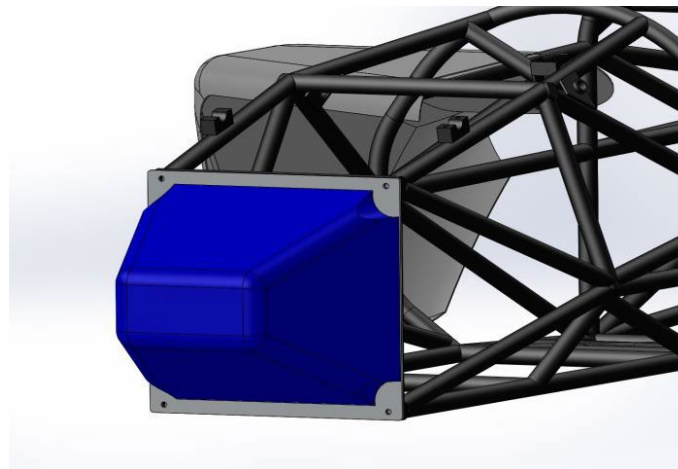


SES(等価構造計算書)

F.8 Front Protection



Attenuator and Diagonal

IAは4択 テスト方法はそれぞれのタイプに従うこと

BLANK

Attenuator and Diagonal

No Test:

+

Standard Foam

Standard Honeycomb

Custom-Non-Composite

Custom-Composite : モノコック構造の意味

IAタイプにより試験方法は4種類

No Test: Standard Foam + Matched FB

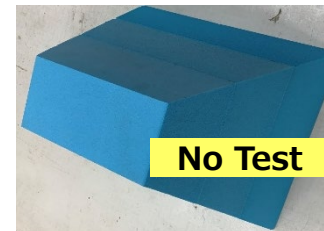
No Test: Standard Honeycomb +

Physical Test: Custom IA + AIP + FB Replica

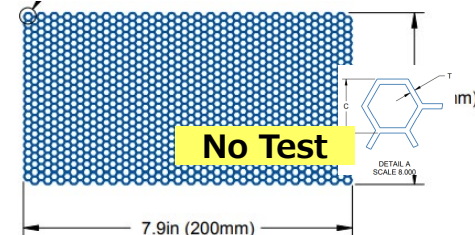
Dynamic Test: Composite IA + AIP + FB Replica

BLANK			
F.8.4.1	Impact Attenuator Type:	4択	BLANK
	Standard Foam Attenuator Height:	304mm (12in)	NA
	Standard Foam Attenuator Width:	355mm (14in)	NA
F.8.4.3	Front Bulkhead Outside to Outside Height:		BLANK
	Front Bulkhead Outside To Outside Width:		BLANK
BLANK			
F.8.4.3	Diagonal Tube, Attenuator Test, or Composite		BLANK
	Minimum	Tube Used	EQ
F.3.2.1	Example: 25.4mm x 1.2mm round	Steel	BLANK
F.3.4.1	Diagonal Minimum Tube:	Size C	BLANK
	Wall thickness:	1.2	mm
F.3.4.1	Square side:	25	mm
	Wall thickness:	0.0012	m
	Square side:	0.025	m
	Tube cross sectional area (A):	9.10E-05	m^2
	Tube second moment of inertia (I):	6.70E-09	m^4
F.3.4.2	Young's Modulus (E):	2.00E+11	0.00E+00 Pa
F.3.5	Critical Buckling Modulus	Sy: 3.05E+08	0.00E+00 Pa
	Sy:	E_1*I_1/2 <= E_2*I_2: 1.34E+03	EQ
	Bending Deflection	S_1*A_1/2 <= S_2*A_2: 2.78E+04	EQ
	Energy	4*S_1*I_1/2 <= 4*S_2*I_2/r: 6.43E+02	EQ
		Bending_1/(48*EI): 1.00E-02	EQ
		0.5*Bending^2/(48*EI): 3.22E+00	EQ

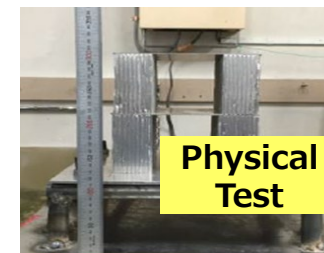
それぞれの項目を選択すること



No Test



No Test



Physical Test



Dynamic Test

要求されたエビデンスを添付すること

(if not already on 3-Point test tab)

これらは凡例であり、
形式は問わない

3

2023年 追加

要求されたエビデンスを添付すること

- Standard IAで、FBHにDiagonalが必要になる場合は、これらの入力も忘れないこと。

2023年 追加

Anti-Intrusion Plate

Composite AIP の場合はPhysicalテストが必須

Physicalテスト必須

No additional test for Steel or Aluminum AIP.

Composite AIP -

BLANK

F.8.2.1 Anti-Intrusion Plate (AIP) material: EQ
Steel: 1.5mm (0.060in), Aluminum: 4.0mm (0.157in): mm BLANK

- F.8.3.2 AIP plates made of any material besides steel or aluminum must either:
F.8.3.2.a Be physically tested on a replica bulkhead up to 120kN, with the load distributed over the 200 mm x 100mm minimum IA area.
F.8.3.2.b Show F.8.3.4 120kN equivalence from F.4.3.1 laminate testing.

EQ

F.8.3.2	Composite Anti Intrusion:	Steel	N/A
F.8.3.2	Composite AIP Equivalence:	<input type="text"/>	N/A
	Type SES Tab Name Of Layup Used:	<input type="text"/>	N/A
	Core thickness:	<input type="text"/> mm	N/A
Scaling option, layup repeats:	Outer skin thickness:	Layup mm	N/A
Scaling option, layup repeats:	Inner skin thickness:	Typo mm	N/A
	Thickness of panel:	#VALUE! mm	N/A
	Composite Panel Height:	<input type="text"/> mm	N/A
	Composite Panel Width:	<input type="text"/> mm	N/A
	Top Edge of FB to Top Edge of IA:	<input type="text"/> mm	N/A
F.8.3.1	Minimum Required Impact Attenuator Height:	100 mm	N/A
	Minimum Required Impact Attenuator Width:	200 mm	N/A
	Second moment of inertia I, Vertical:	m^4	N/A
	Second moment of inertia I, Horizontal:	m^4	N/A
	Young's Modulus (E):	Layup Pa	N/A
	Ultimate Tensile Strength (S):	Name Pa	N/A
	Shear:	Typo Pa	N/A
F.8.3.1	Max Bending Moment, Vertical (120kN Partial UDL):	Nm	N/A
	Max Bending Moment, Horizontal (120kN Partial UDL):	Nm	N/A
	Max Bending * Max y / I = Max Stress, Vertical:	Pa	N/A
	Max Bending * Max y / I = Max Stress, Horizontal:	Pa	N/A
	UTS (S) / Max Stress = Safety Factor, Bending:		N/A
	Perimeter Shear Stress, 120kN Load:	Pa	N/A
	Safety Factor, Perimeter Shear:		N/A

EQ

F.8.2.1 Anti-Intrusion Plate (AIP) material: EQ
Steel: 1.5mm (0.060in), Aluminum: 4.0mm (0.157in): mm N/A
F.8.3.2 - AIP 3-Point & Shear or 120kN Physical Test required.

- F.8.3.2 AIP plates made of any material besides steel or aluminum must either:
F.8.3.2.a Be physically tested on a replica bulkhead up to 120kN, with the load distributed over the 200 mm x 100mm minimum IA area.
F.8.3.2.b Show F.8.3.4 120kN equivalence from F.4.3.1 laminate testing.

BLANK

F.8.3.2	Composite Anti Intrusion:	Composite	EQ
F.8.3.2	Composite AIP Equivalence:	<input type="text"/>	BLANK
	Type SES Tab Name Of Layup Used:	<input type="text"/>	BLANK
	Core thickness:	<input type="text"/> mm	BLANK
Scaling option, layup repeats:	Outer skin thickness:	Layup mm	EQ
Scaling option, layup repeats:	Inner skin thickness:	Typo mm	EQ
	Thickness of panel:	#VALUE! mm	EQ
	Composite Panel Height:	<input type="text"/> mm	BLANK
	Composite Panel Width:	<input type="text"/> mm	BLANK
	Top Edge of FB to Top Edge of IA:	<input type="text"/> mm	BLANK
F.8.3.1	Minimum Required Impact Attenuator Height:	100 mm	EQ
	Minimum Required Impact Attenuator Width:	200 mm	EQ
	Second moment of inertia I, Vertical:	m^4	EQ
	Second moment of inertia I, Horizontal:	m^4	EQ
	Young's Modulus (E):	Layup Pa	BLANK
	Ultimate Tensile Strength (S):	Name Pa	BLANK
	Shear:	Typo Pa	BLANK
F.8.3.1	Max Bending Moment, Vertical (120kN Partial UDL):	Nm	EQ
	Max Bending Moment, Horizontal (120kN Partial UDL):	Nm	EQ
	Max Bending * Max y / I = Max Stress, Vertical:	Pa	EQ
	Max Bending * Max y / I = Max Stress, Horizontal:	Pa	EQ
	UTS (S) / Max Stress = Safety Factor, Bending:		EQ
	Perimeter Shear Stress, 120kN Load:	Pa	EQ
	Safety Factor, Perimeter Shear:		EQ

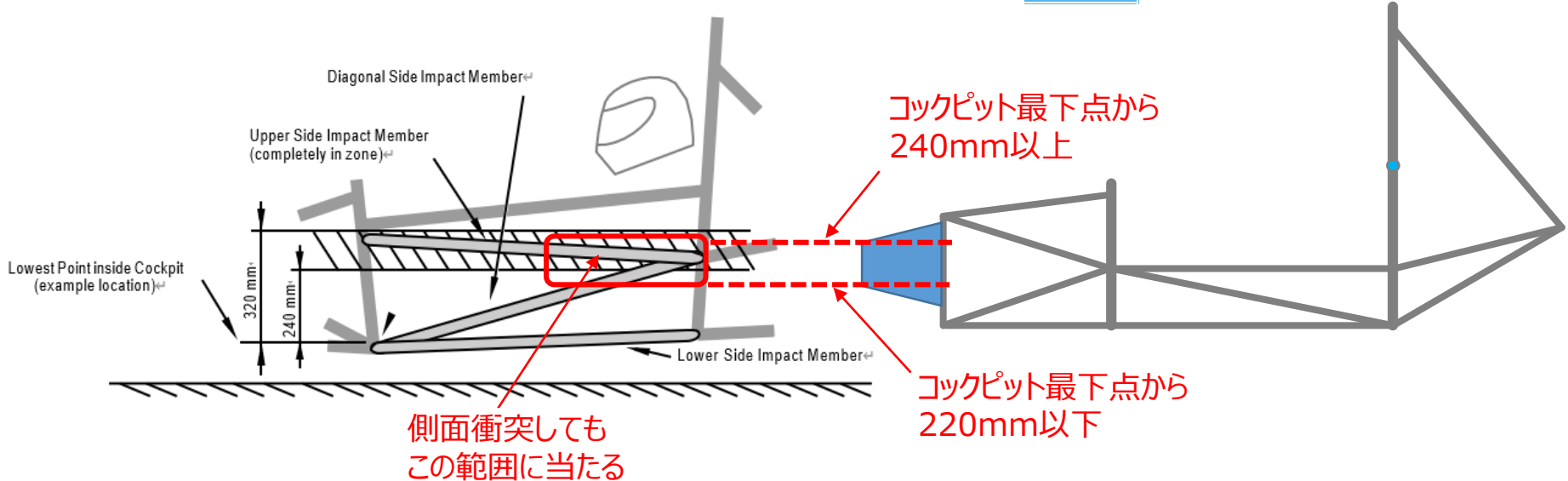
「BLANK」となっている項目の
入力が必須
「EQ」とならなければならない

IA Attachment

以下項目は、他の車両から側面衝突を受けた場合、IA先端部がSISのUpper部に当たること乗員を保護するという考え方に基づく

すなわち、IAのTop部分はこの高さでなければならない

BLANK		
Front top of IA > 240mm above lowest point in cockpit:	mm	BLANK
Front bottom of IA < 220mm above lowest point in cockpit:	mm	BLANK
F.8.5.2 IA to AI plate mounting method:		BLANK
	mm	BLANK
		BLANK
	0.00E+00 N	EQ
	N/mm ²	BLANK
	0 N/mm ²	EQ
	mm ²	BLANK
		EQ



Anti-Intrusion Plate, IA Attachment

要求されたエビデンスを添付すること
各チームの考え方や計算方法があるため、具体例は示さない。

Insert Pictures - continued:

(d.) Wing Detachment Material Properties

(e.) Other Wing Detachment Calculations
(if not using standard fastener shear)

Insert measurement of IA front top edge height.

Shear Dimensions

Do not count holes as part of the area.
Even with precrush, honeycomb bond area is
usually <50% of the face.

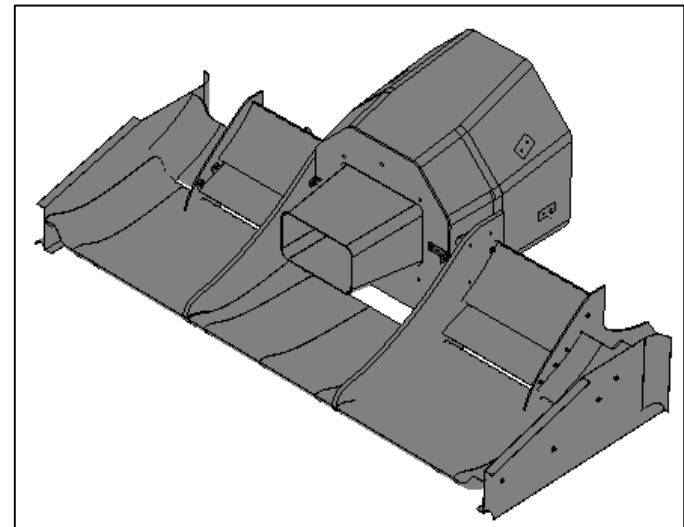
Insert measurement of IA front top edge height.

Shear Dimensions

Do not count holes as part of the area.
Even with precrush, honeycomb bond area is
usually <50% of the face.

AIP 及び IA固定方法については、下記アイソメ
図に加え、三面図にブラケット・ステイ・ボルトなどの
詳細情報を入力して添付すること。

例年、これらの不備が多く再審査の原因



引用したCAD図は東海大学のものである
大変分かりやすく、審査しやすい図面である
詳細は示さないが、敬意を持って紹介する

Wing Detachment

Front Wing を含む場合の考え方は従来と同様

Front Wing Status は5種類あり入力項目が違うの要注意

	EQ		
Front Wing Status:	No Front Wing	N/A	
	No Front Wing	N/A	
	Front Wing Physically Tested With IA	N/A	
	Front Wing Physically Tested Without IA	EQ	
	Standard Shear Calculation	EQ	
	Custom Calculation	EQ	
F.8.7.2.a	Peak deceleration force <= 120000N	95000 N	
	Peak deceleration remains <= 40g:	32.3 g	

Front Wingが無い場合、項目選択以外の入力不要
IAと共に物理テストをした場合、以下を選択し入力不要

	EQ		
Front Wing Status:	No Front Wing	N/A	
		N/A	
		N/A	
	0	N	
	Peak Attenuator Force:	95000 N	
F.8.7.2.a	Peak deceleration force <= 120000N	95000 N	
	Peak deceleration remains <= 40g:	32.3 g	

IA無しで物理テストをした場合、項目選択 + 必要項目を入力
標準IAで剪断力の計算をした場合、項目選択 + 必要項目を入力
Custom IAで剪断力の計算をした場合、項目選択 + 必要項目を入力

	BLANK		
Front Wing Status:	Front Wing Physically Tested Without IA	EQ	
	Tested failure force:	N	
	Which column has the front wing force data?	BLANK	
	Wing detachment force:	0 N	
	Peak Attenuator Force:	95000 N	
F.8.7.2.a	Peak deceleration force <= 120000N	95000 N	
	Peak deceleration remains <= 40g:	32.3 g	

BLANK

Physical Tests

Insert Test Pictures - may be added below:

(a.) IA and FB test fixture before the test
(F.8.7.4.d) which also shows the method of
spa

物理テストをした場合
テスト前後の写真・
実験方法を示す写真を
添付すること

(b.) I
(F.8.7.4

(c.) IA / AIP Force Displacement Curve

(d.) IA Energy Displacement Curve

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 weighted average force and energy calculations in columns three and four. Do not assume all steps

Disp.	Force	Weighted	Energy
mm	N	N	J
MAX	MAX	MAX	MAX
0	0	0	0

Paste in logged data from test below:

It is acceptable to resample the data at a lower

Disp.	Force
mm	N
MAX	MAX
0	0

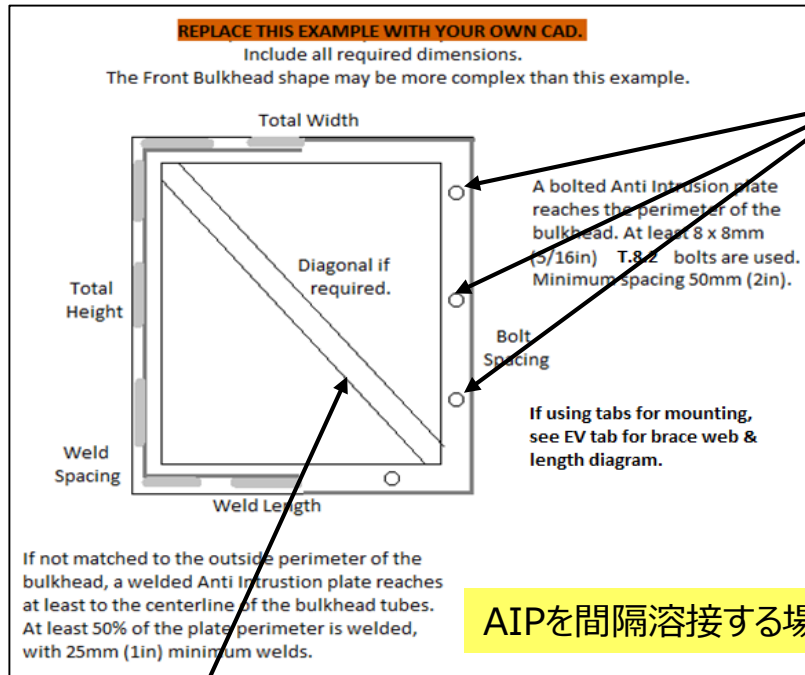
Paste in logged data from test below:

It is acceptable to resample the data at a lower

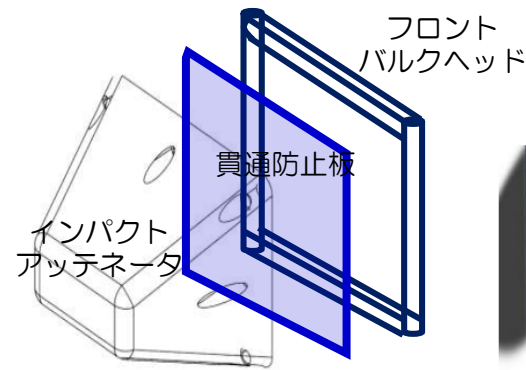
Disp.	Force
mm	N
MAX	MAX
0	0

物理テストをした場合
実験結果の生データを
入力する事
※1mm毎の圧縮データを推奨

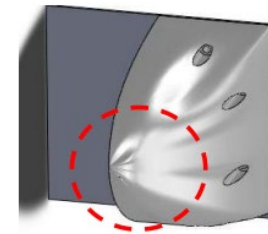
Front Bulkhead



**BH に直接穴を開けてボルト締結する場合
→ インサートを入れること。(レギュレーション要件)**



標準IAは加工禁止



NOT PERMITTED: changed design or dimensions for Standard IA TYPE12

AIPを間隔溶接する場合、比率が計算できること

F.8.4.3 標準IA (Form) でフロントバルクヘッドの外側寸法が400 x 350 mmより大きい場合、標準IA (Honeycomb) を使用している場合、Diagonalが必要。

Front Bulkhead

Tube と Composite で入力項目が違う

「Tube」の場合

F.8.2.4 A 25mm gap is required between the AIP + FB + Diagonal and the pedal assembly.

BLANK			
F.6.1	Front Bulkhead	Tube	EQ
		Tube Used	EQ
F.3.2.1	Example: 25.4mm x 1.6mm round	Steel	BLANK
F.3.4.1	Front Bulkhead Minimum Tube: Size B		BLANK
	Wall thickness: 1.2	mm	BLANK
F.3.4.1	Square side: 25	mm	BLANK
	Wall thickness: 0.0012	m	EQ
	Square side: 0.025	m	EQ
	Tube cross sectional area (A): 1.14E-04	m ²	EQ
	Tube second moment of inertia (I): 8.51E-09	m ⁴	EQ
F.3.4.2	F.3.5	Young's Modulus (E): 2.00E+11	0.00E+00 Pa
F.3.5	Critical	Sy: 3.05E+08	0.00E+00 Pa
Buckling Modulus		E ₁ *I ₁ <= E ₂ *I ₂ : 1.70E+03	EQ
	Sy:	S ₁ *A ₁ <= S ₂ *A ₂ : 3.48E+04	EQ
Bending		4*S ₁ *I ₁ /r <= 4*S ₂ *I ₂ /r: 8.17E+02	EQ
Deflector		Bending ₁ /(48*EI): 1.00E-02	EQ
Energy		0.5*Bending ² /(48*EI): 4.09E+00	EQ

EQ			
F.7.3	Front Bulkhead Construction:	Tube	Tube Diagonal
	Front Bulkhead Tubes Replaced Size B:	0	Diagonal Size C: 0
	Type SES Tab Name Of Layout Used:		
	Front Bulkhead		
	Core thickness:		mm
	Scaling option, layup repeats:	Outer skin thickness:	Layup mm
	Scaling option, layup repeats:	Inner skin thickness:	Typo mm
		Thickness of panel:	#VALUE! mm
	Front Bulkhead Height:		mm
	Front Bulkhead Width:		mm
	Cutout Height:		mm
	Cutout Width:		mm
	Composite Panel Height:	0	mm
F.3.4.2.a	Young's Modulus (E): 2.00E+11	Layup	Pa
	Ultimate Tensile Strength (S): 3.65E+08	Name	Pa
	Shear: 2.11E+08	Typo	Pa
F.7.3.2	5mm FBHS Section		
	Core thickness:	0	mm
	Outer skin thickness:	0	mm
	Inner skin thickness:	0	mm
	Thickness of panel:	0	mm
F.3.4.2.a	Young's Modulus (E): 2.00E+11	0.00E+00	Pa
	Ultimate Tensile Strength (S): 3.65E+08	0.00E+00	Pa
	Shear: 2.11E+08	0.00E+00	Pa
	0 x Steel Tube	Flat (h)	
F.3.2.1	Minimum FB wall thickness:	0.0012	0 m
	Outer Diameter / Panel Thickness:	0.025	#VALUE! m
F.3.4.1	Additive cross section (A): 0.00E+00	#VALUE!	m ²
	Additive second moment of inertia (I): 0.00E+00	#VALUE!	m ⁴

「Composite」の場合

F.8.2.4 A 25mm gap is required between the AIP + FB + Diagonal and the pedal assembly.

EQ			
F.6.1	Front Bulkhead	Composite	EQ
		Tube Used	EQ
F.3.2.1	Example: 25.4mm x 1.6mm round	Steel	N/A
F.3.4.1	Front Bulkhead Minimum Tube: Size B		N/A
	Wall thickness: 1.2	mm	N/A
F.3.4.1	Square side: 25	mm	N/A
	Wall thickness: 0.0012	m	N/A
	Square side: 0.025	m	N/A
	Tube cross sectional area (A): 1.14E-04	m ²	N/A
	Tube second moment of inertia (I): 8.51E-09	m ⁴	N/A
F.3.4.2	F.3.5	Young's Modulus (E): 2.00E+11	0.00E+00 Pa
F.3.5	Critical	Sy: 3.05E+08	0.00E+00 Pa
Buckling Modulus		E ₁ *I ₁ <= E ₂ *I ₂ : 1.70E+03	N/A
	Sy:	S ₁ *A ₁ <= S ₂ *A ₂ : 3.48E+04	N/A
Bending		4*S ₁ *I ₁ /r <= 4*S ₂ *I ₂ /r: 8.17E+02	N/A
Deflector		Bending ₁ /(48*EI): 1.00E-02	N/A
Energy		0.5*Bending ² /(48*EI): 4.09E+00	N/A

BLANK			
F.7.3	Front Bulkhead Construction:	Composite	Tube Diagonal
	Front Bulkhead Tubes Replaced Size B:	2	Diagonal Size C: 0
	Type SES Tab Name Of Layout Used:		
	Front Bulkhead		
	Core thickness:		mm
	Scaling option, layup repeats:	Outer skin thickness:	Layup mm
	Scaling option, layup repeats:	Inner skin thickness:	Typo mm
		Thickness of panel:	#VALUE! mm
	Front Bulkhead Height:		mm
	Front Bulkhead Width:		mm
	Cutout Height:		mm
	Cutout Width:		mm
	Composite Panel Height:	0	mm
F.3.4.2.a	Young's Modulus (E): 2.00E+11	Layup	Pa
	Ultimate Tensile Strength (S): 3.65E+08	Name	Pa
	Shear: 2.11E+08	Typo	Pa
F.7.3.2	5mm FBHS Section		
	Core thickness:	0	mm
	Outer skin thickness:	0	mm
	Inner skin thickness:	0	mm
	Thickness of panel:	0	mm
F.3.4.2.a	Young's Modulus (E): 2.00E+11	0.00E+00	Pa
	Ultimate Tensile Strength (S): 3.65E+08	0.00E+00	Pa
	Shear: 2.11E+08	0.00E+00	Pa
	2 x Steel Tube	Flat (h)	
F.3.2.1	Minimum FB wall thickness:	0.0016	0 m
	Outer Diameter / Panel Thickness:	0.025	#VALUE! m
F.3.4.1	Additive cross section (A): 2.28E-04	#VALUE!	m ²
	Additive second moment of inertia (I): 1.70E-09	#VALUE!	m ⁴

AIP Attachment

要求されたエビデンスを添付すること

BLANK		EQ	
F.8.2.2	AIP to FB Attachment:		BLANK
F.8.4.3.d	Al plate must match entire Front Bulkhead perimeter:		EQ
	Scroll to bottom:		BLANK
	Scroll to bottom:	mm	BLANK
EQ		EQ	
F.8.2.3.b	Bolting AIP to tube Front Bulkhead		N/A
	FB tube inserts or on tabs:		N/A
	Maximum Fastener centerline offset from tube surface:	mm	N/A
	Mount cross section on tube surface:		N/A
See diagrams: EV Acc tab AY28-BI28	Mount thickness (B):	mm	N/A
	Mount length (L):	mm	N/A
	Mount thickness (T):	mm	N/A
	Mount face (H):	mm	N/A
	Su-Weld:		N/A
	Su-Weld:		N/A
0.00E+00	Parabolic shear 3*Test Load/2*area <= Shear:		N/A
EQ		EQ	
F.8.2.3.b	Bolting AIP to composite Front Bulkhead		N/A
Fasteners per washer:	Washer/bolt perimeter:	mm	N/A
	Panel thickness: #VALUE!	mm	N/A
	Core thickness: 0	mm	N/A
	Outer skin thickness: Layup	mm	N/A
	Inner skin thickness: Typo	mm	N/A
Fasteners per insert:	Insert Perimeter on bulkhead:	mm	N/A
Fasteners per backing plate:	Backing plate thickness:	mm	N/A
	Backing plate perimeter on bulkhead:	mm	N/A
	Minimum - Fastener spacing, edge, or corner distance:	mm	N/A
	Skin shear strength: 0.00E+00 Pa		N/A
F.8.2.3.b	Perimeter shear strength >15000N: #VALUE!	N	N/A
	Tearout strength >15000N: #VALUE!	N	N/A

Bolted
Welded
Laminated
Bonded

選択肢は4種類
それぞれ入力項目が違ふ

Bolted		EQ	
F.8.2.2	AIP to FB Attachment:	Bolted	EQ
F.8.2.3.b	Al plate must match entire Front Bulkhead perimeter:		EQ
	Number of 8mm critical fasteners (8 required):		BLANK
	Minimum distance between bolt centers:	mm	BLANK
BLANK		EQ	
F.8.2.3.b	Bolting AIP to tube Front Bulkhead		BLANK
	Locate Al bolts through FB tube inserts or on tabs:		BLANK
	Maximum Fastener centerline offset from tube surface:	mm	BLANK
See diagrams: EV Acc tab AY28-BI28	Mount cross section on tube surface:		BLANK
	Mount thickness (B):	mm	BLANK
	Mount length (L):	mm	BLANK
	Mount thickness (T):	mm	BLANK
	Minimum gusset height normal to mount face (H):	mm	BLANK
F.3.5	0.0 15kN shear bending M*y / I <= Su-Weld:		EQ
0.00E+00	0.0 5kN normal bending M*y / I <= Su-Weld:		EQ
0.00E+00	Parabolic shear 3*Test Load/2*area <= Shear:		EQ
EQ		EQ	
F.8.2.3.b	Bolting AIP to composite Front Bulkhead		N/A
	Locate Al bolts through FB tube inserts or on tabs:		N/A
	Maximum Fastener centerline offset from tube surface:	mm	N/A
	Mount cross section on tube surface:		N/A
See diagrams: EV Acc tab AY28-BI28	Mount thickness (B):	mm	N/A
	Mount length (L):	mm	N/A
	Mount thickness (T):	mm	N/A
	Minimum gusset height normal to mount face (H):	mm	N/A
F.3.5	0.0 15kN shear bending M*y / I <= Su-Weld:		N/A
0.00E+00	0.0 5kN normal bending M*y / I <= Su-Weld:		N/A
0.00E+00	Parabolic shear 3*Test Load/2*area <= Shear:		N/A
EQ		EQ	
F.8.2.3.b	Bolting AIP to composite Front Bulkhead		N/A
Fasteners per washer:	Washer/bolt perimeter:	mm	N/A
	Panel thickness: #VALUE!	mm	N/A
	Core thickness: 0	mm	N/A
	Outer skin thickness: Layup	mm	N/A
	Inner skin thickness: Typo	mm	N/A
Fasteners per insert:	Insert Perimeter on bulkhead:	mm	N/A
Fasteners per backing plate:	Backing plate thickness:	mm	N/A
	Backing plate perimeter on bulkhead:	mm	N/A
	Minimum - Fastener spacing, edge, or corner distance:	mm	N/A
	Skin shear strength: 0.00E+00 Pa		N/A
F.8.2.3.b	Perimeter shear strength >15000N: #VALUE!	N	N/A
	Tearout strength >15000N: #VALUE!	N	N/A
BLANK		EQ	
F.8.2.3.c	Bonding AIP to composite Front Bulkhead		EQ
	Is there an opening in the Front Bulkhead?		EQ
	What is the brand name of the adhesive?		BLANK
F.5.5.3	Minimum shear / peel strength of adhesive:	N/mm ²	BLANK
	50% adhesive reduction for safety factor:	0 N/mm ²	EQ
	Minimum bond area:	mm ²	BLANK
	Calculated bond strength:		EQ

Welded		EQ	
F.8.2.2	AIP to FB Attachment:	Welded	EQ
F.8.2.3.a	Al plate must at least reach the centerline of Front Bulkhead tubes:		EQ
	At least half the perimeter must be welded:	%	BLANK
	Shortest weld >= 25mm (1in):	mm	BLANK
EQ		EQ	
F.8.2.3.b	Bolting AIP to tube Front Bulkhead		N/A
	Locate Al bolts through FB tube inserts or on tabs:		N/A
	Maximum Fastener centerline offset from tube surface:	mm	N/A
See diagrams: EV Acc tab AY28-BI28	Mount cross section on tube surface:		N/A
	Mount thickness (B):	mm	N/A
	Mount length (L):	mm	N/A
	Mount thickness (T):	mm	N/A
	Minimum gusset height normal to mount face (H):	mm	N/A
F.3.5	0.0 15kN shear bending M*y / I <= Su-Weld:		N/A
0.00E+00	0.0 5kN normal bending M*y / I <= Su-Weld:		N/A
0.00E+00	Parabolic shear 3*Test Load/2*area <= Shear:		N/A
EQ		EQ	
F.8.2.3.b	Bolting AIP to composite Front Bulkhead		N/A
Fasteners per washer:	Washer/bolt perimeter:	mm	N/A
	Panel thickness: #VALUE!	mm	N/A
	Core thickness: 0	mm	N/A
	Outer skin thickness: Layup	mm	N/A
	Inner skin thickness: Typo	mm	N/A
Fasteners per insert:	Insert Perimeter on bulkhead:	mm	N/A
Fasteners per backing plate:	Backing plate thickness:	mm	N/A
	Backing plate perimeter on bulkhead:	mm	N/A
	Minimum - Fastener spacing, edge, or corner distance:	mm	N/A
	Skin shear strength: #VALUE! Pa		N/A
F.8.2.3.b	Perimeter shear strength >15000N: #VALUE!	N	N/A
	Tearout strength >15000N: #VALUE!	N	N/A
EQ		EQ	
F.8.2.3.c	Bonding AIP to composite Front Bulkhead		N/A
	Is there an opening in the Front Bulkhead?		N/A
	What is the brand name of the adhesive?		N/A
	Minimum shear / peel strength of adhesive:	N/mm ²	N/A
F.5.5.3	50% adhesive reduction for safety factor:	0 N/mm ²	N/A
	Minimum bond area:	mm ²	N/A
	Calculated bond strength:		N/A
BLANK		EQ	
F.8.2.3.d	Laminated AIP to composite Front Bulkhead		EQ
	Does the AIP form the front bulkhead of the monocoque?		EQ
	Type SES Tab Name Of Enclosing Layup Used:		BLANK
	Skin used:		BLANK
Scaling option, layup repeats:	AIP Perimeter Length:	mm	EQ
	Skin shear area - centerline x 1 thickness:	#VALUE! m ²	EQ
	Skin shear strength:	Typo Pa	EQ
F.8.2.3.d	Single tearout path >= 120000N:	0.00%	EQ
	Front Hoop Lamination:		BLANK
	Lap joint strength:	Typo Pa	EQ
	Total bond width including both sides of the Front Hoop:	mm	BLANK
	Bond shear area:	0 m ²	EQ
F.8.2.3.d	Bond failure >= 120000N: #VALUE!	#VALUE!	EQ

Laminated

2023年、Bondedが追加された

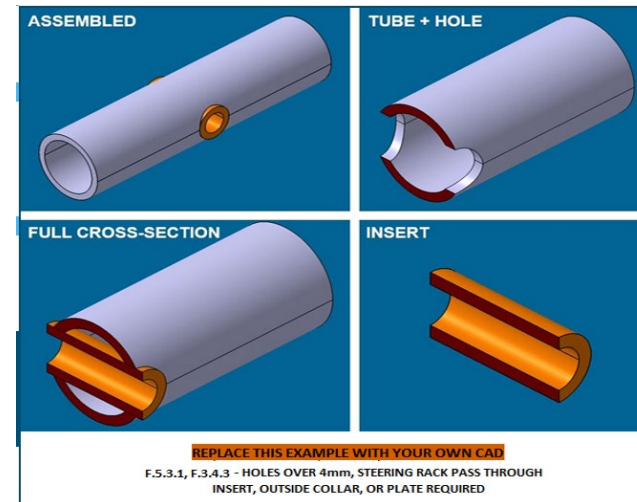
注意: AIP Attachment

Centerline Insertsの場合 「Welded Inserts」の対象となる

EQ		
Bolting AIP to tube Front Bulkhead		
F.8.2.3.b	Locate AI bolts through FB tube inserts or on tabs:	Centerline Inserts
		EQ
		EQ

「F.3.4.3 Welded Inserts」のシート内で
AIP Insertsが「YES」に判定されるので、
本シートへ入力すること。

EQ
Any holes over 4mm drilled in
F.3.2.1 required tubes?
Tube Chassis BO134: No
AIP Inserts: Yes
EV Accumulator: No
EQ
Does the steering rack
interrupt any required tubes?
Tube Chassis BO135: No
FILL OUT THIS TAB.
BLANK



Insert/Collar cross sectional area (A ₂):		mm ²
F.8 Front Protection	F.3.4.3 Welded Inserts	F.5.12 Bolted Members

注意: AIP Attachment

Offset Mountsの場合

Bolting AIP to tube Front Bulkhead

F.8.2.3.b Locate AI bolts through FB tube inserts or on tabs:

Maximum Fastener centerline offset from tube surface: mm

Mount cross section on tube surface:

See diagrams: EV Acc tab AY28-BI28

Mount thickness: mm

Mount length: mm

Minimum gusset thickness: mm

Minimum gusset height normal to mount face: mm

Centerline Inserts

EQ

EQ

N/A

N/A

N/A

N/A

N/A

N/A

Single Layer

H-Shape

L-Shape

U-Shape

Rectangular Tube

Tab形状を選択し、その形状に応じた (B),(L),(T),(H)を入力する

ns: EV Acc tab AY28-BI28

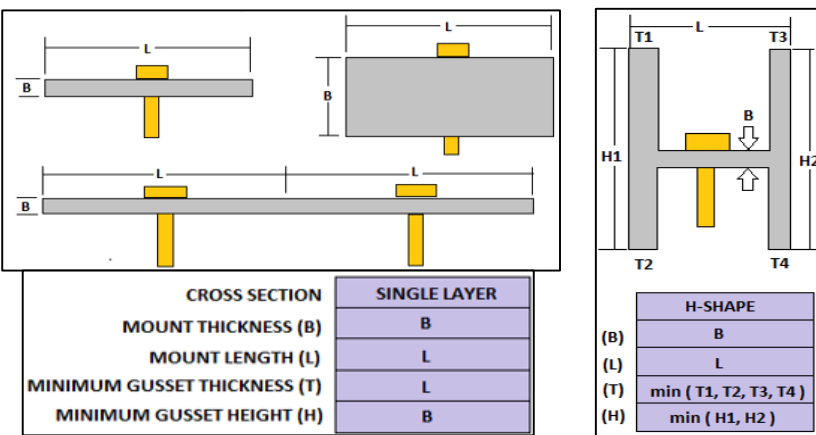
Mount thickness (B): mm

Mount length (L): mm

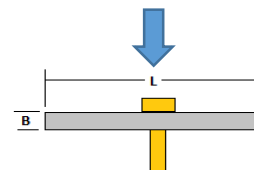
Minimum gusset thickness (T): mm

Minimum gusset height normal to mount face (H): mm

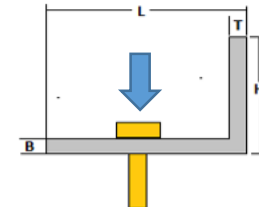
これらの絵は、「グレーのハッチング面が溶接面」と解釈する。



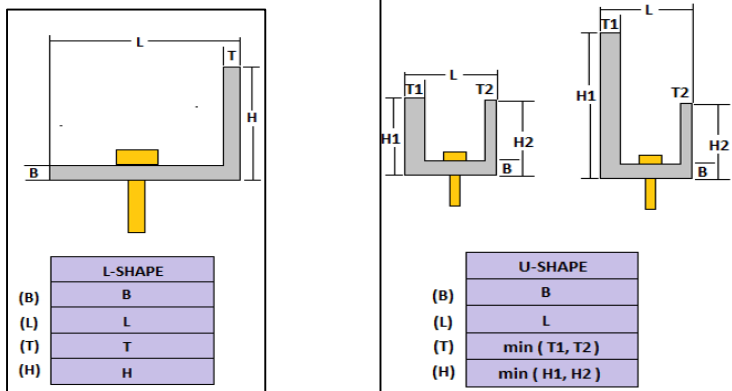
Single Layer



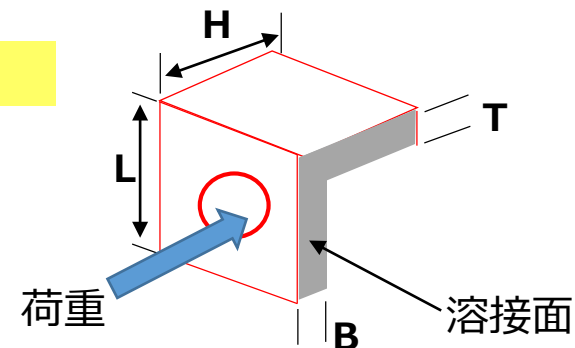
L-Shape



グレーの溶接面に対して矢印方向の荷重が掛かると解釈し、TabのFBHへの取り付け方法を検討すること



「L-Shape」の例



Physical Test Fixture Guidance

要求されたエビデンスを添付すること

それぞれ空欄で要求される寸法が分かるCAD図や写真を記載すること

BLANK

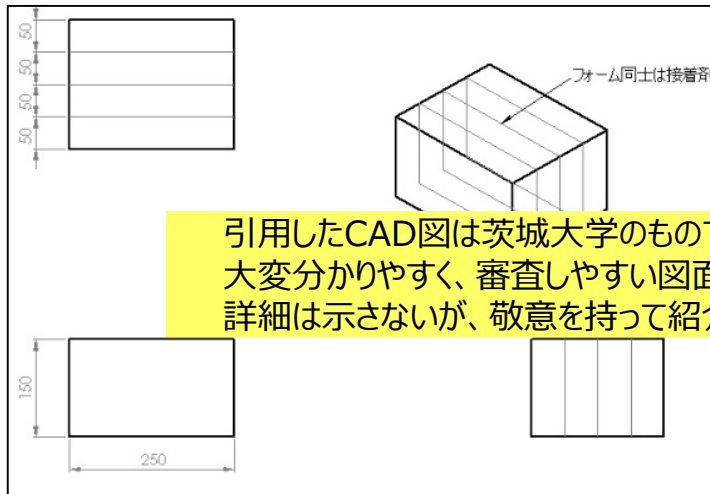
Physical Test Fixture Guidance

F.8.7.6.b The tested IA must be attached to a structurally representative section of the chassis.

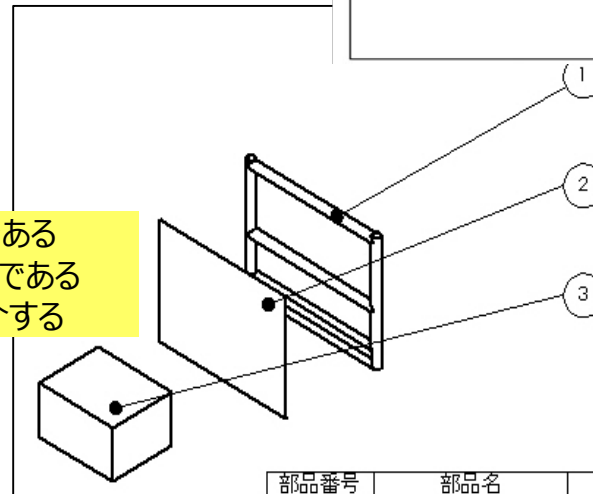
BLANK			
F.8.7.6.c F.8.4.2.a F.8.4.2b	Front Bulkhead Outside to Outside Height:	0	mm
	Front Bulkhead Outside To Outside Width:	0	mm
	Fixture Thickness on table ≥ 50 mm:		mm
	Tested IA starting length > 200 mm:		mm
	Custom IA WIDTH over 200mm length ≥ 200 mm:		mm
	Custom IA HEIGHT over 200mm length ≥ 100 mm:		mm
		BLANK	
		BLANK	
		BLANK	
		N/A	
		N/A	

200mm以上確認

50mm以上再現



引用したCAD図は茨城大学のものである
大変分かりやすく、審査しやすい図面である
詳細は示さないが、敬意を持って紹介する



部品番号	部品名
------	-----

Physical Tests

準静的 と Dynamicで入力項目が違う
それぞれで要求される空欄に記載すること 「EQ」とならなければならない

Impact Attenuator And / Or Wing Failure Test

BLANK			
Type of test used?:			BLANK
Name of Test Facility:			BLANK
Dates of tests:			BLANK
Maximum crushed displacement:		mm	N/A
Post crush displacement, demonstrating any springback:		mm	N/A
Crushed attenuator height:		mm	N/A
AI plate deformation:		mm	N/A

F.8.7.6d

F.8.7.2b All calculated values must be based on a mass of 300kg and an initial velocity of 7m/s

F.8.7.7a Average deceleration from a dynamic test must be calculated from raw, unfiltered data

F.8.7.7b Peaks above 40g must not be seen after the application of specific filtering. See rule.

F.8.7.2b The impact attenuator must absorb at least 7350J. Springback may be ignored.

Make sure to use stepwise integration: $\text{current_force} * (\text{current_disp} - \text{prev_disp}) + \text{previous_total}$
Do not assume steps are identical. Use similar procedure for average force.

INCORRECT: $\text{Final_force} * \text{final_displacement}$, or negative energy slope when there is positive fo

BLANK			
F.8.7.2a	Peak attenuator force:		N
	Peak attenuator only deceleration $\leq 40g$:		g
	Average attenuator force:		N
	Average attenuator only deceleration $\leq 20g$:		g
F.8.7.2b	Energy absorbed $\geq 7350J$:		J
	Energy absorption check:	7350	J
EQ			
EQ			
EQ			

Composite AIP 120kN Physical Test

Teams may use a crushed attenuator of the version installed on the car to test a composite AIP.
Split the data following the IA test for the IA sections above and the 120kN test below.

EQ			
Type of test used?:			N/A
Name of Test Facility:			N/A
Dates of tests:			N/A
Maximum crushed displacement:		mm	N/A
Post crush displacement, demonstrating any springback:		mm	N/A
AI plate deformation:		mm	N/A
Maximum AIP force $> 120kN$:		N	N/A

F.8.7.6d

F.8.3.1.b

要求されたエビデンスを添付すること

Insert Test Pictures - may be added below:

- (a.) IA and FB test fixture before the test (F.8.7.4.d) which also shows the method of spacing AIP at least 50mm from any rigid structure (F.8.7.6.c)
- (b.) IA, Anti-Intrusion Plate after the IA test (F.8.7.4.d) which shows the deflection was less than 25.4mm (F.8.7.6.d)
- (c.) IA / AIP Force Displacement Curve
- (d.) IA Energy Displacement Curve

BLANK

Physical Tests

F.8.4.3

F.8.7.7

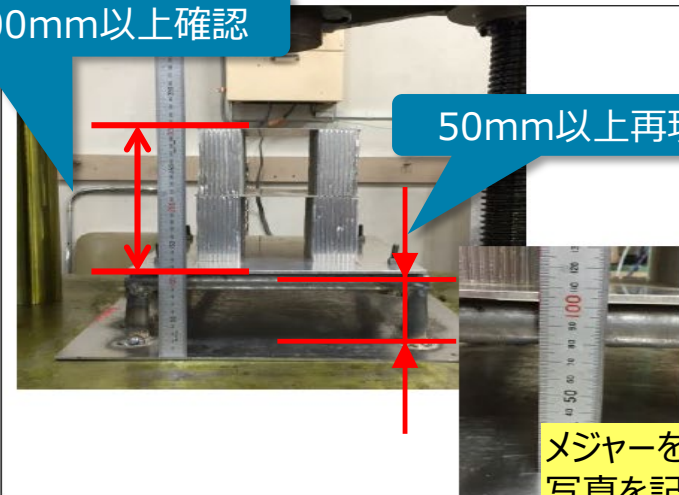
Impact Attenuator

and / or Wing Failure Test

「Dates of tests」試験日を証明できる写真を添付すること。
(写真内に日付が分かるものを一緒に撮影する)

BLANK	BLANK
Blank of test used?	BLANK
Name of Test Facility:	BLANK
Dates of tests:	BLANK

200mm以上確認

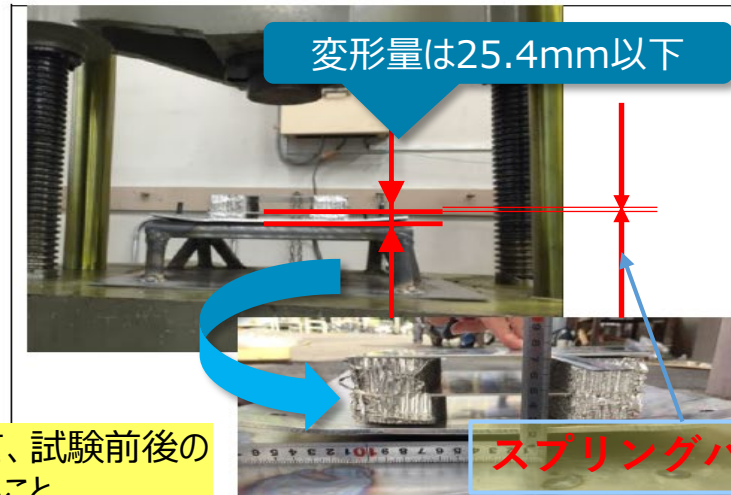


50mm以上再現

メジャーを入れて、試験前後の写真に記載すること

- ①インパクトアッテネータ試験前の写真
 - ②貫通防止板から50mm以上再現し、その上にインパクトアッテネータを載せる
- ※足の先にプレートを置き、溶接を推奨！

変形量は25.4mm以下

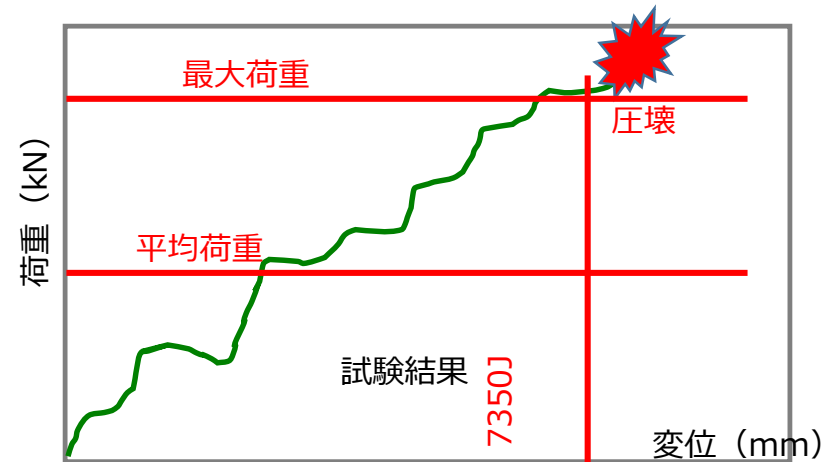
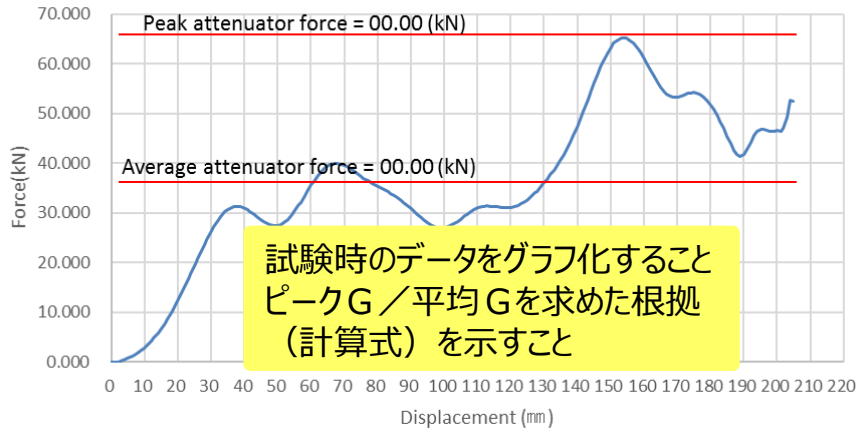


スプリングバック量

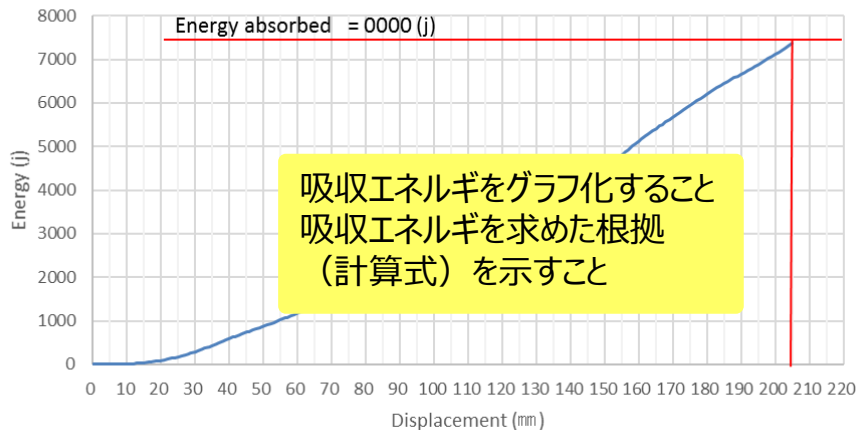
- ①インパクトアッテネータ試験後の写真
- ②貫通防止板の変形量を測定
- ③IAのスプリングバック量も測定

Physical Tests

Force Displacement Curve (kN)



Energy Displacement Curve (j)



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 weighted average force and energy calculations in columns three and four. Do not assume all steps are three and four. Do not assume all steps are

Disp. mm	Force N	Weighted Average Force	Energy J
MAX	MAX	Force	MAX
15	6511	N	12.386
0	0		0
1	4		0.004
2	35		0.039
3	169		0.204
4	407		0.666

1mmごとに記入することを推奨する
平均荷重と吸収エネルギーをどのように求めたか
分かる計算式示すことを推奨する

10	2813		9.234
11	3694		6.507
12	4186		7.88
13	4713		8.899
14	5875		10.588
15	6511		12.386

最大変位量までデータを示す

補 足

圧縮試験機でアッテネータを連続的に圧縮し、その時のストローク（mm）に対しての反力（kN）を求める。

最終的なエネルギーは微小な変形時に必要なエネルギー（計測した力 * 単位長さの変形量）を積み上げて、最終的にルールで決められた 7350 J 以上になることを求める。

変形量に対するエネルギーは数値を積み上げる = 積分する > 変形 0 ~（完全につぶれるまで）エネルギーを積み上げる。

$$\text{エネルギー} E = F [\text{N}] * S [\text{m}] = F [\text{kN}] * 1000 * S [\text{mm}] / 1000$$

$$\text{減速度} = F [\text{N}] / 300\text{kg} * 9.8\text{ms} = F [\text{N}] / 2940 = \bigcirc \text{G}$$

以下のサンプルを参考にIADを資料を作成する

Impact Attenuator Energy calculation sample sheet			
measuring data1			
		Energy=F*Displacement [J]	
		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	

生データを添付すること

measuring data2

