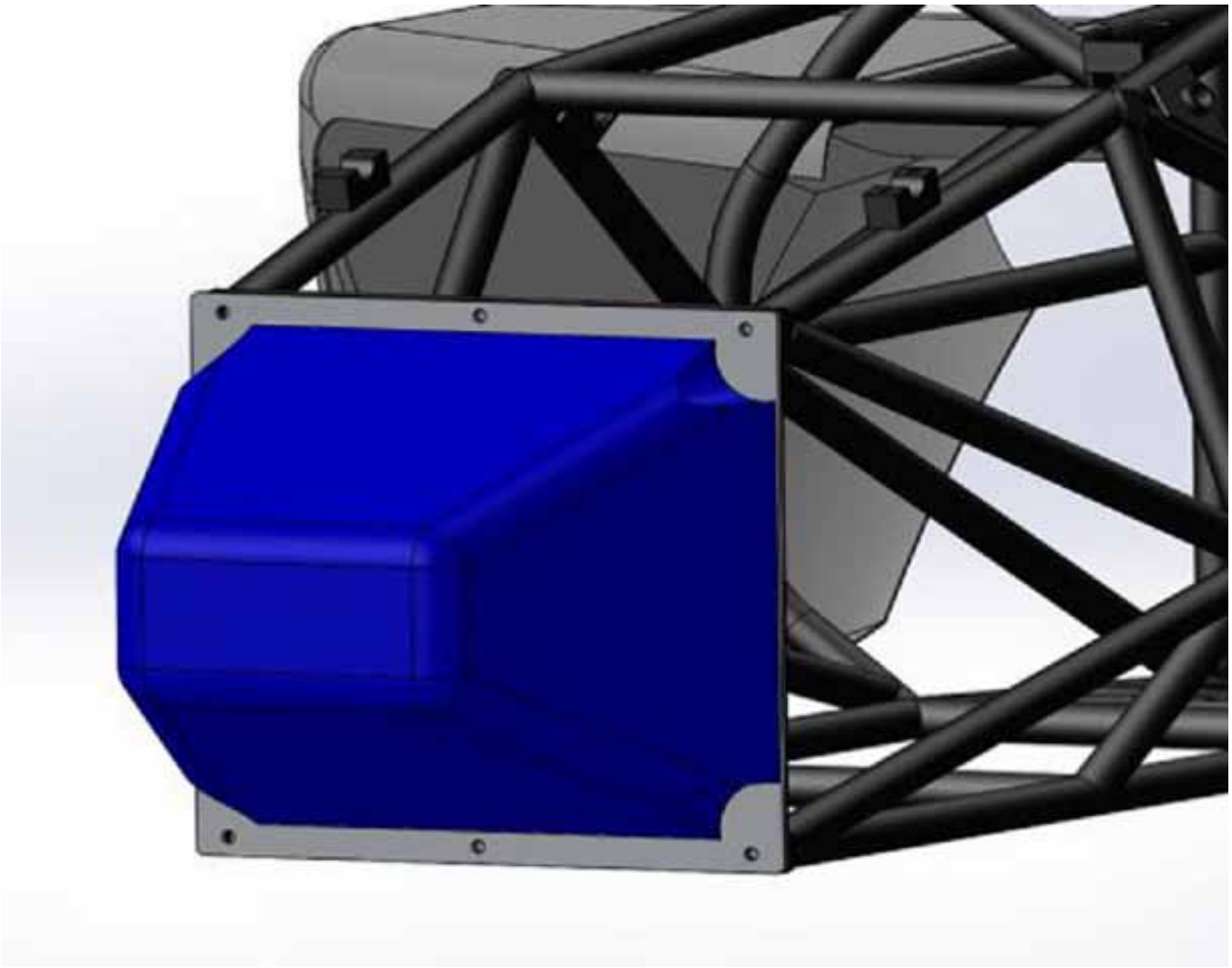
“ Impact Attenutor Data report “



Contents

1. Notes on rule
2. How to report IAD
3. It is a required item to IAD
   (Attachment data)

1. **Notes on rule**
2. **How to report IAD**
3. **It is a required item to IAD (Attachment data)**

Structure of IAD : Requirements

In the FSAE rules, as shown below:

T.2.25 Impact Attenuator Data (IAD)

T.2.25.1 All teams must submit an Impact Attenuator Data (IAD) report as described in section **DR - Document Requirements**.

T.2.25.2 Impact Attenuator Functional Requirements

These are not test requirements

a. Decelerates the vehicle at a rate not exceeding 20 g average and 40 g peak

b. Energy absorbed must meet or exceed 7350 J

When:

- Total mass of Vehicle is 300 kg
- Impact velocity is 7.0 m/s

T.2.25.3 When using the standard Impact Attenuator, the IAD Report must meet the following:

a. Test data will not be submitted

b. All other requirements of this section must be included.

c. Photos of the actual attenuator must be included

d. Evidence that the Standard IA meets the design criteria provided in the Standard Impact Attenuator specification must be appended to the report. This may be a receipt or packing slip from the supplier.

T.2.25.4 The Impact Attenuator Data Report when NOT using the Standard Impact Attenuator must include:

a. Test data that proves that the Impact Attenuator Assembly meets the functional requirements

b. Calculations showing how the reported absorbed energy and decelerations have been derived.

c. A schematic of the test method.

d. Photos of the attenuator, annotated with the height of the attenuator before and after testing.

The Notes on a Rule

The fixed method of AIP and a Bulk Head : no rule change from 2018

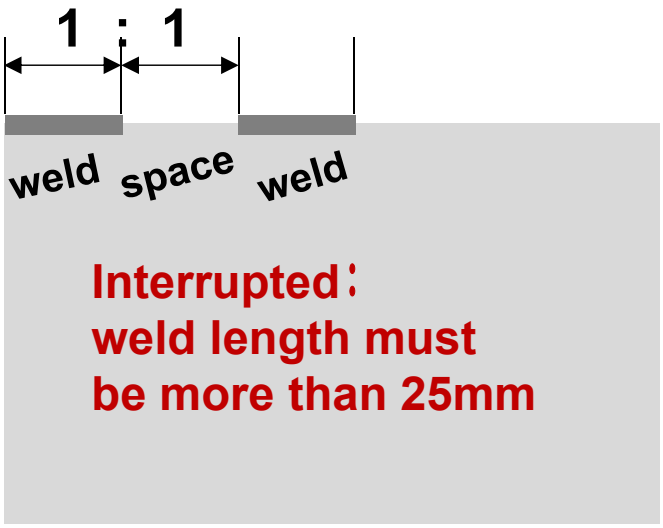
T.2.22.3 For tube frame Front Bulkheads, the attachment of the Anti Intrusion Plate directly to the Front Bulkhead must be documented in the team's SES submission.
The accepted methods of attachment are:

a. Welding, where the welds are either continuous or interrupted. If interrupted, the weld/space ratio must be at least 1:1. All weld lengths must be greater than 25 mm.

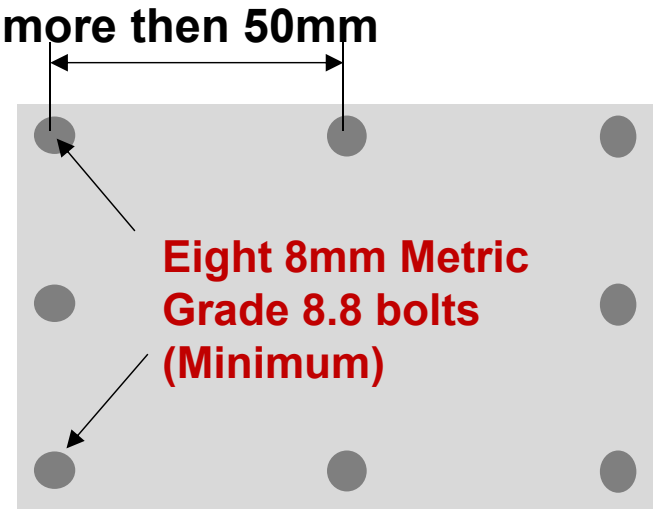
b. Bolted joints, using no less than eight 8 mm or 5/16" minimum diameter **Critical Fasteners**, see **T.10.2** and **T.10.3**. The distance between any two bolt centers must be at least 50 mm.

An insertion is required, when making a hole in a Bulk Head and bolted.

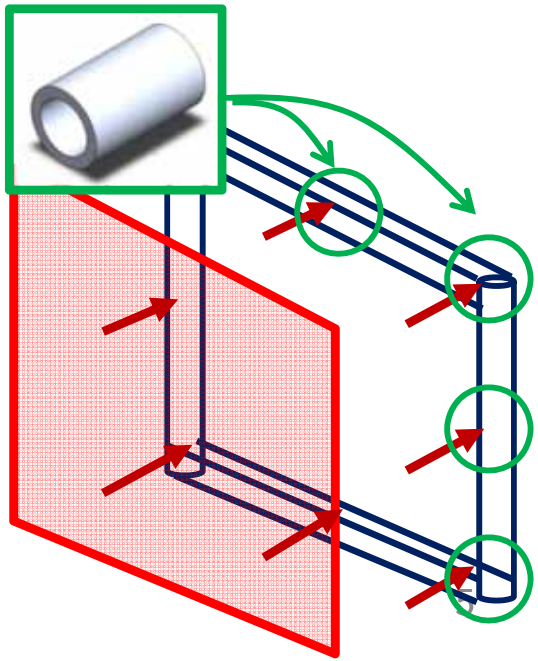
The welds are either continuous or interrupted



Case of "Welding"



Case of "Bolts joint"



The Notes on a Rule

The fixed method of IA and AIP: no rule change from 2018

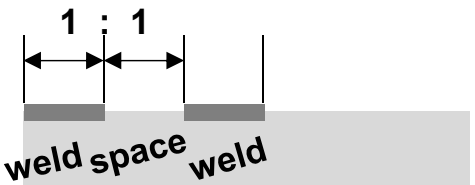
T.2.23.3 The attachment of the Impact Attenuator to the Anti Intrusion Plate must be documented in the IAD submission. The accepted methods of attachment are:

a. **Welding**, where the welds are either continuous or interrupted. If interrupted, the weld/space ratio must be at least 1:1. All weld lengths must be greater than 25 mm.

b. **Bolted joints**, using no less than four 8 mm or 5/16" minimum diameter Critical Fasteners, see **T.10.2** and **T.10.3**, where the distance between any two bolt centers must be at least 50 mm. **Foam IA's must not be solely attached by the bolted method.**

c. **By the use of a structural adhesive**. The adhesive must be appropriate for use with both substrate types. The appropriate adhesive choice, substrate preparation, and the equivalency of this bonded joint to the bolted joint in **T.2.23.3b above** must be documented in the team's IAD report.

A hole is made in the standard IA and, in bolted, an insertion is required.



Interrupted: weld length must be more than 25mm

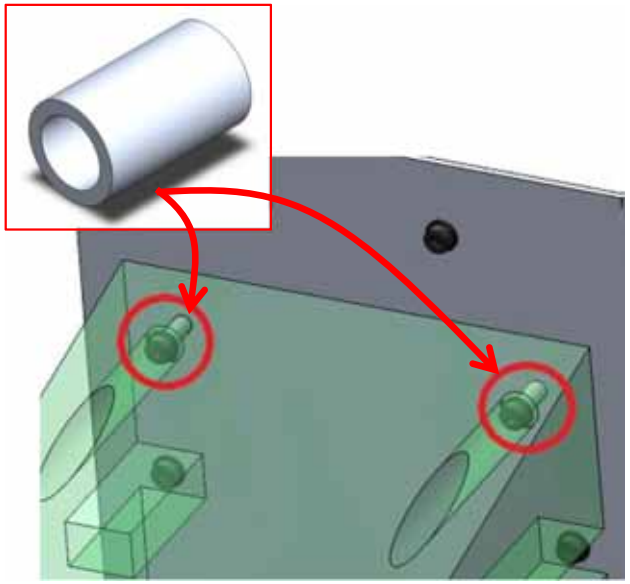
Case of "Welding"

Eight 8mm Metric Grade 8.8 bolts (Minimum)

Case of "Bolts joint"

It is required to be equivalent to bolted.

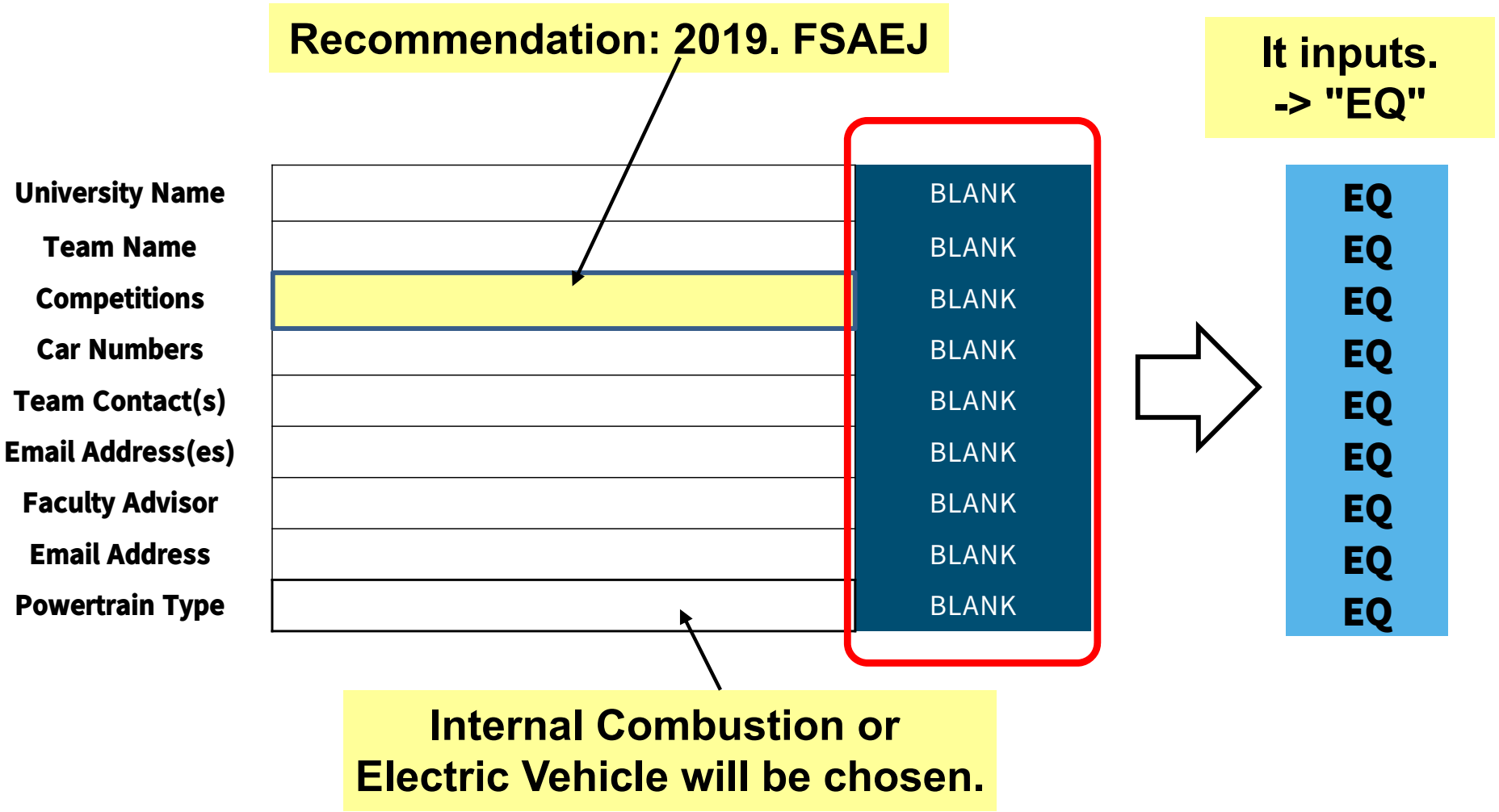
Case of "structural adhesive"



1. Notes on rule
2. **How to report IAD**
3. It is a required item to IAD (Attachment data)

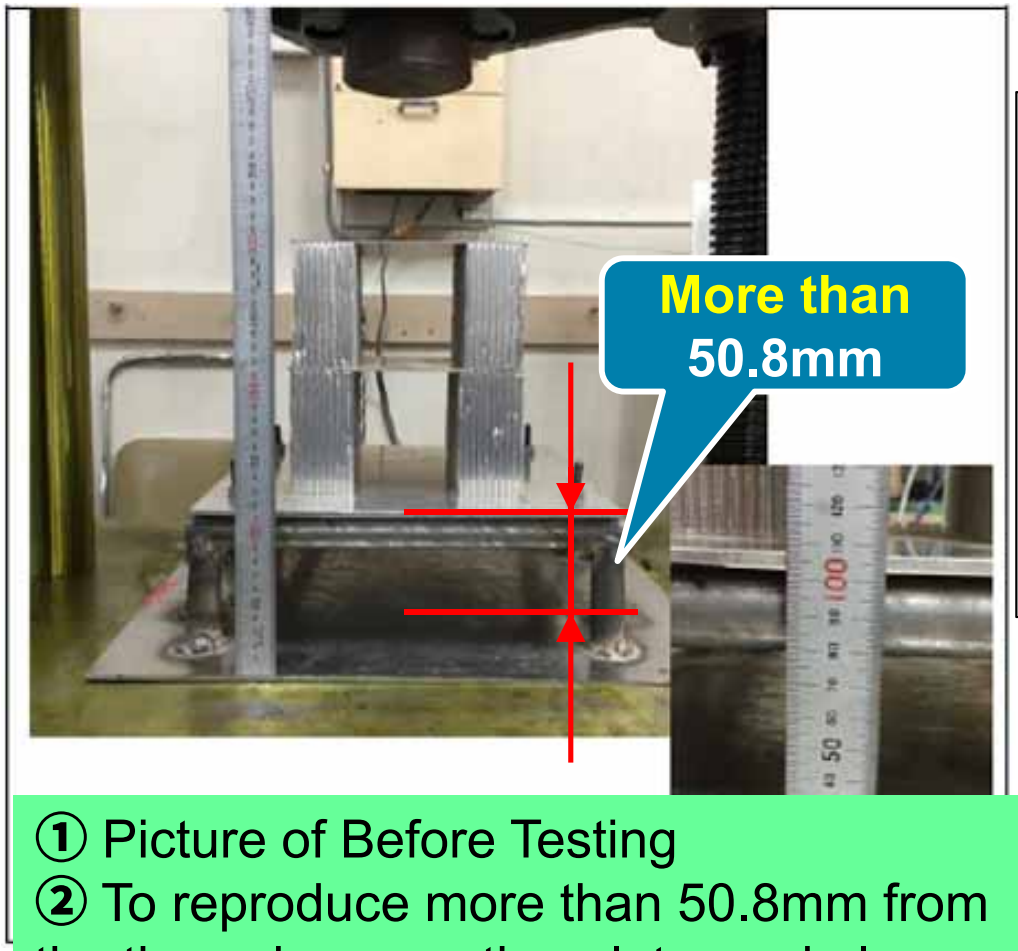
The Input of Team Information

Although there is no restriction in expression, you should input correctly.



The Photo before TEST, Input and Judgment

Specify the photograph before a test like a sample.
You should photo the scale clear.



① Picture of Before Testing
② To reproduce more than 50.8mm from the through-preventing plate, and place the impact attenuator on it

【Before TEST】

BLANK

Impact Attenuator

BLANK			
Impact Attenuator:			BLANK
Impact Attenuator Material:			BLANK
Description of form/shape:			BLANK
Minimum width over 200mm length >= 200mm (7.874in):		mm	BLANK
Minimum height over 200mm length >= 100mm (3.937in):		mm	BLANK
Al plate material:			BLANK
to Al plate mounting method:			BLANK
T.2.23.3b Is adhesive used in the IA to Al plate mounting?:			BLANK
Al plate to Bulkhead mounting method:			BLANK

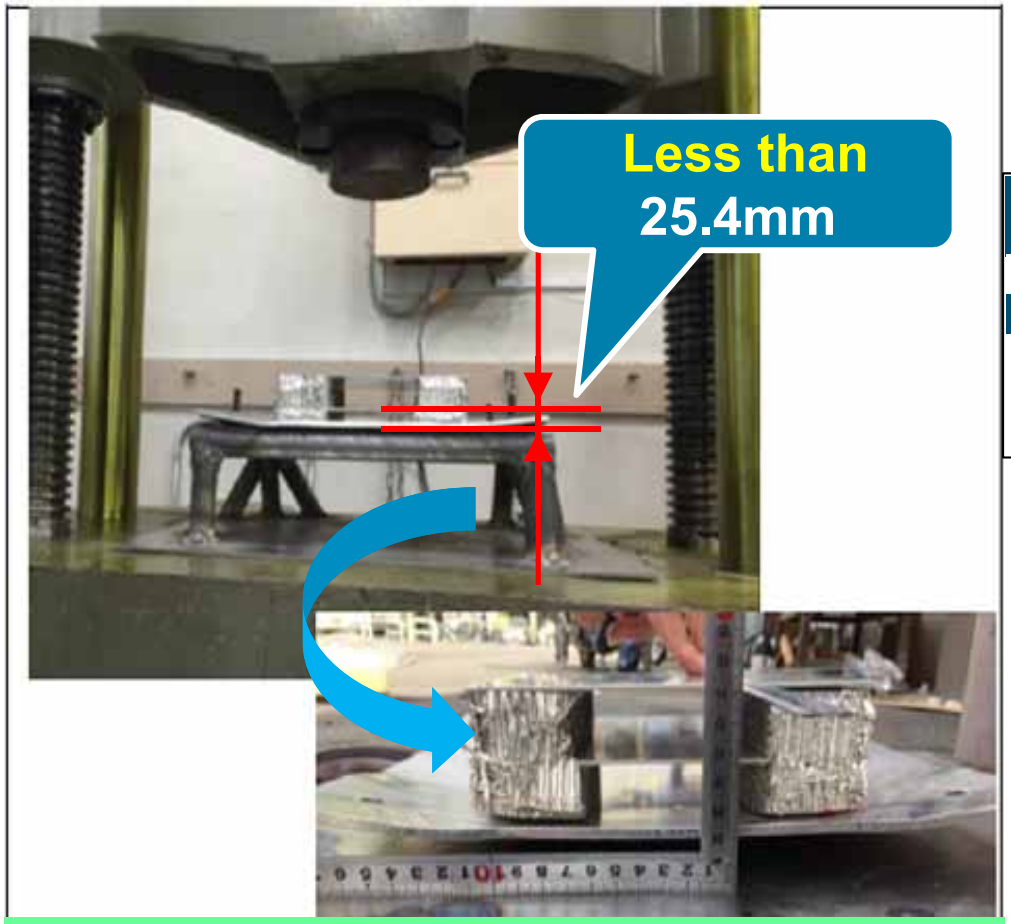
A blank is inputted correctly.
-> a result is judged automatically.

All will be set to EQ if it is O.K.

EQ

The Photo after TEST, Input and Judgment

Specify the photograph after a test like a sample.
You should photo the scale clear.



① Picture of After Impact
② Measurement AIP Displacement

【After TEST】

BLANK	Crushed Attenuator			
	BLANK			
	Maximum crushed displacement:		mm	BLANK
	Post crush displacement, demonstrating any springback:		mm	BLANK
T.2.23.4b	AI plate deformation:		mm	BLANK

A blank is inputted correctly.
-> a result is judged automatically.

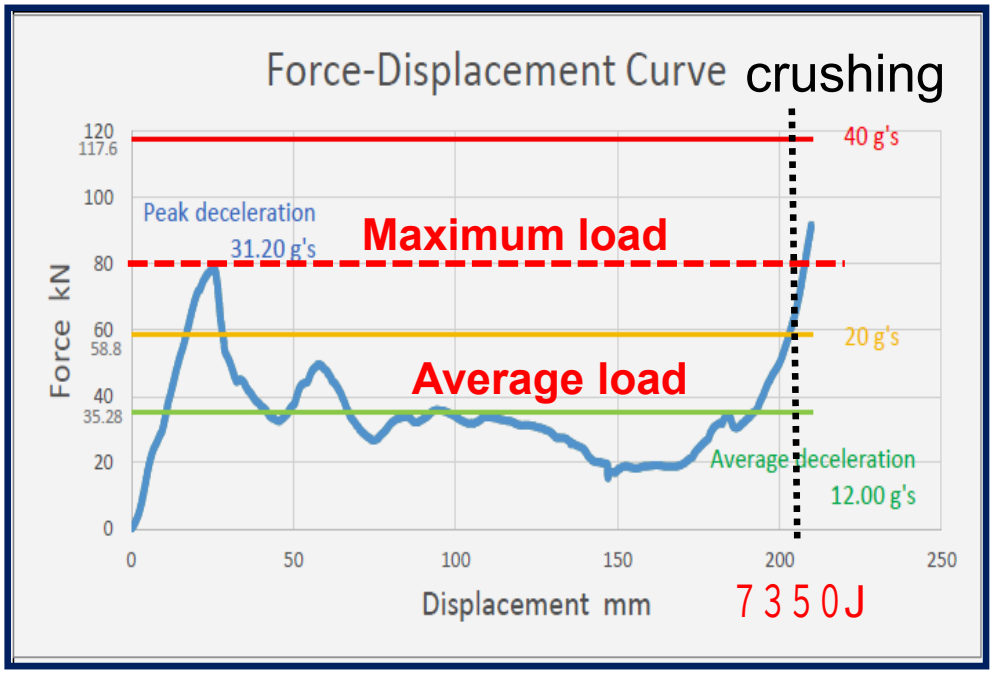
All will be set to EQ if it is O.K.

⇨ **EQ**

Force Displacement Curve

The maximum, average load, and the auxiliary line at the time of 7350J arrival are put into TEST data.

Ave. deceleration and the Max. deceleration are asked from a graph.



Test result

It writes in the auxiliary line of 7350J arrival (vertical axis), the auxiliary line of the amount of crash (horizontal axis), the auxiliary line of the maximum load, the auxiliary line of average load

TEST data -> (standard IA: it is unnecessary)

BLANK

Attenuator Test

BLANK

Test type:	Example: Barrier Impact, Drop Test, Quasi-static Crush		BLANK
Test site:			BLANK
T.2.25.2a Peak attenuator force:		N	BLANK
Peak attenuator only deceleration <= 40g:		g	BLANK
Average attenuator force:		N	BLANK
Average attenuator only deceleration <= 20g:		g	BLANK

A blank is inputted correctly.
-> a result is judged automatically.

All will be set to EQ if it is O.K.

EQ

Attachment of Test Data

Continuously compressing the attenuator in the compression tester to obtain the reaction force (KN) with respect to stroke (mm) at that time.

The final energy is built up the necessary when very small deformation energy (deformation amount of the measured force * unit length), are ultimately determined to become more 7350j which is determined by the rule. Because it integrates, but does not and down in the middle.　Energy to the amount of deformation stacking a number = integrating> deformation 0 to pile up to the energy until collapse completely.

Energy E ＝　F [N]＊S [m] ＝ F [kN] ＊１０００ ＊ S [mm]/１０００

Deceleration＝ F [N] /300kg＊ 9.8ms= F [N] /2940=○G

Paste in logged data from test below:

It is acceptable to resample the data at a lower frequency to reduce the number of datapoints. Repeat the energy

Impact Attenuator Energy calculation sa

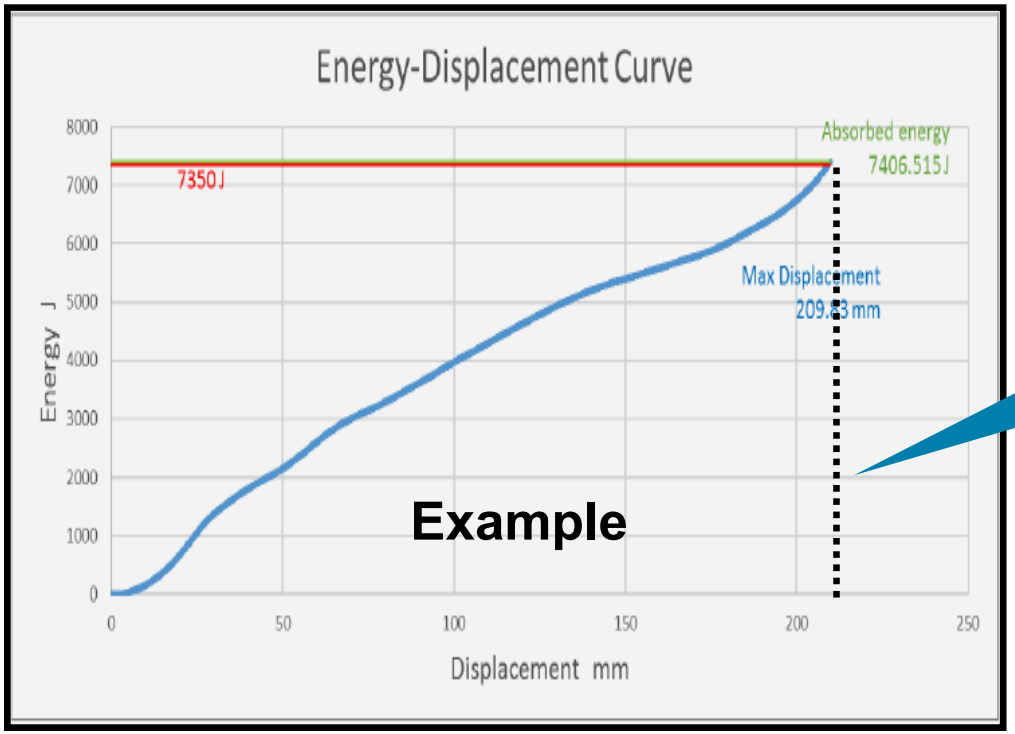
measuring data1		
	measuring data2	
		Energy=F*Displaceme
		unit [N*m]
Displacement [mm]	Force [kN]	Energy [J = kN*1000*mm/1000]
0	0	0
1	10	10
2	20	30
3	30	60
4	31	91
5	29.4	120.4
6	33	153.4
7	35	188.4
8	36	224.4
9	38	262.4
10	40	302.4
11	45	347.4
12	50	397.4
13	51	448.4
14	52	500.4
15	55	555.4
16	58	613.4
17	59	672.4
18	60	732.4
19	61	793.4
20	62	855.4

Displacement is written per mm.

A detailed data statement like a 0.1-mm unit is unnecessary.

Energy Displacement Curve

Experimental data
(integration graph of absorbed energy)
Since it is integration, a graph does not fall.



Example

The amount of displacement at the time of crash

A blank is inputted correctly.
-> a result is judged automatically.

BLANK

Energy Calculation

T.2.25.2b All calculated values must be based on a mass of 300kg and an initial velocity of 7m/s

BLANK			
T.2.25.2b	Energy absorbed >= 7350J:	J	BLANK

All will be set to EQ if it is O.K.

EQ

Test included Wing

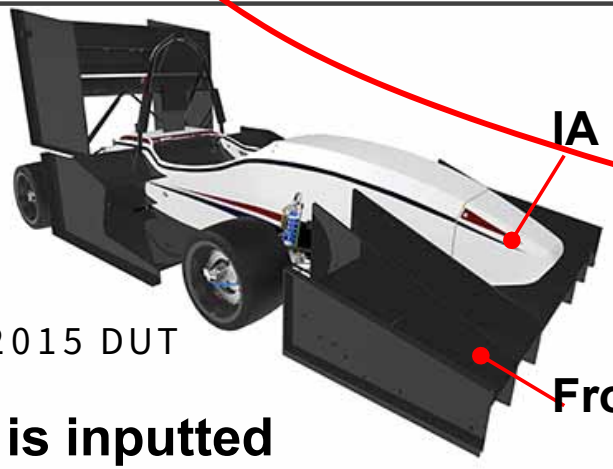
Total intensity is indicated when there is an aero part.

T.2.24.2 Outside Primary Structure

b. Prove the combination of the Impact Attenuator Assembly and non crushable object(s) does not exceed the peak deceleration specified in **T.2.25.2**

Any of the following methods may be used to prove the design does not exceed 120 kN:

- Physical testing of the Impact Attenuator Assembly including any required non crushable object(s). See the FSAE Online Website FAQs for an example of the structure to be included in the test for wings and wing mounts
- Combining the peak force from physical testing of the Impact Attenuator Assembly with the failure load for the mounting of the non crushable object(s), calculated from fastener shear and/or link buckling
- Combining the “standard” Impact Attenuator peak load of 95 kN with the failure load for the mounting of the non crushable object(s), calculated from fastener shear and/or link buckling



2015 DUT

- **Test (IA including Wing)**
- **Test (IA) and Calculations (Wing)**
- **STD IA and Calculations (Wing)**

A blank is inputted correctly. -> a result is judged automatically.

All will be set to EQ if it is O.K.

EQ

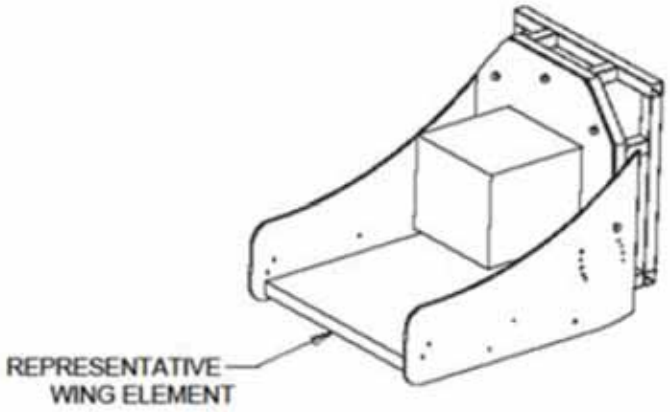
BLANK — Front Wing Calculation

T.2.24.2 All non-crushable objects ahead of the plane of the crushed IA must be accounted for.

BLANK			
Front Wing Status:			BLANK
Wing detachment force:		N	N/A
Peak Attenuator Force:	0	N	EQ
Peak deceleration force <= 120000N	0	N	EQ
Peak deceleration remains <= 40g:	0	g	EQ
Energy absorption check:	7350	J	EQ

Test included Wing

Test when there is aerodynamic parts will be as follows.



Structure Combined IA and Wing

This is clearly indicated the structure of the IA and the aerodynamic parts in the drawings at the crushing test (strength test) in its structure.

This is the recommended method (that is very objective) to indicate its strength.

That aerodynamic parts does not disturb the effect of IA!

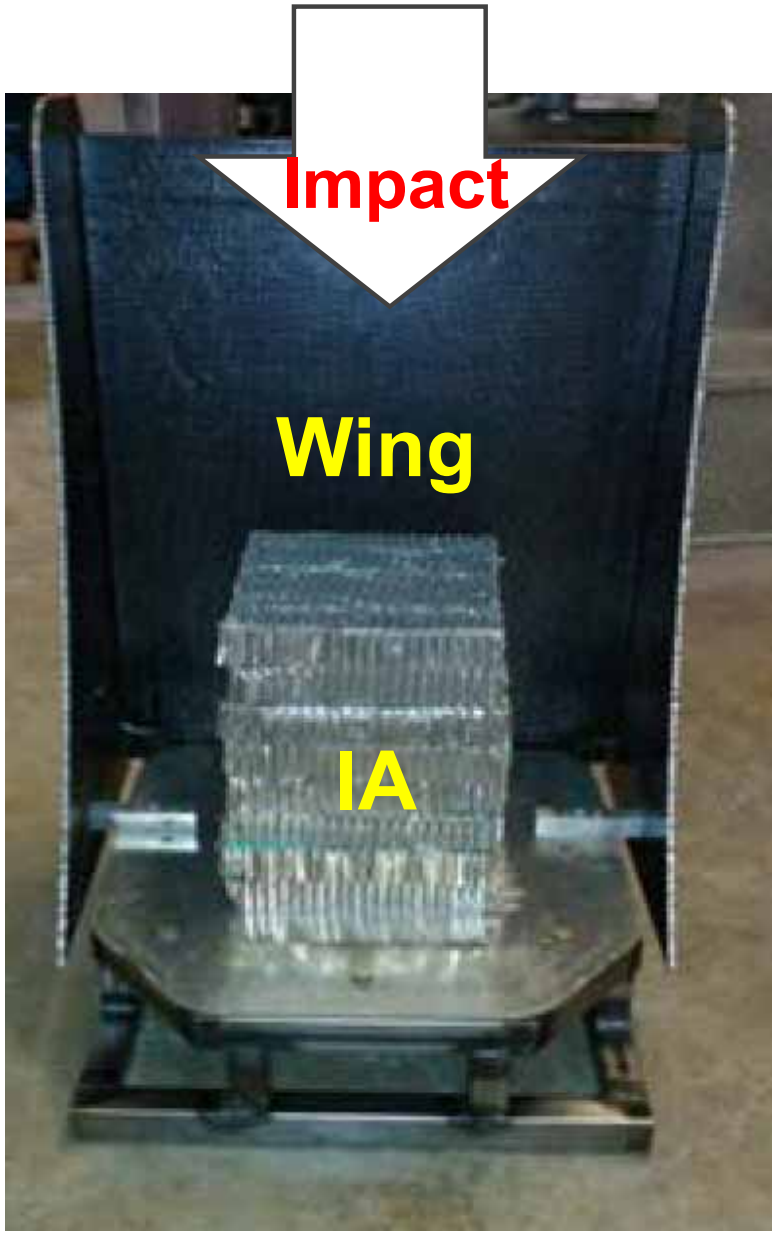


Figure Before Impact

Intensity calculation of adhesives

About evaluation in case IA and AIP are being fixed by structural adhesive.

EQ Adhesive Shear Calculation

T.2.23.3b - Standard and other foam attenuators may not be attached by bolting alone.

Adehsives must be suitable for both materials being bonded.

While the lock is engaged:
A quick release attenuator must not be removable with less force than standard bolt shear.

Honeycomb attenuators:
No wall wetting may be factored into the bond area. Use a calculation of pre-crushed area.
Multiple layer of honeycomb require pre-crushed bond on both sides of a plate between each la

EQ				
T.2.23.3	Baseline number of fasteners:	4		N/A
			N	N/A
	Number of above fasteners used:			N/A
	Attenuator bonding material:	0		N/A
	Anti-Intrusion plate material:	0		N/A
			N/mm^2	N/A
			mm^2	N/A
				N/A

A blank is inputted correctly.
-> a result is judged automatically.

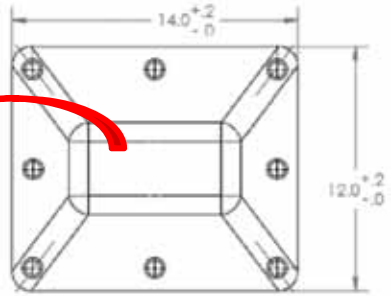
All will be set to EQ if it is O.K.

⇨ **EQ**

You have to prove the following conditions by evidence.

Structural adhesive

It is required to be equivalent to bolted.



The adhesive shearing power per the unit area
×
Adhesion area

≧

The shearing power per one bolt
×
8

IA is directly attached to FBH

T.2.25.8
Teams using Impact Attenuators (typically structural noses) directly attached to the Front Bulkhead, which shortcut the load path through the bulk of the Anti Intrusion Plate, must conduct an additional test.
This test must prove that the Anti Intrusion Plate can withstand a load of 120 kN (300 kg multiplied by 40 g), where the load applicator matches the minimum Impact Attenuator dimensions.

EQ	Thin Wall Peak Force Test

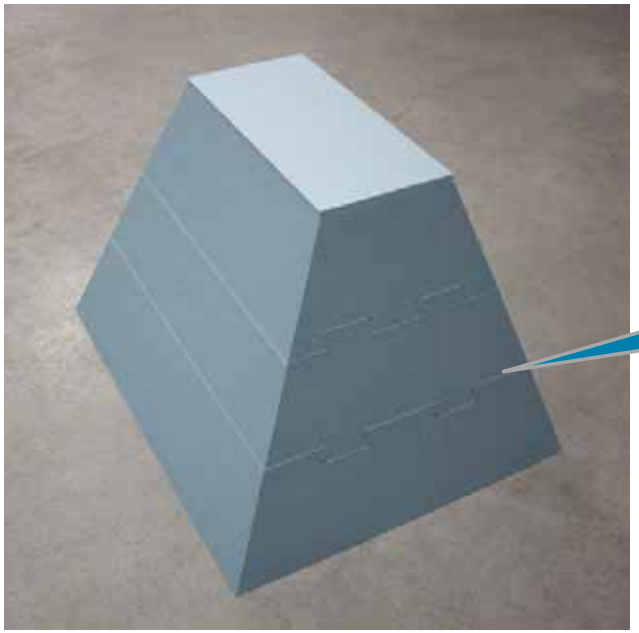
T.2.25.8
Teams with a thin wall IA (e.g. structural noses) must test the AI to 120kN applied through the IA area.
Attach logged test data to the right.
Attach notes and calculations above, or on another tab.

1. Notes on rule
2. How to report IAD
3. **It is a required item to IAD (Attachment data)**

Standard Impact Attenuator

T.2.25.3 When using the standard Impact Attenuator, the IAD Report must meet the following:

a. Test data will not be submitted
b. All other requirements of this section must be included.
c. **Photos** of the actual attenuator must be included
d. **Evidence** that the Standard IA meets the design criteria provided in the Standard Impact Attenuator specification must be appended to the report. This may be a receipt or packing slip from the supplier.

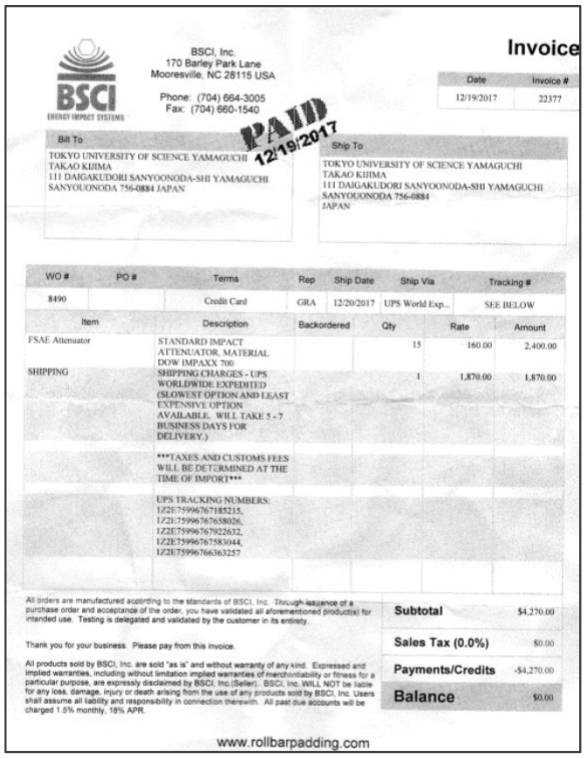


The example of a Photo.

Caution !

1) **It was officially recognized in FSAE**
2) **Needs documentation by officially**
3) **Your team modified, it is not STD IA**

The example of Evidence



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8490		Credit Card	GRA	12/20/2017	UPS World Exp...	SEE BELOW

Item	Description	Backordered	Qty	Rate	Amount
FSAE Attenuator	STANDARD IMPACT ATTENUATOR, MATERIAL DOW IMPAXX 700		15	160.00	2,400.00
SHIPPING	SHIPPING CHARGES - UPS WORLDWIDE EXPEDITED (SLOWEST OPTION AND LEAST EXPENSIVE OPTION AVAILABLE. WILL TAKE 5 - 7 BUSINESS DAYS FOR DELIVERY.)		1	1,870.00	1,870.00
	TAXES AND CUSTOMS FEES WILL BE DETERMINED AT THE TIME OF IMPORT				
	UPS TRACKING NUMBERS: 1Z2E75996767185215, 1Z2E75996767658026, 1Z2E75996767922632, 1Z2E75996767583044, 1Z2E75996766363257				

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Subtotal	$4,270.00
Sales Tax (0.0%)	$0.00
Payments/Credits	-$4,270.00
Balance	$0.00

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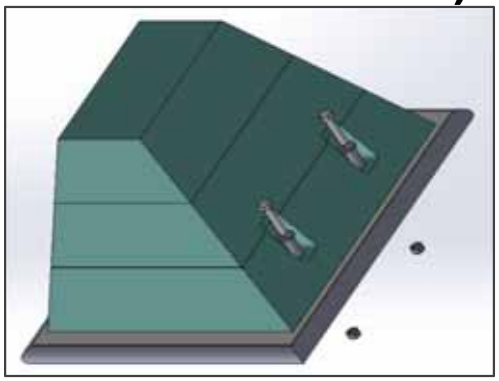
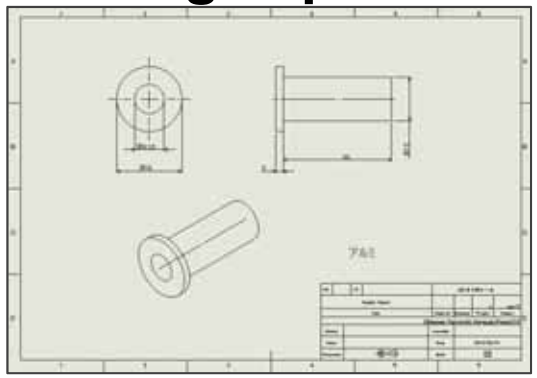
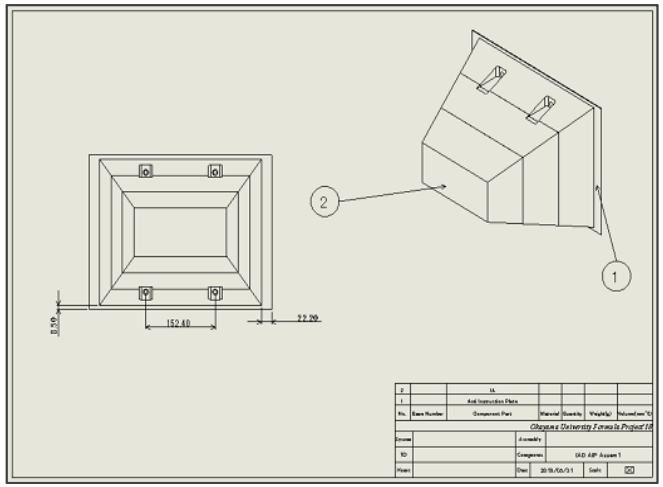
Accompanying Drawing

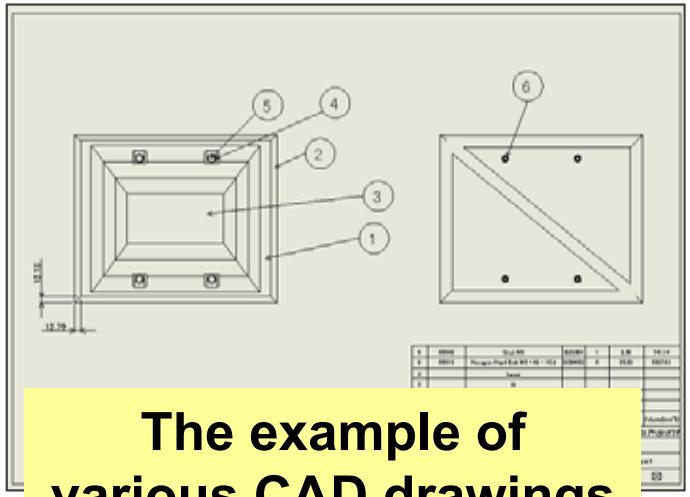
A size required for a CAD (A three-view + isometric) drawing is put in.

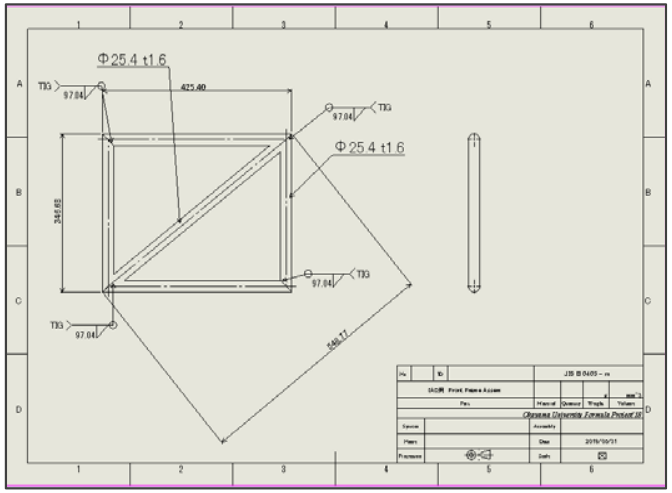
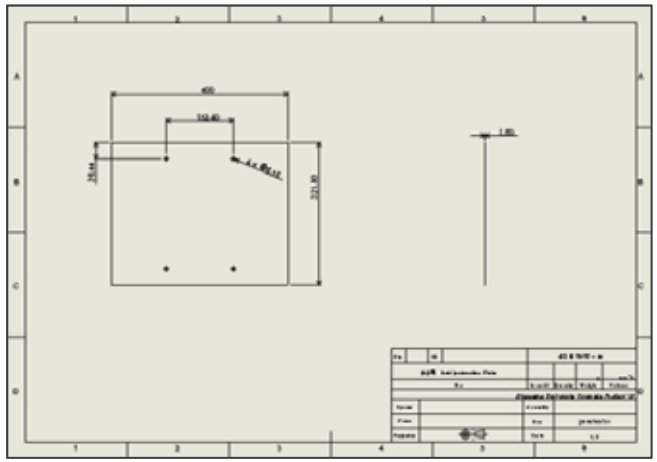
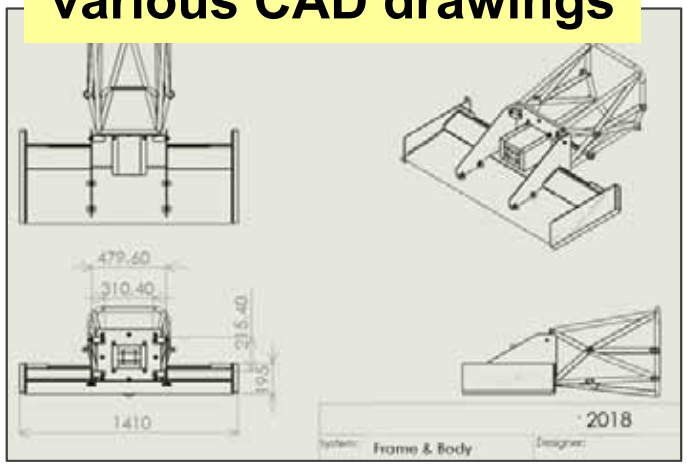
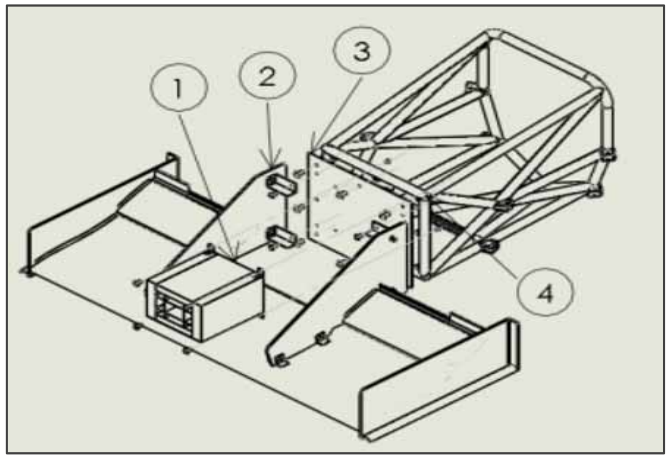
- The attachment position to AIP
- Front Bulkhead size
- Specifications of AIP (material, thickness, and size)
- The attachment method to IA=>AIP
- The attachment method to AIP=>FBH











The example of various CAD drawings