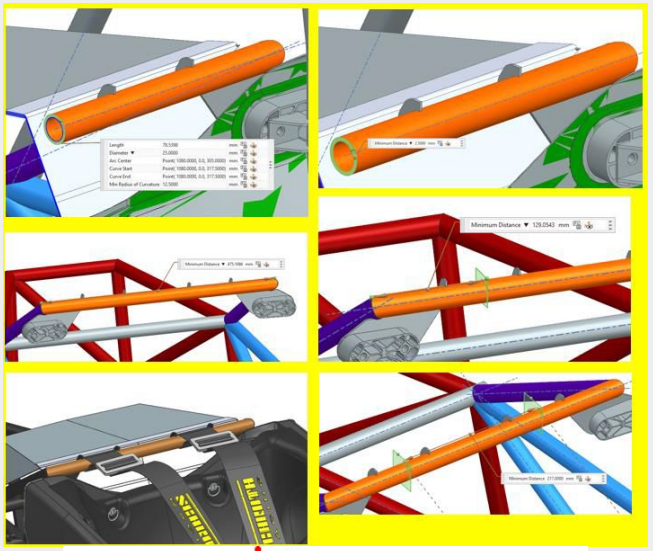
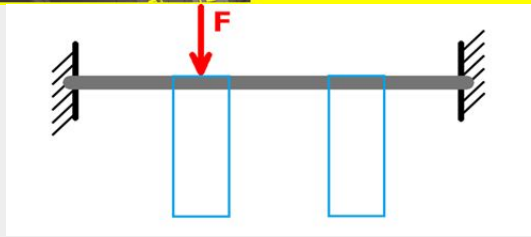
SES COMMON MISTAKES

General

Wrong harness distance on tab *T5.5 Shoulder Harness Bar*.



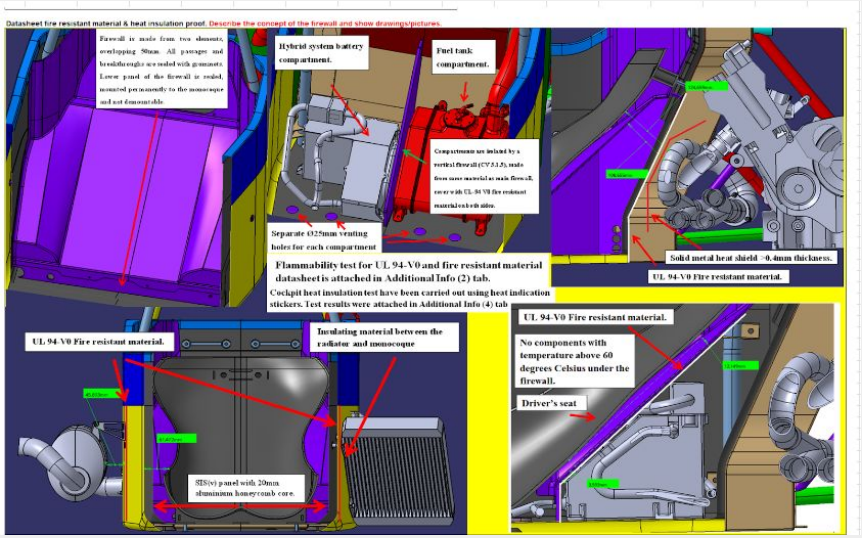


SES COMMON MISTAKES

General

Lack of clear information on firewall lay-up and assembly to the structure.

Example of good firewall description

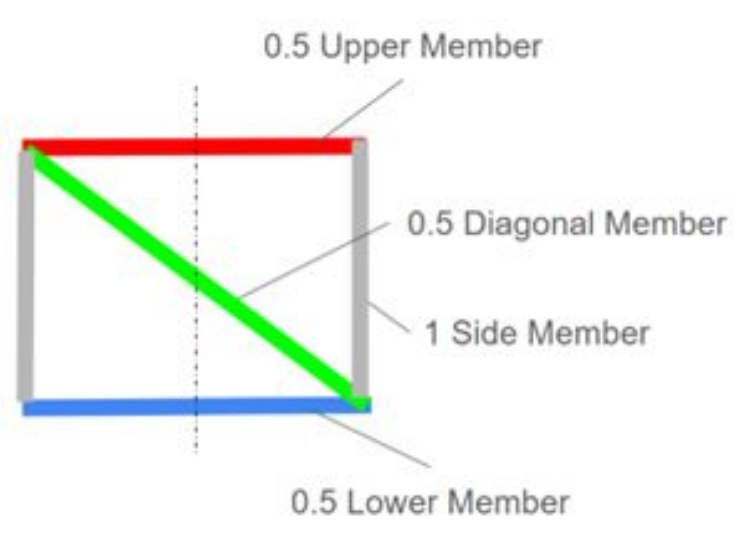


SES COMMON MISTAKES

Tubular chassis

Incorrect tube count → Typically on FBH, FBHS and (EV only) ACPS/TSPS Rear

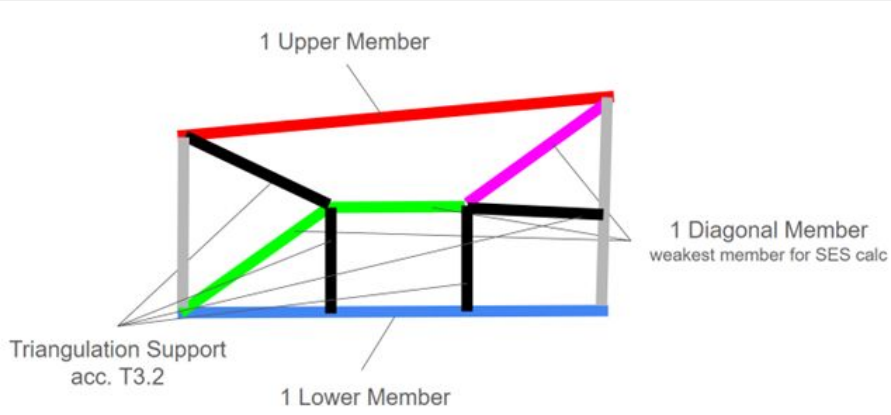
FBH - ACPS/TSPS Rear Example



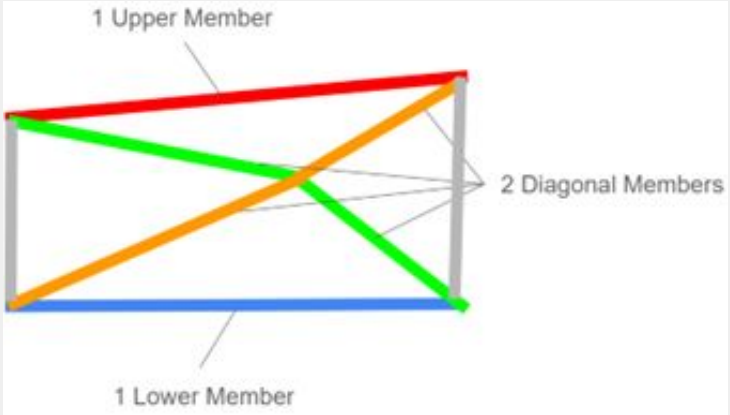
N° of tubes = 2.5

SES COMMON MISTAKES

FBHS Examples



N° of tubes = 3



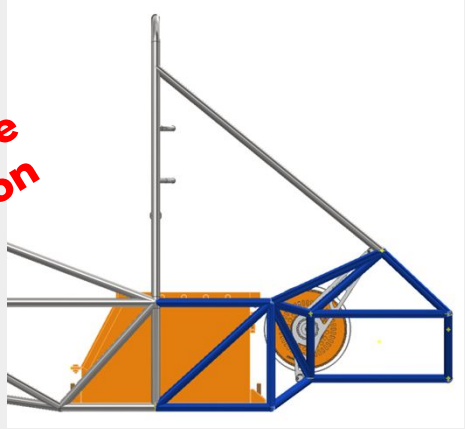
N° of tubes = 4

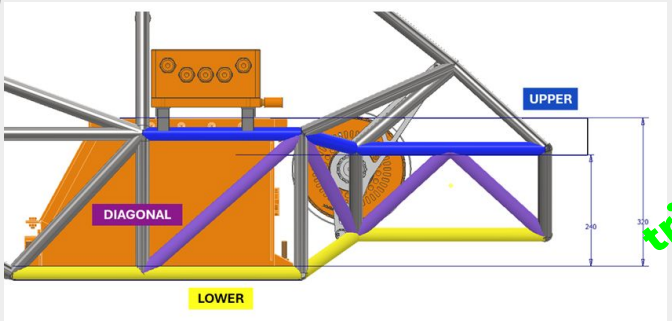
SES COMMON MISTAKES

Tubular chassis

Wrong structure triangulation :
FBHS, SIS and (EV only)
ACPS/TSPS side.

Inappropriate triangulation



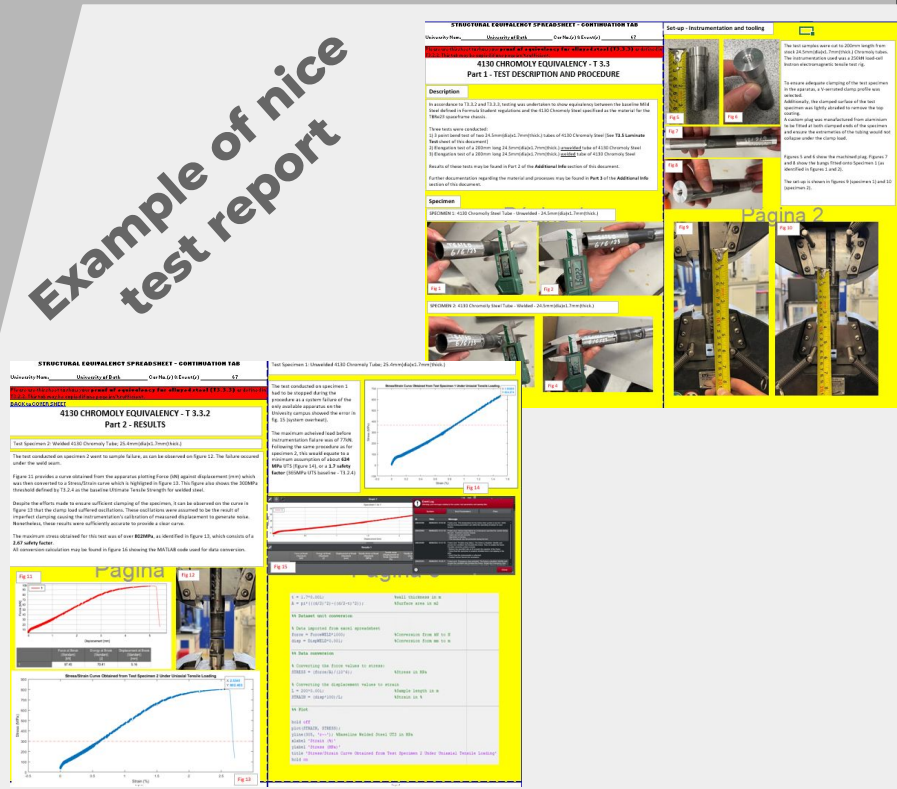


Good triangulation

SES COMMON MISTAKES

Tubular chassis

Lack of test for strength on welded condition when using alloyed steels.



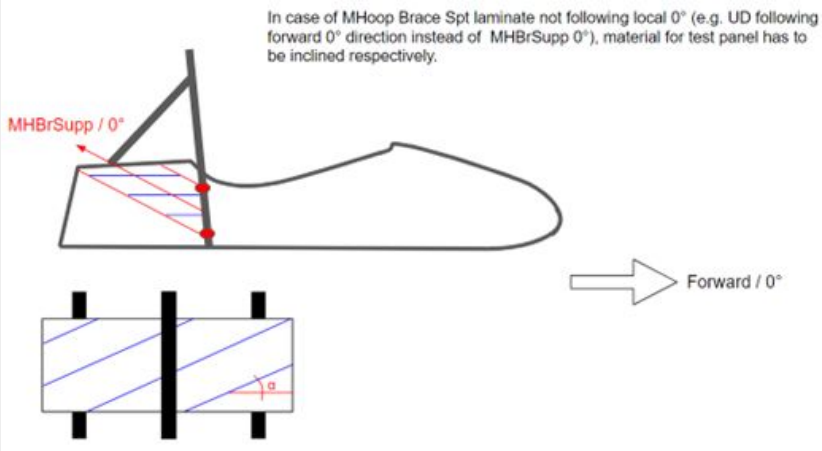
SES COMMON MISTAKES

Monocoque chassis

Wrong panel height calculation, typically on MHBS, FHB, FBHS.

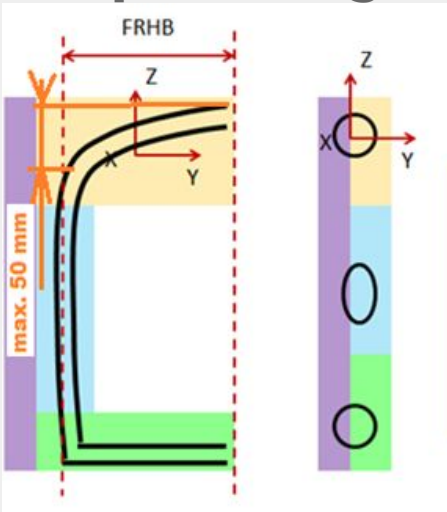
Important! Always consider the most restrictive measure in case of holes or cuts in the panel.

MHBS Panel height calculation

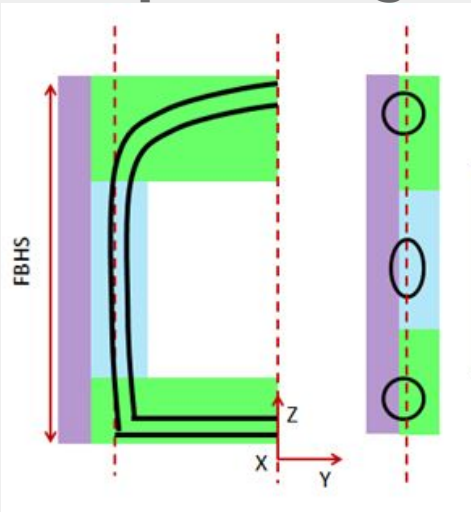


SES COMMON MISTAKES

FHB panel height



FBHS panel height



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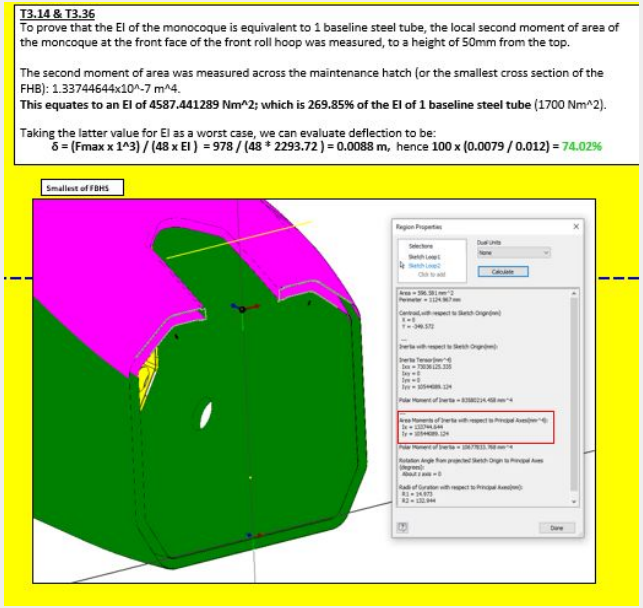
SES COMMON MISTAKES

Monocoque chassis

Incorrect calculation of skins inertia for the geometrical probe of panel strength.

Example of FHB panel strength equivalence



SES COMMON MISTAKES

Monocoque chassis

Incorrect election of peak values or reference points for gradient calculation in alternative material test results (3 point bending and shear tests).

Reference points don't match with test graph

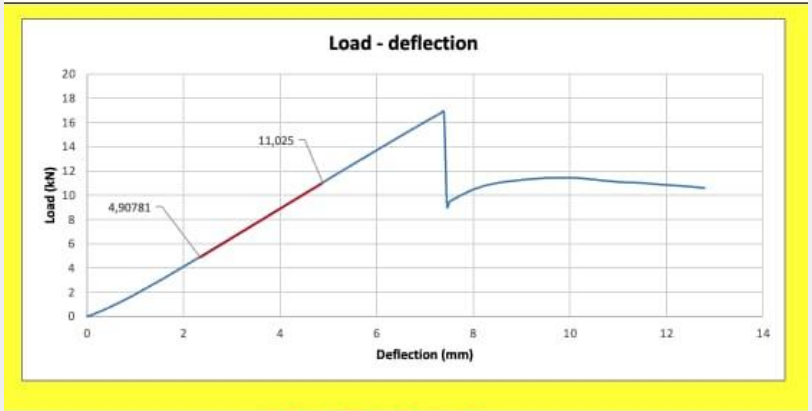


Figure 2: Load Deflection Curve for vertical Side impact structure

Enter values for minimum and maximum load/deflection in linear-elastic region.
Gradient must be >= that of two baseline steel tubes

x_1 (mm)	3,344	y_1 (N)	4907,813	Gradient (N/mm)	3204
x_2 (mm)	5,877	y_2 (N)	11025		

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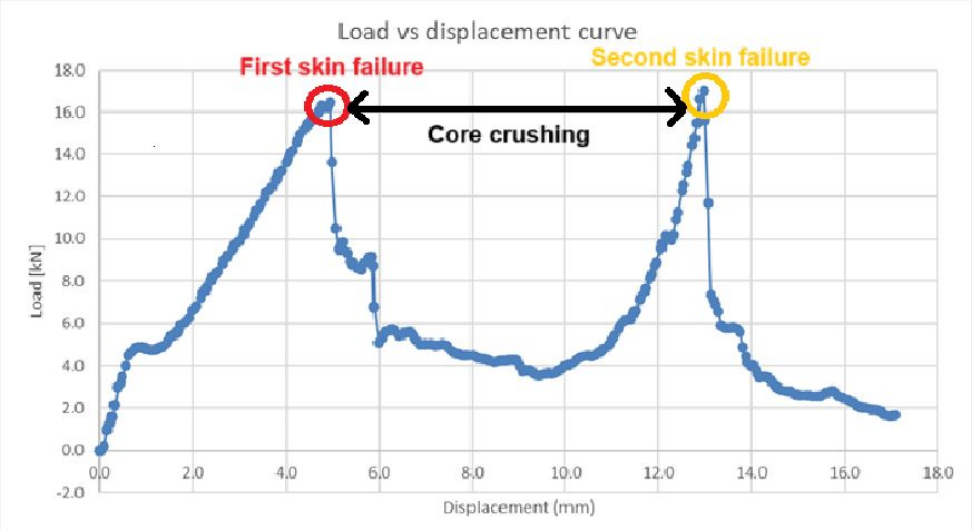
SES COMMON MISTAKES

Peak identification in shear tests



2025 SES RELEVANT CHANGE

Change in rig compliance consideration

Rig compliance minimum value increased to 85% (previously 75%).

Relation between rig compliance and gradient calculation removed.

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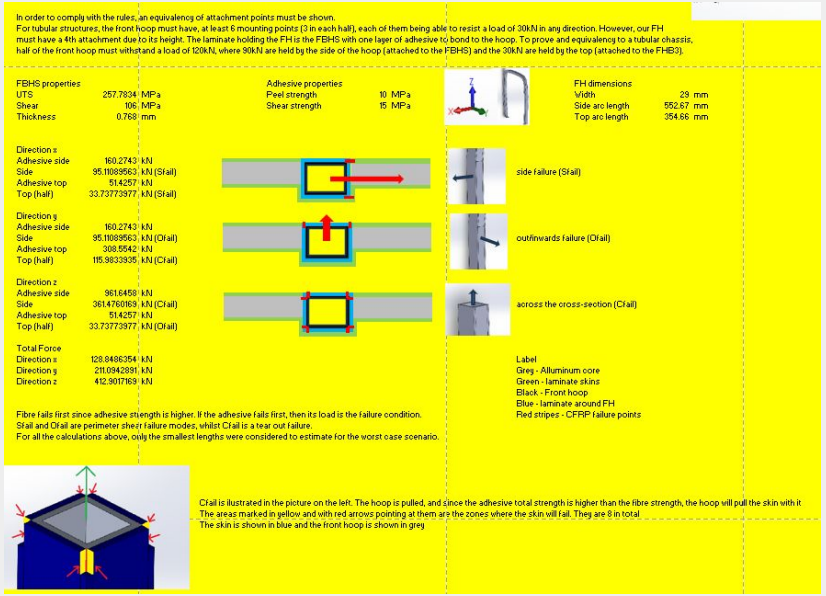
SES COMMON MISTAKES

Monocoque chassis

Lack of calculation to justify that the laminated FH complies with *T3.9.5* and *T3.9.6*

Example of good calculations

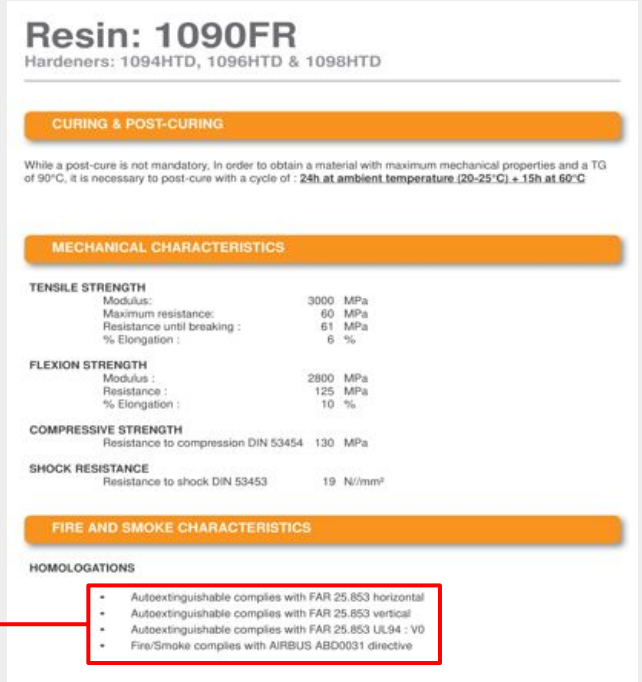


ASES COMMON MISTAKES

Lack of datasheets and/or proof of purchase for relevant materials:

- FRP
- Adhesives and resins
- Aluminum
- Foams, cores, insulation materials...

Missing material fire rating on datasheet.



Resin: 1090FR

Hardeners: 1094HTD, 1096HTD & 1098HTD

CURING & POST-CURING

While a post-cure is not mandatory, in order to obtain a material with maximum mechanical properties and a TG of 90°C, it is necessary to post-cure with a cycle of : **24h at ambient temperature (20-25°C) + 15h at 60°C**

MECHANICAL CHARACTERISTICS

TENSILE STRENGTH			
	Modulus:	3000	MPa
	Maximum resistance:	60	MPa
	Resistance until breaking :	61	MPa
	% Elongation :	6	%
FLEXION STRENGTH			
	Modulus :	2800	MPa
	Resistance :	125	MPa
	% Elongation :	10	%
COMPRESSIVE STRENGTH			
	Resistance to compression DIN 53454	130	MPa
SHOCK RESISTANCE			
	Resistance to shock DIN 53453	19	N//mm²

FIRE AND SMOKE CHARACTERISTICS

HOMOLOGATIONS

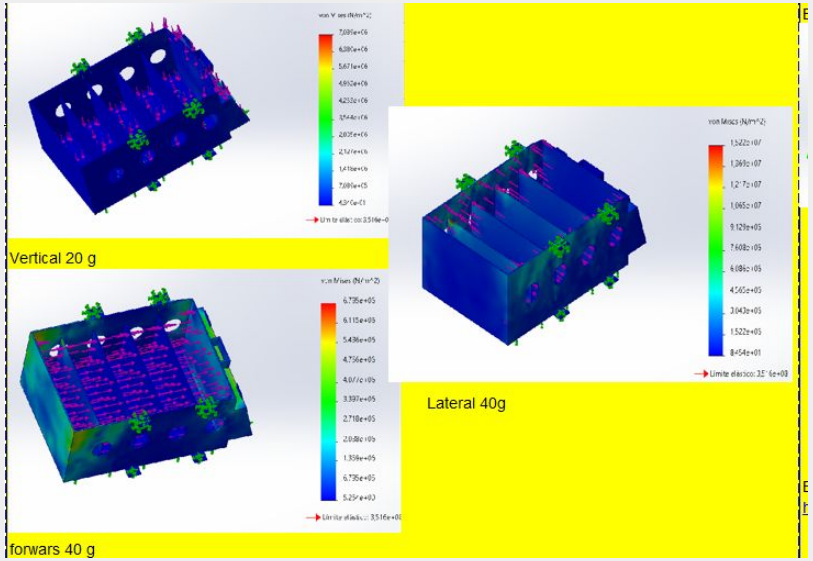
- Autoextinguishable complies with FAR 25.853 horizontal
- Autoextinguishable complies with FAR 25.853 vertical
- Autoextinguishable complies with FAR 25.853 UL94 : V0
- Fire/Smoke complies with AIRBUS ABD0031 directive

Fire rating specifications

ASES COMMON MISTAKES

FEM analysis as part of accumulation mechanical strength justification without proper model explanation.

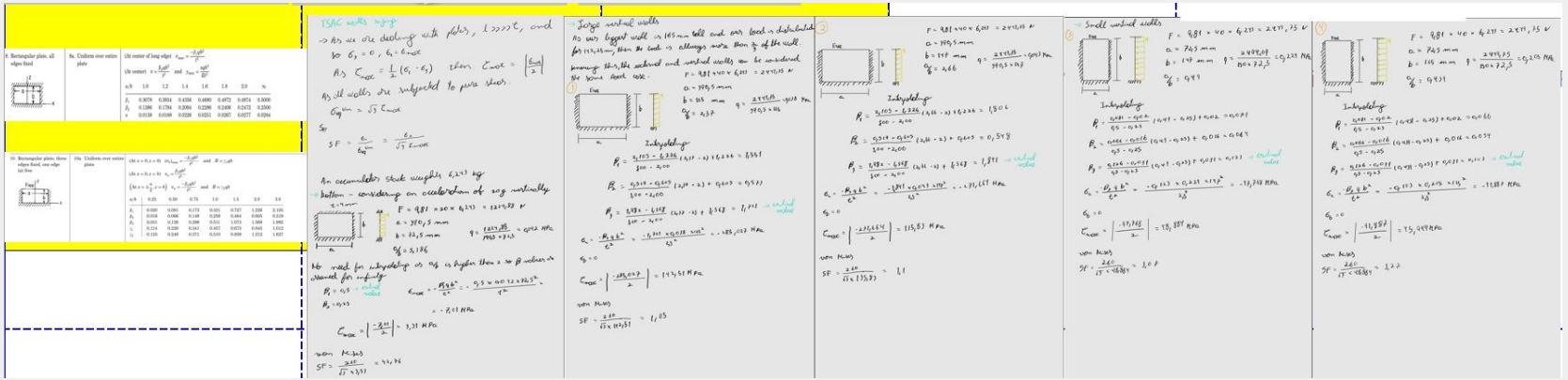
Missing calculations for some of the components of the accumulator structure → All accumulator structure components must withstand the accelerations marked in *T9.3.1*.



FEM analysis as justification without detailed model explanation

SES COMMON MISTAKES

Analytical calculations for different accumulator walls



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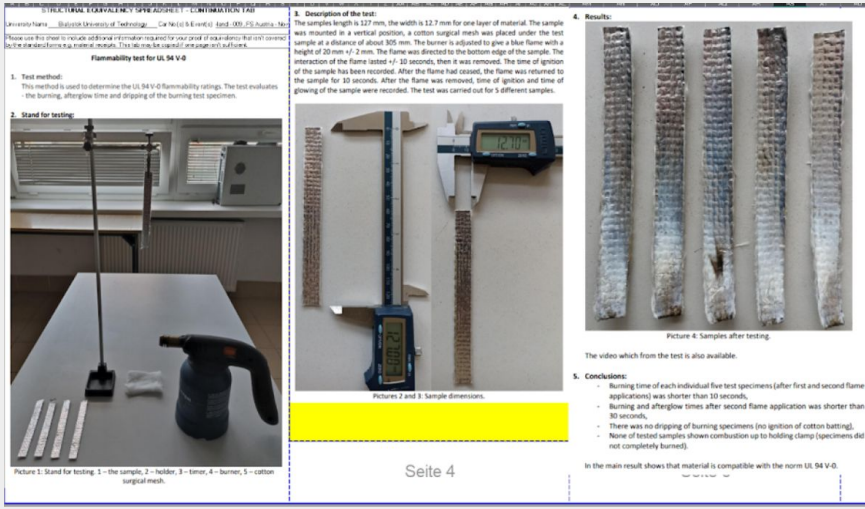
ASES COMMON MISTAKES

Poor visibility of the required dimensions and values in the attached images.

Incomplete information in the fire retardant material test report (if applicable).

Lack of strength calculations for bolted joints between accumulator internal components and accumulator attachments.

Example of good fire retardant material test report



STRUCTURAL EQUIVALENCY SPREADSHEET – CONFIRMATION TAB

Flammability test for UL 94 V-0

1. Test method:
This method is used to determine the UL 94 V-0 flammability ratings. The test evaluates - the burning, afterglow time and dripping of the burning test specimen.

2. Stand for testing:

Picture 1: Stand for testing. 1 – the sample, 2 – holder, 3 – timer, 4 – burner, 5 – cotton surgical mesh.

3. Description of the test:
The samples length is 127 mm, the width is 12.7 mm for one layer of material. The sample was mounted in a vertical position, a cotton surgical mesh was placed under the test sample at a distance of about 305 mm. The burner is adjusted to give a blue flame with a height of 20 mm +/- 2 mm. The flame was directed to the bottom edge of the sample. The interaction of the flame lasted +/- 10 seconds, then it was removed. The time of ignition of the sample has been recorded. After the flame had ceased, the flame was returned to the sample for 10 seconds. After the flame was removed, time of ignition and time of glowing of the sample were recorded. The test was carried out for 5 different samples.

Pictures 2 and 3. Sample dimensions.

Seite 4

4. Results:

Picture 4: Samples after testing.

The video which from the test is also available.

5. Conclusions:
- Burning time of each individual five test specimens (after first and second flame applications) was shorter than 10 seconds,
- Burning and afterglow times after second flame application was shorter than 30 seconds,
- There was no dripping of burning specimens (no ignition of cotton batting),
- None of tested samples shown combustion up to holding clamp (specimens did not completely burned).

In the main result shows that material is compatible with the norm UL 94 V-0.

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SES/ASES DURING TECH. INSPECTION

What to bring?

All tests samples correctly marked for alternative materials on accumulator and primary structure.

Physically tested IA assembly, including representative test fixture (if applicable).

Physical or digital copy of SES (mechanical) and ASES (accumulator).

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SES/ASES DURING TECH. INSPECTION

Common problems

Firewall doesn't match with SES design → Presence of holes and gaps.

IA height above 350mm due to car setup.

Cockpit opening and cockpit cross section smaller than required by rules.

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SES/ASES DURING TECH. INSPECTION

Common problems

Lack of inspection holes on Front Hoop, Main Hoop and Main Hoop Bracing.

Difficult to check primary structure mounting points

Presence of manufacturing defects: delaminations, improper welds, etc.

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DOUBTS & QUESTIONS

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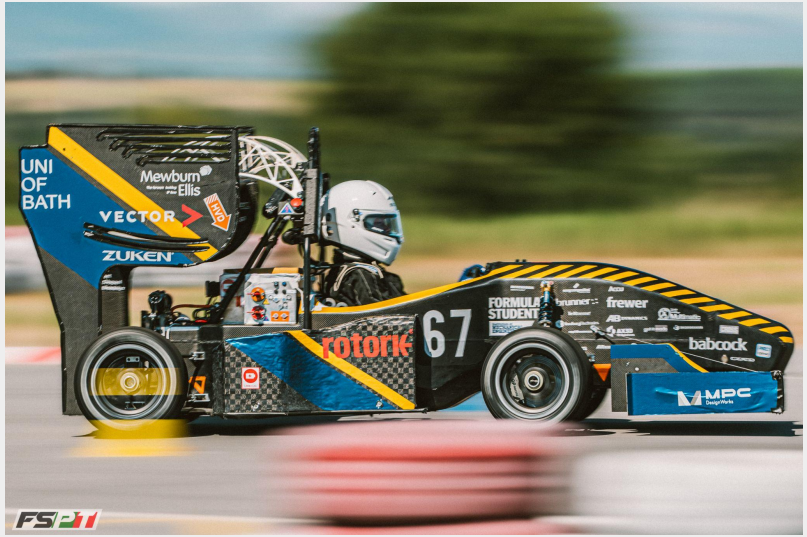
FSPT

TALKS

SLIDE TITLE



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WHAT'S NEW?

SUBTITLE (IF NEEDED)

TEXT BLOCK 1
LINE 1
LINE 2
LINE 3
LINE 4
LINE 5
LINE 6
LINE 7
LINE 8

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SLIDE TITLE

SUBTITLE (IF NEEDED)

TEXT BLOCK 1
LINE 1
LINE 2
LINE 3
LINE 4

TEXT BLOCK 2
LINE 1
LINE 2
LINE 3
LINE 4

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