SES Guidance EV

Accumulator Side Protection,
Tractive and HV side Protection (EV only)
Rear Impact Protection (EV only)

Accumulator Side Protection

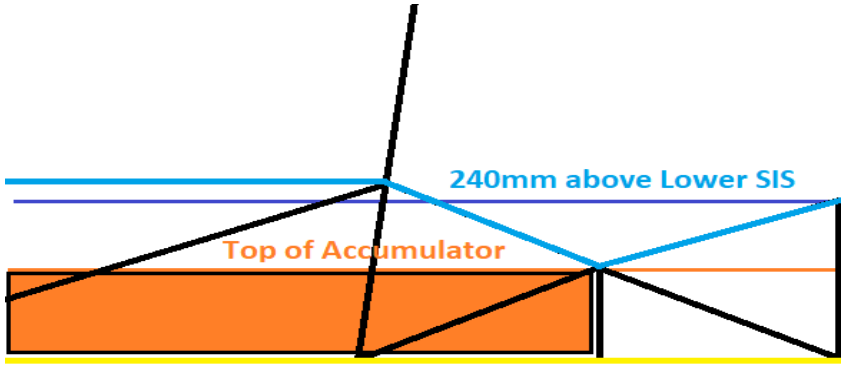
Teams must attach drawings that can confirm the entered values.

F.11.2.1 Side Impact Protection

a. All Accumulator Containers must be protected from side impact by structure Equivalent to SIS(F.6.4, F.7.5)
   The Accumulator Container must not be part of the Equivalent structure.
b. Accumulator Container side impact protection must go to a minimum height that is the lower of the two:
   - The height of the Upper Side Impact Structure
   - The top of the Accumulator Container at that point

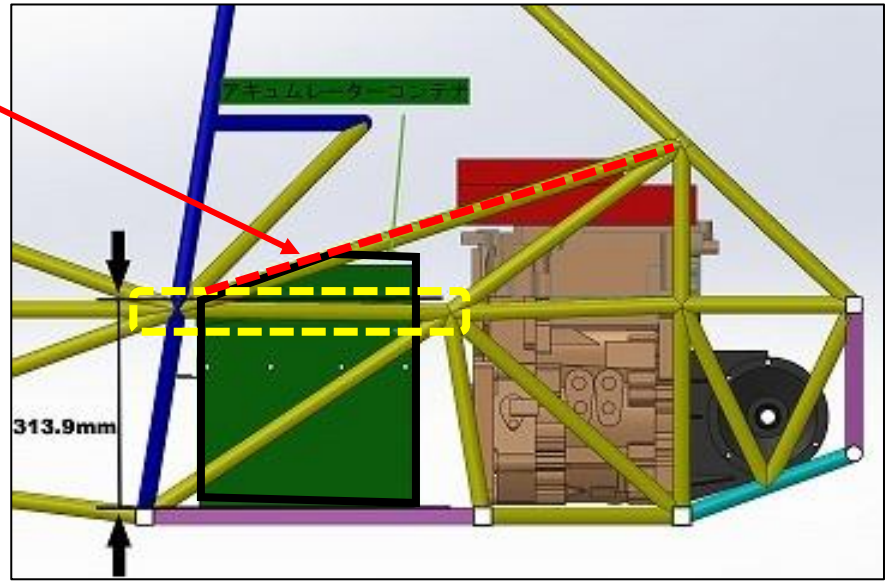
If the yellow broken line pipe is at the same height as 240 mm above the Lower SIS (= Upper SIS), the ACC may protrude above.
In other words, the pipe indicated by the red broken line may be omitted.

There is no maximum height.



The triangulated HV protection between the SIS and Rear Impact may be as low as 240mm above the Lower SIS or the top of the accumulator, whichever is lower.
There is no maximum height.

BLANK				
F.11.2.1.a Accumulator Side Protection	**Minimum**	**Tube Used**		EQ
F.3.2.1.m Example: 25.4mm x 1.6mm round	Size B	Round		EQ
F.3.4.1.b Wall thickness:	1.2		mm	BLANK
Outer Diameter (OD):	25		mm	BLANK
Wall thickness:	1.2		mm	BLANK
Outer Diameter (OD):	25.0		mm	BLANK
Tube cross sectional area (A):	114		mm^2	BLANK
Tube second moment of inertia (I):	8509		mm^4	BLANK



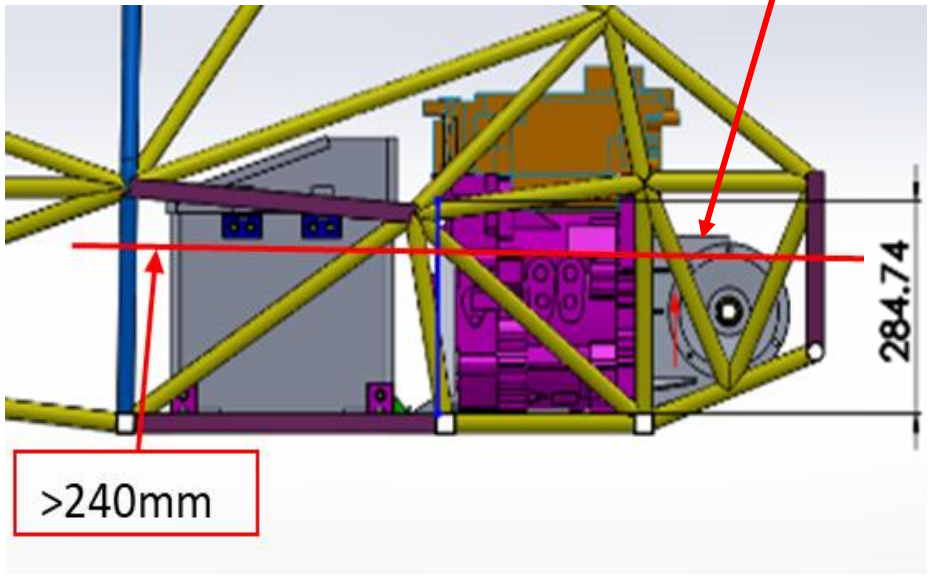
Air Gap to Driver's Seat

Teams must attach drawings that can confirm the entered values.

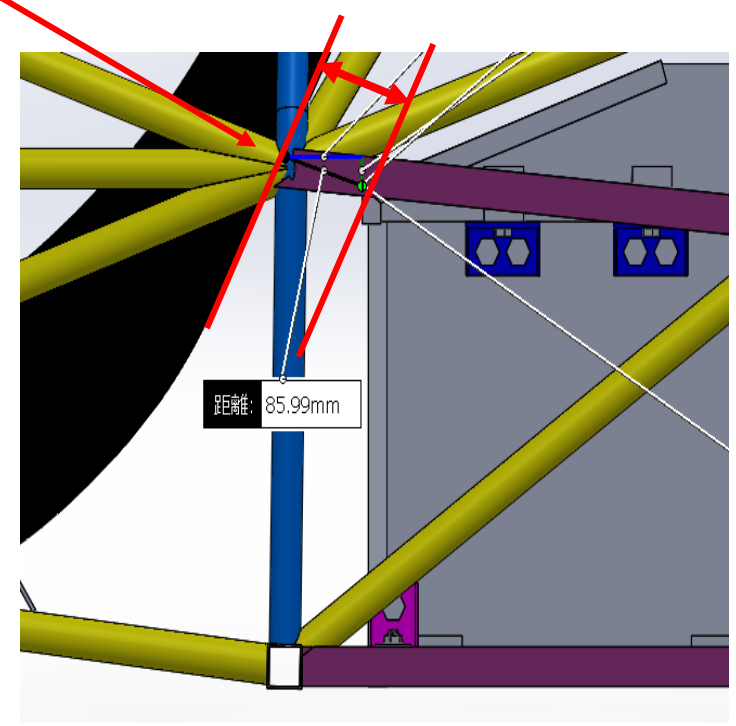
T.1.6 Heat insulation requirements apply at operating and failure temperatures.
T.1.6.3.b An air gap no less than 25mm is required between the accumulator and the driver's seat.

BLANK				
T.1.6.3.b	Air gap to driver's seat >=25mm:		mm	BLANK
	Top surface of HV Protection:			BLANK

Please show in the CAD drawing that it is 240mm or more as shown in the left figure.



Enter the minimum distance between the ACC and the seat as shown in the figure on the right.



Tractive and HV Side Protection

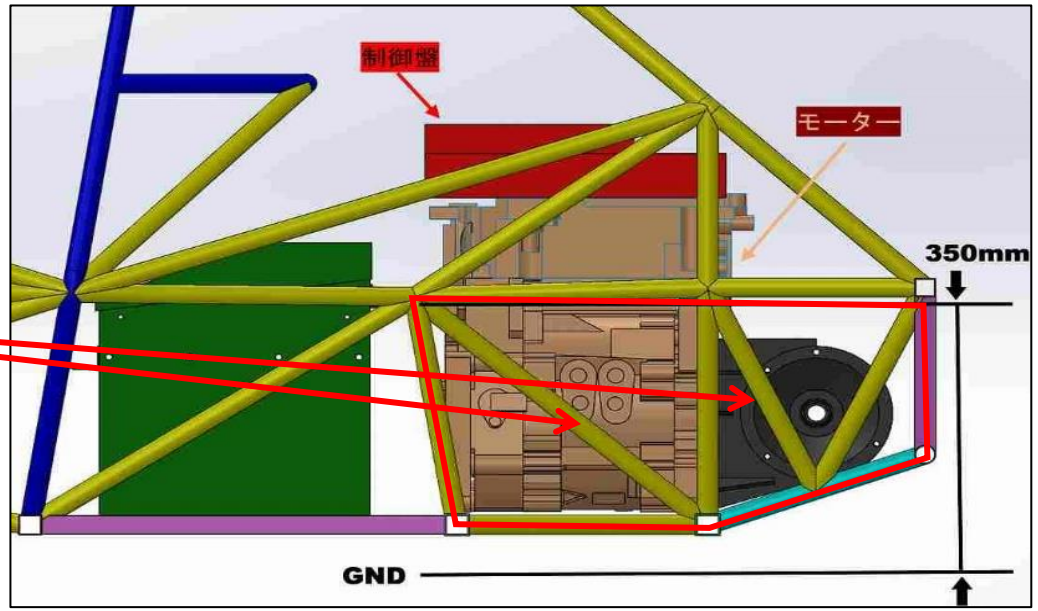
Teams must attach drawings that can confirm the entered values.

Tractive and HV Side Protection (EV Only)

This side protection is required below

F.11.2.1.a From the side, below 350mm, all HV components must be protected with an upper tube, a lower tube, and a diagonal tube or tubes completely triangulating the upper and lower tubes.

BLANK				
F.11.2.1.c	**Tractive Side Protection**	**Minimum**	**Tube Used**	EQ
F.3.2.1.n	Example: 25.4mm x 1.2mm round	Size C		BLANK
F.3.4.1.c	Wall thickness:	1.2	mm	BLANK
	Square side:	25	mm	BLANK
	Wall thickness:	1.2	mm	BLANK
	Square side:	25.0	mm	BLANK
	Tube cross sectional area (A):	91	mm^2	BLANK
	Tube second moment of inertia (I):	6695	mm^4	BLANK



In addition to the pipes indicated by arrows, this applies to all pipes that make up Side.

Required for the zone within the red frame in the diagram on the right. Similar to MHBS and FBHS, a pipe of Φ25.4mm and t=1.2mm or more is required.

F.11.2.1.b The entire top edge of the upper tube must be at least 240mm above the lowest point of the top surface of the Lower SIS tube.

BLANK		
EV motor location:	Select Drop Down	BLANK
Top surface of HV Protection:		BLANK

Teams must attach drawings that can confirm the entered values.

Rear Impact Protection

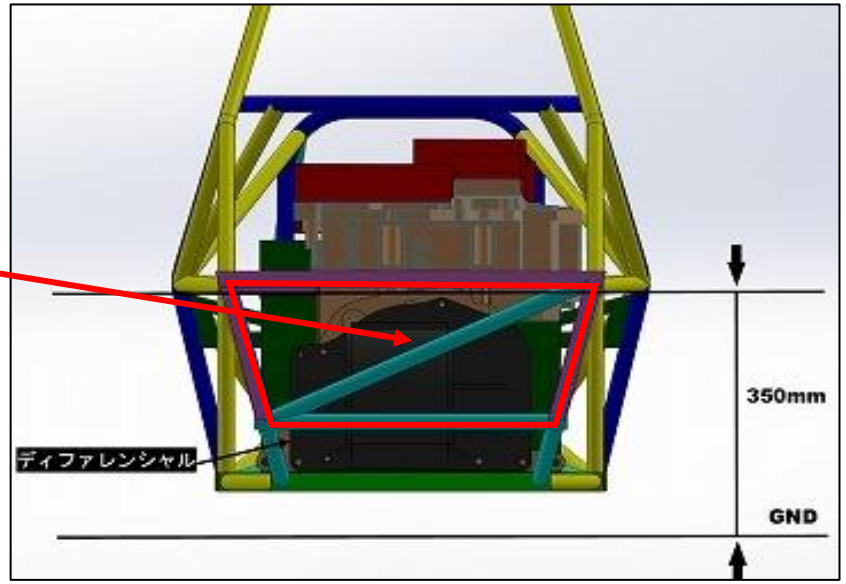
Teams must attach drawings that can confirm the entered values.

F.11.2.2 From the rear, below 350mm, all HV components must be protected with an upper tube, a lower tube, and a diagonal tube or tubes completely triangulating the upper and lower tubes. Triangulation may be asymmetric.
If a billet plate replaces all three tubes, it must fully overlap the tractive side protection tubes.
F.11.2.2.a Increase from Size C to Size B if the accumulator is < 100mm (3.937in) from the rear impact .

Required in the zone surrounded by the red frame in the diagram.Φ25.4mm, t=1.6mm or□25mm, t=1.2mm or more pipe required

このRear Impact Protectionは 350mm以下で必要であり、通常は三角構造が求められる。

	BLANK				
F.11.2.2.a	Min distance from Accumulator to Rear Impact?			mm	BLANK
	Accumulator Rear Impact Protection	**Minimum**			BLANK
F.3.2.1.m	Example: 25.4mm x 1.6mm round	Size B			BLANK
F.3.2.1.b	Wall thickness:	1.2		mm	BLANK
	Square side:	25		mm	BLANK
	Wall thickness:	1.2		mm	BLANK
	Square side:	25.0		mm	BLANK
	Tube cross sectional area (A):	114		mm^2	BLANK
	Tube second moment of inertia (I):	8509		mm^4	BLANK



F.11.2.2.b The entire top edge of the upper tube or plate must be at least 240mm above the lowest point of the top surface of the Lower SIS tube.

BLANK			
Top surface of Lower SIS to top Rear Impact >=240mm:		mm	BLANK

Teams must attach drawings that can confirm the entered values.

Rear Impact Protection

Teams must attach drawings that can confirm the entered values.

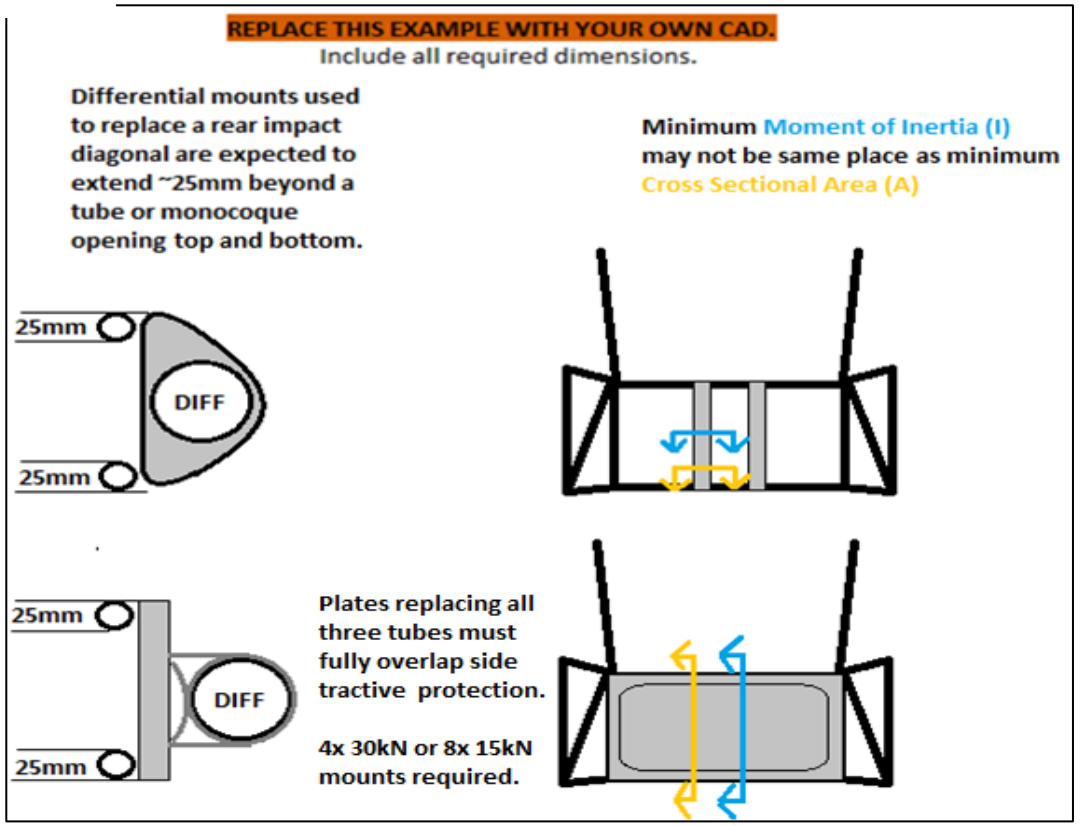
The idea of replacing rear impact protection consisting of a normal triangular structure

F.11.2.2.b The Rear Protection must be fully triangulated to the rest of the frame with structural tubing.
If a plate replaces all three tubes, 4x 30kN or 8x 15kN mounts are required.
Bolted joints must be documented if a removable panel or tube is used.

BLANK					
F.11.2.2.a	**Rear Impact Tubes Replaced:**	**0**			BLANK
F.3.3-5	Material:	Steel			BLANK
F.3.4.2	Young's Modulus (E):	2.00E+11		Pa	BLANK
	Yield Strength (Sy):	3.05E+08		Pa	BLANK
	Ultimate Strength (Su):	3.65E+08		Pa	BLANK
				Pa	BLANK
		0.00E+00		mm^2	BLANK
		0.00E+00		mm^4	BLANK
	Mount longitudinal Edge to Moment of Inertia Centroid (R):	12.500		mm	BLANK
Buckling Modulus	E_1*I_1 <= E_2*I_2:	0.00E+00			BLANK
Critical Strength	S_1*A_1 <= S_2*A_2:				BLANK
Bending	4*S_1*I_1/r <= 4*S_2*I_2/r:				BLANK
Deflection	Bending_1/(48*EI):				BLANK
Energy	0.5*Bending^2/(48*EI):				BLANK

**As shown in the figure on the right,
If the Diff Mount or Rear Bulkhead has the same or higher strength, the triangular structure pipe can be omitted.**

E: Longitudinal elastic modulus
Sy: Yield strength
Su: Maximum tensile strength



SES Guidance EV

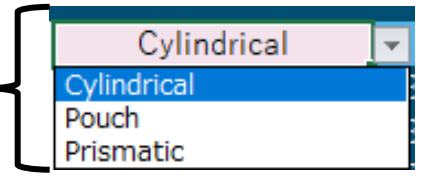
F.10-11 EV Accumulator

Accumulator Segments

"Voltage", "Capacity", etc. will be compared with the ESF submitted in advance.
Do not make input mistakes.

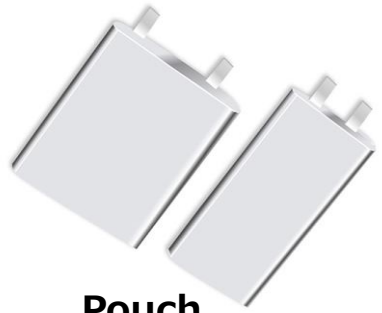
	BLANK			
	Cell type:			BLANK
	Maximum Voltage:		V	BLANK
	Cell mass:		g	BLANK
	Nominal Capacity:		mAh	BLANK
	Maximum segment cells in series:			BLANK
	Maximum segment cells in parallel:			BLANK
EV.5.1.2	Maximum segment voltage:	0.0	V	EQ
EV.5.1.2	Maximum segment capacity:	0.00	MJ	EQ
	Number of segments in series:			BLANK
	Number of segments in parallel:			BLANK
EV.3.3.2	Maximum accumulator voltage:	0.0	V	EQ
	Maximum accumulator capacity:	0.00	kWh	EQ

	BLANK			
	Accumulator, number of segments high:			BLANK
	Accumulator, number of segments wide:			BLANK
	Accumulator, number of segments long:			BLANK
	S x P = 0	**L x W x H =**	0	EQ
F.10.3.2.b	Maximum segment mass <=12kg (26.4lbs):		kg	BLANK
F.10.3.2.d	Min fastener count in fastened connections between vertical walls:			2



Choose from 3 options

Cylindrical



Pouch

Prismatic

Accumulator Segments Input Example

The red frame part is particularly different from 2023. Be careful.

EQ

Accumulator Segments

	EQ			
	Cell type:	Pouch		EQ
	Maximum Voltage:	4.2	V	EQ
	Cell mass:	255	g	EQ
	Nominal Capacity:	10000	mAh	EQ
	Maximum segment cells in series:	12		EQ
	Maximum segment cells in parallel:	1		EQ
EV.5.1.2	Maximum segment voltage:	50.4	V	EQ
EV.5.1.2	Maximum segment capacity:	1.81	MJ	EQ
	Number of segments in series:	8		EQ
	Number of segments in parallel:	1		EQ
EV.3.3.2	Maximum accumulator voltage:	403.2	V	EQ
	Maximum accumulator capacity:	4.03	kWh	EQ

Total number of cells is 96

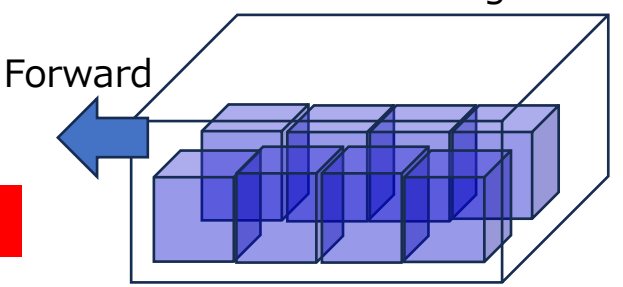
Number of cells in one segment

1 = 1 series inside segment

Number of segments

1 = All segments are in series

If 8 segments were installed as shown in the figure



Height = 1 step
Horizontal = 2 rows
Front and rear = 4 pieces

	EQ			
	Accumulator, number of segments high:	1		EQ
	Accumulator, number of segments wide:	2		EQ
	Accumulator, number of segments long:	4		EQ
	S x P = 8	**L x W x H =** 8		EQ
F.10.3.2.b	Maximum segment mass <=12kg (26.4lbs):	6	kg	EQ
F.10.3.2.d	Min fastener count in fastened connections between vertical walls:			2

=G73*G74

=G79*G80*G81

Segment number is automatically calculated

=IF(D82=G82,"EQ",IF(OR(D82=0,G82=0),"BLANK","CHECK"))

Judgment criteria:
If D82=G82, it is "EQ"
In the example on the left, 8=8

Accumulator Segments Input Example

Differences from 2023 → 20G resistance and 40G resistance are automatically calculated

Material	E (Pa)	S_Ultimate (Pa)	Shear (Pa)
Steel Unwelded	2.00E+11	3.65E+08	2.11E+08
Steel Welded	2.00E+11	3.00E+08	1.73E+08
6061-T6 Unwelded	6.90E+10	2.90E+08	1.67E+08
6061-T6 Welded	6.90E+10	1.75E+08	1.01E+08

Enter material properties

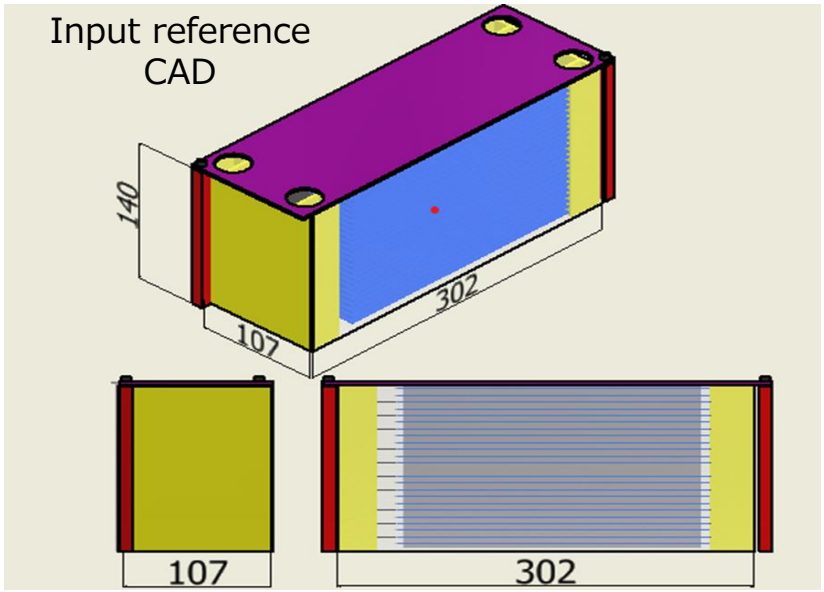
EQ Accumulator Segments

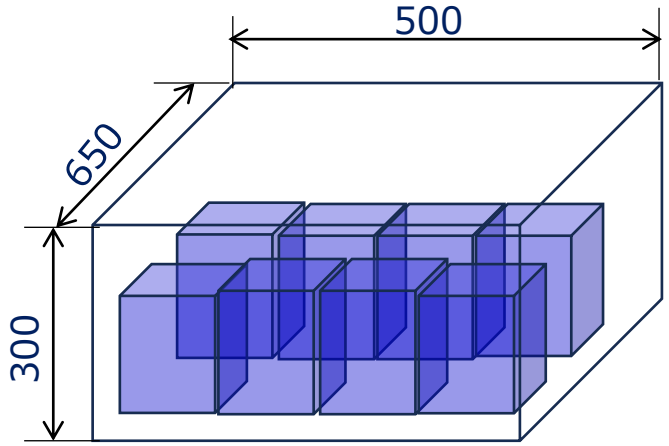
EQ			
F.10.3.4.a Restraint Method:	Friction		EQ
Segment structure material:	Aluminum		EQ
F.10.3.4 Cell mounting and bracing material:	E:	6.90E+10 Pa	EQ
	UTS:	2.90E+06 Pa	EQ
	Shear:	1.67E+08 Pa	EQ
Segment structure top view cross section between walls:		mm^2	BLANK
F.10.3.4.b Vertical acceleration 20*mass*segments_high:	0.00E+00	N	BLANK
Segment compression strength UTS*top_view_area:	0.00E+00	0.00%	BLANK
Segment structure front view cross section between walls:		mm^2	BLANK
F.10.3.4.b Lateral acceleration 40*mass*segments_wide:	0.00E+00	N	BLANK
Segment compression strength UTS*top_view_area:	0.00E+00	0.00%	BLANK
Segment structure side view cross section between walls:		mm^2	BLANK
EQ			
Accumulator total front to rear length:	500	mm	EQ
Accumulator total left to right width:	650	mm	EQ
Accumulator total bottom to top height:	300	mm	EQ

Non-segment volumes must be included in mount offset, rows 61-63.
Do not mount to non-segment volumes.

Enter the cross-sectional area of each segment

Enter ACC size





Segment Internal Wall Height

Describe the required top view, front view, and side view with size included.

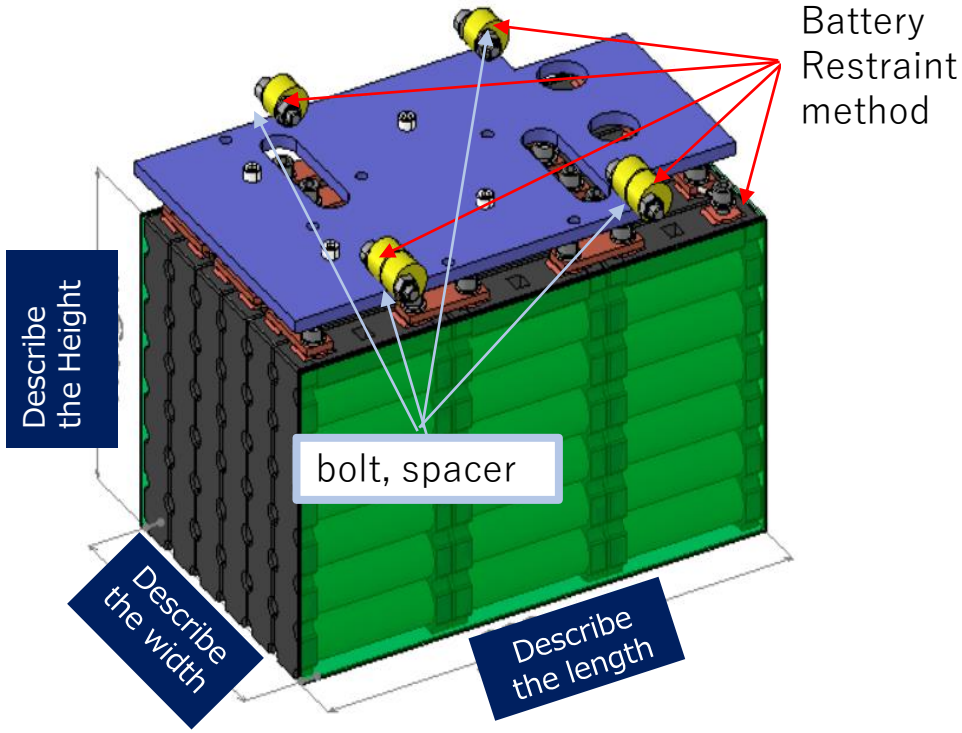
Attention!

Segment top view structural cross section.
Segment front view structural cross section.
Segment side view structural cross section.
Include all dimensions entered below.

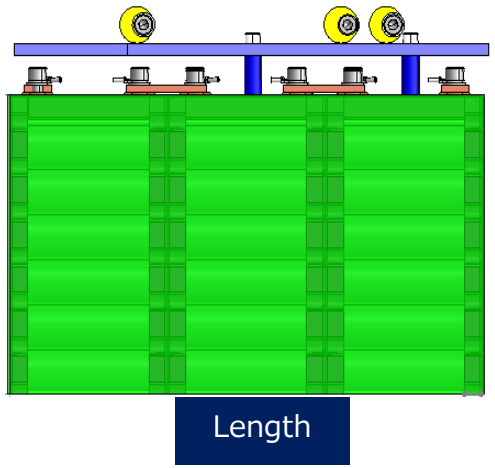
Internal wall height: F.10.3.1.b
Internal walls must be higher than the segment. (Must)
The interior wall should preferably be as high as the lid above the segment, if any. (Should)

Segment:The entire cell must be covered. (Must)
It is preferable to cover the parts above the segment. (Should)

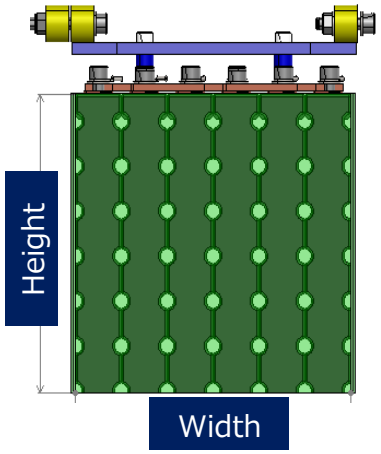
Segment Isometric view



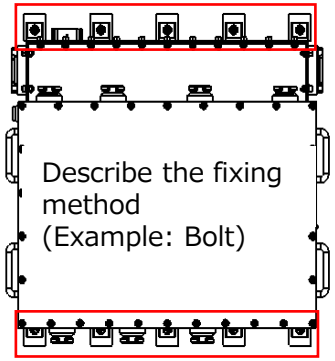
Lateral Cross Section



Longitudinal Cross Section



ACC Restraint Method



Accumulator Container

Items newly added in 2024.

EV.4.3.5 Any Accumulators that may vent an explosive gas must have a ventilation system or pressure relief valve to release the vented gas
EV.4.3.6 Completely sealed Accumulator Containers must have a pressure relief valve
EV.4.3.7 Pressure relief valves must not have line of sight to the driver, with the Firewall installed or removed

This has two choices.
In either case, please attach an image (CAD drawing) like the one on the right.

BLANK

EV.4.3.5-7 BLANK

Any opening, including pressure relief valves, must face away from the driver.

EQ

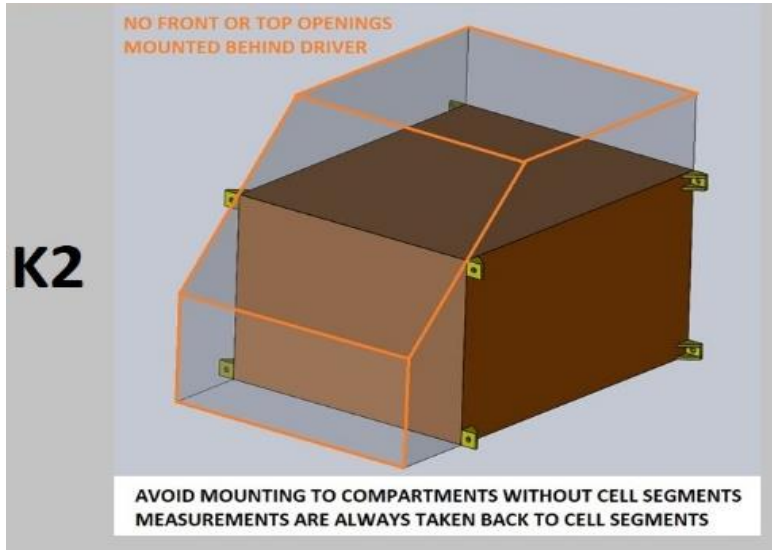
EV.4.3.5-7 Image shows accumulator segments are not completely sealed EQ

Any opening, including pressure relief valves, must face away from the driver.

EQ

EV.4.3.5-7 Image shows pressure relief valve is not pointed at the driver EQ

Any opening, including pressure relief valves, must face away from the driver.



Accumulator Container

The load calculation method has changed in 2024, but the content remains the same. This is the basis for calculating the Corner Attachment and Mass Based Load values.

2023

Composite teams: Enter tab names for materials used.

BLANK

Low Est	0	Total mass of all segments:		kg	BLANK
High Est	0	Total accumulator mass:		kg	BLANK
F.10.5.6		Corner attachment test load:	0	N	each
F.10.5.7		Mass based min attachment number:	4x at 15000	N	each

2024

Composite teams: Enter tab names for materials used.

BLANK

Low Est	High Est	Cell Mass				
0	0	0	Total mass of all segments:		kg	BLANK
			Total accumulator mass:		kg	BLANK
F.10.5.6			Corner attachment test load:	0	N	each
F.10.5.7			Mass based min attachment number:	4x at 15000	N	each

2023

Composite teams: Enter tab names for materials used.

EQ

Low Est	48	Total mass of all segments:	48	kg	EQ
High Est	48	Total accumulator mass:	62	kg	EQ
F.10.5.6		Corner attachment test load:	6082.2	N	each
F.10.5.7		Mass based min attachment number:	10x at 15000	N	each

2024

Composite teams: Enter tab names for materials used.

EQ

Low Est	High Est	Cell Mass				
2	26	2.04	Total mass of all segments:	48	kg	EQ
			Total accumulator mass:	62	kg	EQ
F.10.5.6			Corner attachment test load:	6082.2	N	each
F.10.5.7			Mass based min attachment number:	10x at 15000	N	each

Attachment calculation criteria

Enter the numbers on the right…the result is the same

EQ

	Cell type:	Pouch		EQ
	Maximum Voltage:	4.2	V	EQ
	Cell mass:	255	g	EQ
	Nominal Capacity:	10000	mAh	EQ
	Maximum segment cells in series:	12		EQ
	Maximum segment cells in parallel:	1		EQ
EV.5.1.2	Maximum segment voltage:	50.4	V	EQ
EV.5.1.2	Maximum segment capacity:	1.81	MJ	EQ
	Number of segments in series:	8		EQ
	Number of segments in parallel:	1		EQ
EV.3.3.2	Maximum accumulator voltage:	403.2	V	EQ
	Maximum accumulator capacity:	4.03	kWh	EQ

All 8 segments are 6kg = total 48kg

EQ

	Accumulator, number of segments high:	1		EQ
	Accumulator, number of segments wide:	2		EQ
	Accumulator, number of segments long:	4		EQ
	S x P = 8 L x W x H =	8		EQ
F.10.3.2.b	Maximum segment mass <=12kg (26.4lbs):	6	kg	EQ
F.10.3.2.d	Min fastener count in fastened connections between vertical walls:	2		

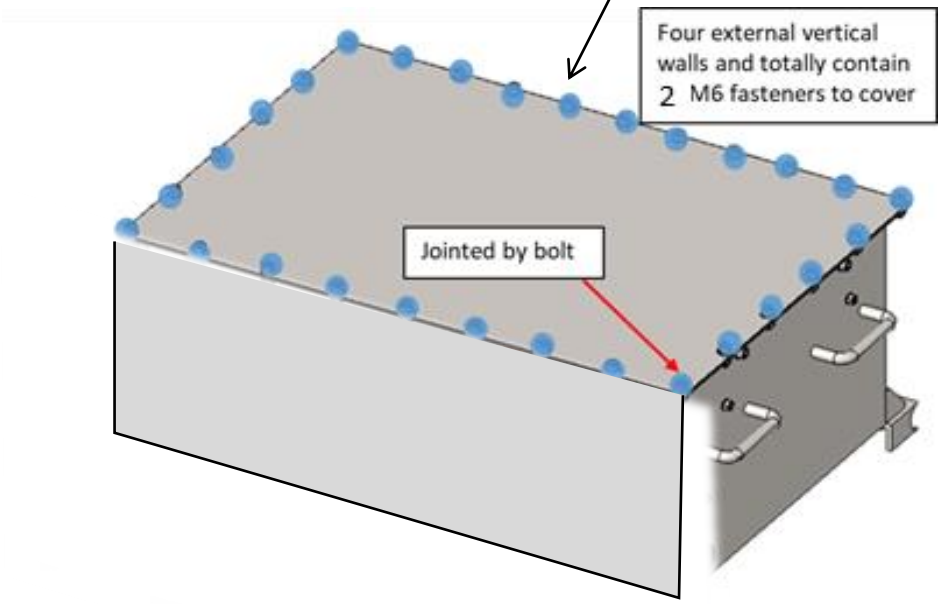
ACC Container External Wall

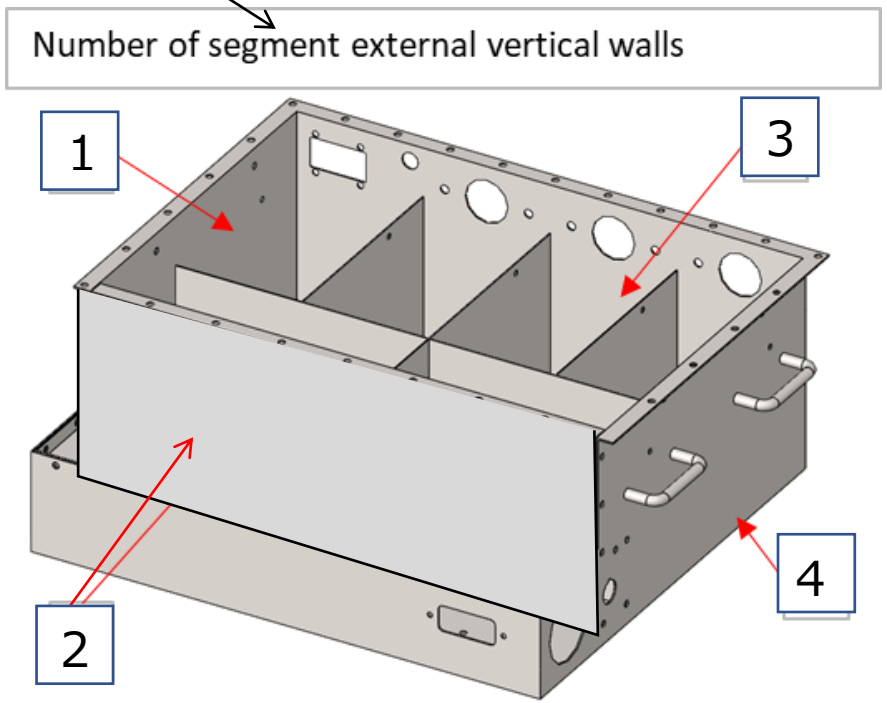
Teams must attach CAD drawings that can confirm the entered values.

BLANK		
F.10.2.4	Number of segment external vertical wall divisions:	BLANK
	Number of cover fasteners:	BLANK

F.10.3.1.c Min 2 per wall division when using fasteners between external walls and floor.
F.10.3.1.d Min 1 per wall division when using fasteners between internal walls and floor.

In particular, Fastener numbers should be displayed clearly.
Isometric drawings are easier to understand than three-view drawings.





ACC Container : How to join walls

Teams must attach CAD drawings that can confirm the entered values.

		BLANK	There are 4 choices	
F.10.2.3	Vertical wall joining method:			BLANK
	Average unit strength of 50% weld, 0.9mm wall:	135	N/mm	N/A
			N	N/A
			mm	N/A
			N/mm^2	N/A
			mm	N/A
F.10.2.3.b				EQ

Select the Vertical Wall joining method,
Teams should input the items required for each "BLANK".

		BLANK	Fastened	
F.10.2.3	Vertical wall joining method:			EQ
	Average unit strength of 50% weld, 0.9mm wall:	135	N/mm	N/A
F.10.2.3.b	Fastener shear capability:		N	BLANK
	Maximum fastener spacing:		mm	BLANK
			N/mm^2	N/A
			mm	N/A
F.10.2.3.b	Fastener shear / spacing >= Unit baseline:			EQ

Indicate weld paths in image.

		BLANK	Welded	
F.10.2.3	Vertical wall joining method:			EQ
	Average unit strength of 50% weld, 0.9mm wall:	135	N/mm	N/A
10.2.3.a	At least half the perimeter must be welded:		%	BLANK
	Shortest weld >= 25mm (1in):		mm	BLANK
			N/mm^2	N/A
			mm	N/A
F.10.2.3.b				N/A

		BLANK	Bonded	
F.10.2.3	Vertical wall joining method:			EQ
	Average unit strength of 50% weld, 0.9mm wall:	135	N/mm	EQ
			N	N/A
			mm	N/A
	Shear strength of adhesive (Use 'Fastened' for rivets):		N/mm^2	BLANK
	Minimum bond overlap (Leave space to rivet):		mm	BLANK
F.5.5.3	0.5*adhesive x overlap >= Unit baseline:			EQ

		EQ	Continuous Layup	
F.10.2.3	Vertical wall joining metho			EQ
	Average unit strength of 50% weld, 0.9mm wall:	135	N/mm	N/A
F.10.2.3.b			N	N/A
			mm	N/A
			N/mm^2	N/A
			mm	N/A
F.10.2.3.b				EQ

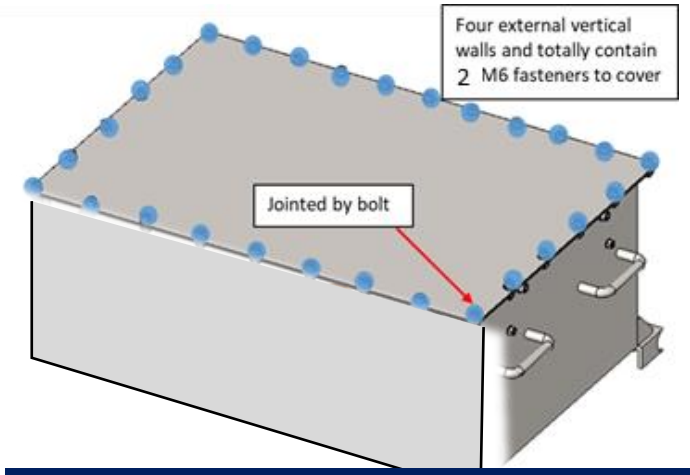
No input required only for Continuous Layup

At Least 75% Covered

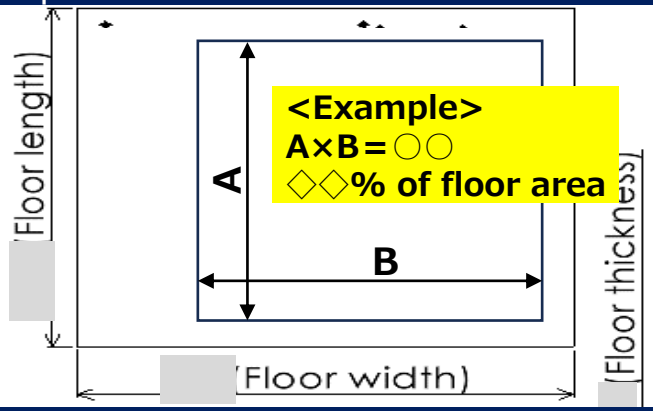
Teams must attach CAD drawings that can confirm the entered values.

Regarding the 75% rule, there are many deficiencies in the evidence every year. If the evidence is insufficient, SES immediately judges it as "Not OK."

F.10.2.1	**MINIMUM ACCUMULATOR FLOOR**			
	BLANK			
F.10.4.3	All segment floor sections >= 75% area:			BLANK
F.10.2.1	**Accumulator Floor Construction:**			EQ
	Steel: 1.25mm (0.049in), Aluminum: 3.2mm (.125in):		mm	BLANK
	Material Used:			BLANK
F.10.2.2	**MINIMUM ACCUMULATOR WALLS**			
	BLANK			
F.10.4.3	All segment wall sections >= 75% area:			BLANK
F.10.2.2	**Minimum Wall Construction:**			EQ
	Steel: 0.90mm (0.035in), Aluminum: 2.3mm (0.090in):		mm	BLANK
	Material Used:			BLANK
F.10.2.2	**MINIMUM ACCUMULATOR COVER/LID**			
	BLANK			
No accumulator holes with line of sight to driver:				BLANK
F.10.4.3	All segment cover sections >= 75% area:			BLANK
F.10.2.2	**Accumulator Lid:**			EQ
	Steel: 0.90mm (0.035in), Aluminum: 2.3mm (0.090in):		mm	BLANK



For the above Accumulator container, Show the floor part in CAD and enter the required size.



Similarly, show the Walls section and Cover/Lid section in CAD and enter the required size.