

S E S (等価構造計算書)

F.8 Front Protection

Attenuator and Diagonal

新しい考え方が展開されている（チームは要確認）

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

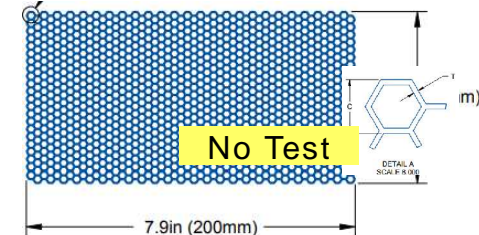
Dynamic Test: Composite IA + AIP + FB Replica

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	Tube Used	BLANK
	Minimum		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
	Square side:	25	mm
F.3.4.1	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	Sy:	3.05E+08
Buckling Modulus	$E_1 I_1 \leq E_2 I_2$:	1.34E+03	EQ
Sy:	$S_1 A_1 \leq S_2 A_2$:	2.78E+04	EQ
Bending	$4 S_1 I_1 \leq 4 S_2 I_2$:	6.43E+02	EQ
Deflection	Bending_1/(48*EI):	1.00E-02	EQ
Energy	0.5*Bending^2/(48*EI):	3.22E+00	EQ

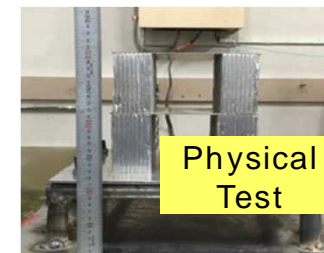
それぞれの項目を選択すること



No Test



No Test



Physical Test



Dynamic Test

Attenuator and Diagonal

要求されたエビデンスを添付すること

Insert Pictures - may be added left or below:

(a.) Standard Impact Attenuator Receipt

(b.) Adhesive Material Properties -

Indicate selected value, include units conversion

(c.) Composite Material Receipts

(if not already on 3-Point test tab)

Invoice

BSCI Inc.
170 Bailey Park Lane
Monroeville, PA 15146 USA
Phone: (724) 664-3005
Fax: (724) 660-1540

Date: 12/19/2017 Invoice #: 23371

PAID 12/19/2017

Bill To: TOKYO UNIVERSITY OF SCIENCE YAMAGUCHI
TAKAO KINOSHITA
111 HIRAKAWA-CHO, SANYO-KU, YAMAGUCHI
SANYO-KU, YAMAGUCHI, JAPAN

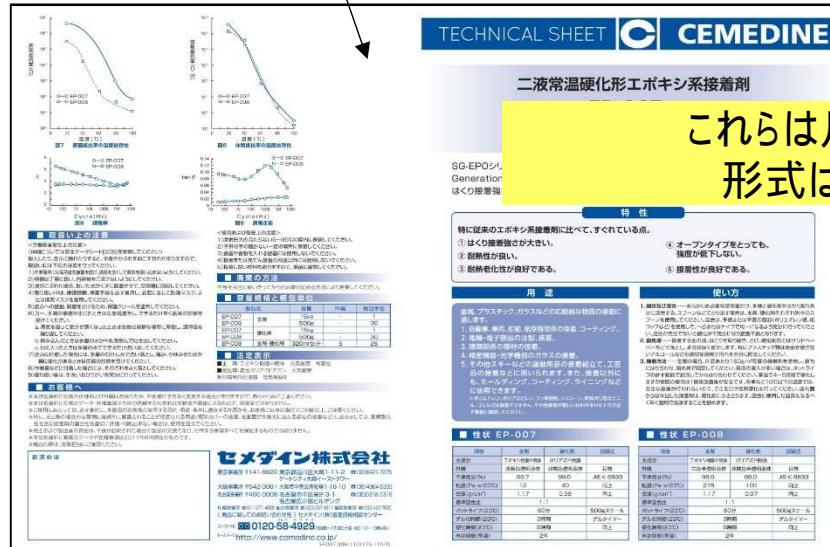
Ship To: TOKYO UNIVERSITY OF SCIENCE YAMAGUCHI
TAKAO KINOSHITA
111 HIRAKAWA-CHO, SANYO-KU, YAMAGUCHI
SANYO-KU, YAMAGUCHI, JAPAN

WO #	PO #	Terms	Rep	Ship Date	Ship Via	Tracking #
8890		Credit Card	GRA	12/20/2017	UPS World Exp.	NIS 881006

Item	Description	Backordered	Qty	Rate	Amount
PSAE Attenuator	STANDARD IMPACT ATTENUATOR MATERIAL FOR IMPACT TEST		15	160.00	2,400.00
SHIPPING	SHIPPING CHARGES - UPS WORLDWIDE EXPEDITED (DELIVERY OPTION AND LEAST EXPENSIVE OPTION AVAILABLE, WE I LAKE 1-7 BUSINESS DAYS FOR DELIVERY)		1	1,870.00	1,870.00

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

www.rollbarpadding.com



これらは凡例であり、
形式は問わない

三菱ケミカル株式会社
MITSUBISHI CHEMICAL CORPORATION

検査日 2019.11.25
検査場所

プリレグ検査表
CERTIFICATE OF CONFORMITY

品名 CSテープ
TR 350G100SB4ZFW5

寸法 L: 125m (125m)

検査項目 (ITEM)

項目	単位	値
プリレグ目付 (g/m ²)	g/m ²	151.0
繊維目付 (g/m ²)	g/m ²	150.0
繊維含有率 (%)	%	33.4

検査結果 (RESULT)

項目	単位	値
欠陥数 (NO. OF DEFECT)		1
欠陥率 (%)	%	0.5

検査員 (INSPECTOR)

合格

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.

BLANK

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

F.8.3.2 AI 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 AI Equivalence:		N/A
	Type SES Tab Name Of Layup Used:		N/A
	Core thickness:	mm	N/A
	Outer skin thickness:	mm	N/A
	Inner skin thickness:	mm	N/A
	Thickness of panel:	0 mm	N/A
	Composite Panel Height:	mm	N/A
	Composite Panel Width:	mm	N/A
	Top Edge of FB to Top Edge of IA:	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

Composite AIP -

EQ

F.8.2.1	Anti-Intrusion Plate (AI) material:	Composite	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 AI 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 AI Equivalence:		BLANK
	Type SES Tab Name Of Layup Used:		BLANK
	Core thickness:	mm	BLANK
	Outer skin thickness:	mm	BLANK
	Inner skin thickness:	mm	BLANK
	Thickness of panel:	0 mm	EQ
	Composite Panel Height:	mm	BLANK
	Composite Panel Width:	mm	BLANK
	Top Edge of FB to Top Edge of IA:	mm	BLANK
F.8.3.1	「BLANK」となっている項目の入力が必須	100 mm	EQ
	「EQ」とならなければならない	200 mm	EQ
		m^4	EQ
		m^4	EQ
		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

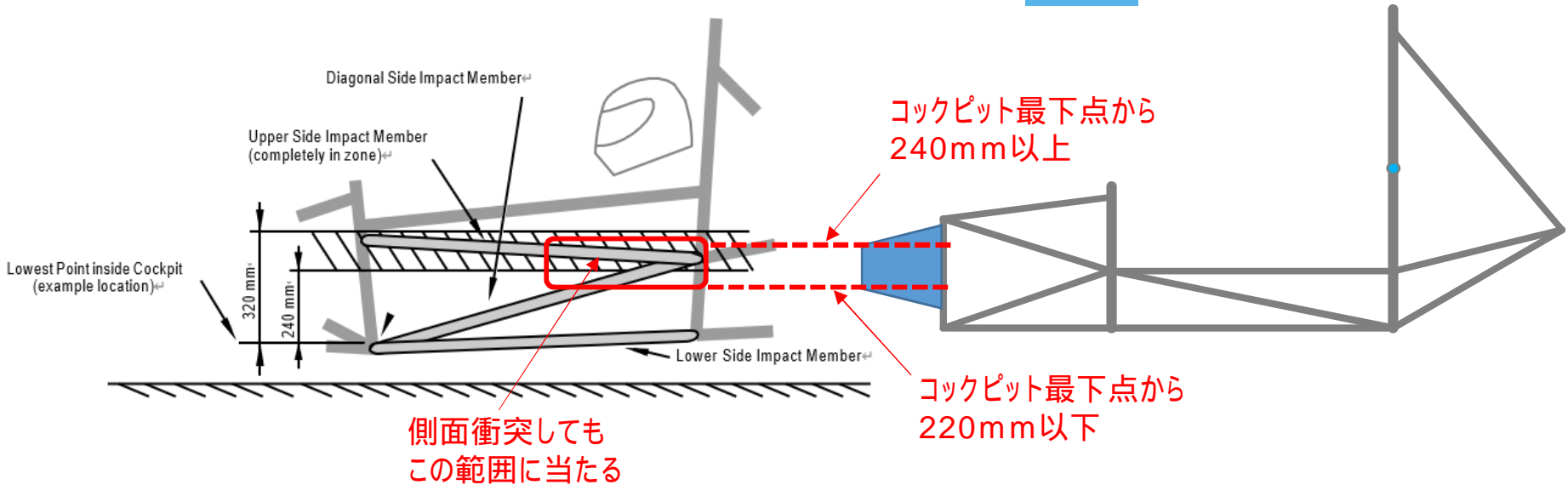
IA Attachment

新しい考え方が展開されている（チームは要確認）

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部に当たることで乗員を保護するという考えに基づく

すなわち、IAのTop部分はこの高さでなければならない

BLANK			
F.8.5.2	Front top of IA > 240mm above lowest point in cockpit:	mm	BLANK
	Front bottom of IA < 220mm above lowest point in cockpit:	mm	BLANK
	IA to AI plate mounting method:		BLANK
			BLANK
		mm	BLANK
			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.

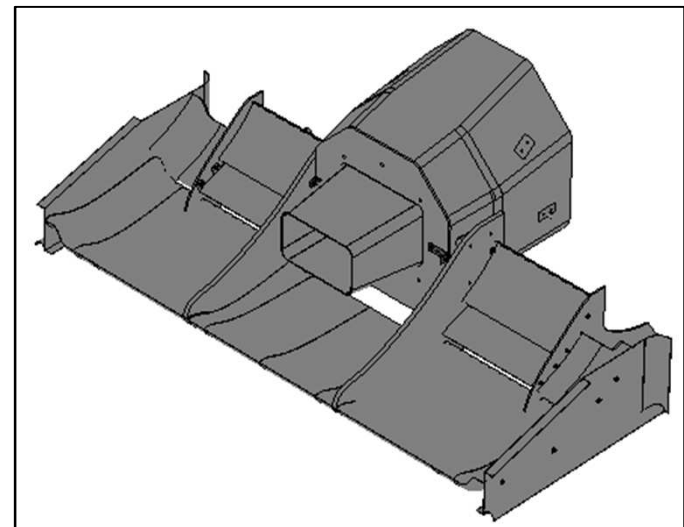
Insert measurement of IA front top edge height.

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	EQ
	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

(b.)

(F.8.7.4

as less

(c.) IA / AIP Force Displacement Curve

(d.) IA Energy Displacement Curve

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

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

Paste in logged

data from test

below:

It is acceptable to

resample the data

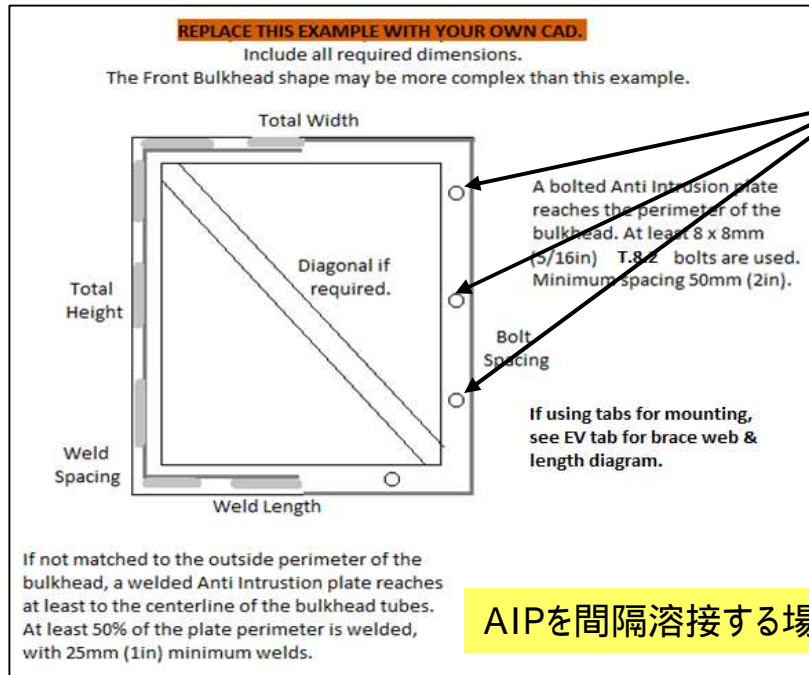
at a lower

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

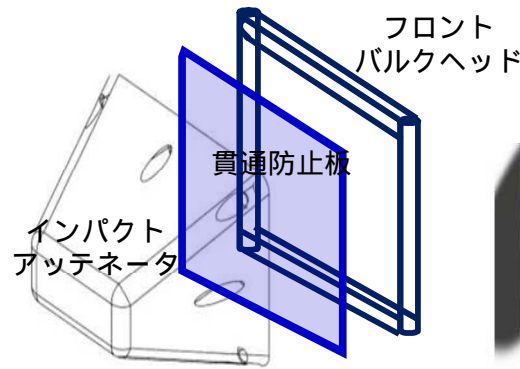
1mm毎の圧縮データを推奨

Front Bulkhead

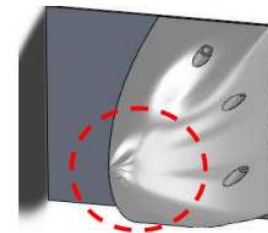
ルール変更あり！ 要求されたエビデンス（各部寸法）を添付すること



BH に穴を開け直接ボルト締結しない
インサートを入れること。（変形防止）



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 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、またはチームが標準ハニカムIAを使用している場合は次のいずれかを満たす必要があります。

- ...
- ...

S E S 注意のこと！



ブレース追加基準は、従来の外寸法の差 = 25 mm ではない！

Front Bulkhead

Tube と Composite で入力項目が違う

「Tube」の場合

BLANK				
F.6.1	Front Bulkhead		Tube	EQ
		Minimum	Tube Used	EQ
F.3.2.1	Example: 25.4mm x 1.6mm round	Steel		BLANK
F.3.4.1	Diagonal 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
Deflection		Bending_1/(48*EI):	1.00E-02	EQ
Energy		0.5*Bending^2/(48*EI):	4.09E+00	EQ

Composite」の場合

EQ				
F.6.1	Front Bulkhead		Composite	EQ
		Minimum	Tube Used	N/A
F.3.2.1	Example: 25.4mm x 1.6mm round	Steel		N/A
F.3.4.1	Diagonal 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
Deflection		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		EQ
	Front Bulkhead Tubes Replaced Size B:	2	Diagonal Size C:	0
	Type SES Tab Name Of Layout Used:			BLANK
	Front Bulkhead			EQ
	Core thickness:		mm	BLANK
	Outer skin thickness:		mm	BLANK
	Inner skin thickness:		mm	BLANK
	Thickness of panel:	0	mm	EQ
	Front Bulkhead Height:		mm	BLANK
	Front Bulkhead Width:		mm	BLANK
	Cutout Height:		mm	BLANK
	Cutout Width:		mm	BLANK
	Composite Panel Height:	0	mm	EQ
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

AIP Attachment

要求されたエビデンスを添付すること

BLANK	
F.8.2.2	AI to FB Attachment: <input type="text"/>
AI plate must match entire Front Bulkhead perimeter	
Number of 8mm critical fasteners (8 required):	<input type="text"/>
Minimum distance between bolt centers:	<input type="text"/> mm

Bolted
Welded
Laminated

EQ	
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:	<input type="text"/> mm
Mount cross section:	<input type="text"/>
Mount thickness (B):	<input type="text"/> mm
Mount length (L):	<input type="text"/> mm
Minimum gusset thickness (T):	<input type="text"/> mm
Minimum gusset height normal to mount face (H):	<input type="text"/> mm
F.3.5	0.0 15kN shear bending $M*y / I \leq Su-Weld$:
0.00E+00	0.0 15kN normal bending $M*y / I \leq Su-Weld$:
0.00E+00	Parabolic shear $3*Test\ Load/2*area \leq Shear$:

選択肢は3種類
それぞれ入力項目が違う

EQ	
F.8.2.2	Bolting AIP to composite Front Bulkhead
Washer/bolt perimeter:	<input type="text"/> mm
Panel thickness:	0 mm
Core thickness:	0 mm
Outer skin thickness:	0 mm
Inner skin thickness:	0 mm
Insert Perimeter on bulkhead:	<input type="text"/> mm
Backing plate thickness:	<input type="text"/> mm
Backing plate perimeter on bulkhead:	<input type="text"/> mm
Minimum - Fastener spacing, edge, or corner distance:	<input type="text"/> mm
Skin shear strength:	0.00E+00 Pa
F.8.2.3b	Perimeter shear strength >15000N: 0.00E+00 N
	Tearout strength >15000N: 0.00E+00 N

BLANK	
F.8.2.2	AI to FB Attachment: Bolted
Front Bulkhead perimeter:	
s (8 required):	<input type="text"/>
Minimum distance between bolt centers:	<input type="text"/> mm

BLANK	
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:	<input type="text"/> mm
Mount cross section:	<input type="text"/>
Mount thickness (B):	<input type="text"/> mm
Mount length (L):	<input type="text"/> mm
Minimum gusset thickness (T):	<input type="text"/> mm
Minimum gusset height normal to mount face (H):	<input type="text"/> mm
F.3.5	0.0 15kN shear bending $M*y / I \leq Su-Weld$:
0.00E+00	0.0 15kN normal bending $M*y / I \leq Su-Weld$:
0.00E+00	Parabolic shear $3*Test\ Load/2*area \leq Shear$:

BLANK	
F.8.2.2	AI to FB Attachment: Welded
AI plate must match the centerline of Front Bulkhead tubes.	
be welded:	<input type="text"/> %
Shortest weld >= 25mm (1in):	<input type="text"/> mm

EQ	
F.8.2.2	AI to FB Attachment: Laminated
AI Bulkhead perimeter:	
Number of 8mm critical fasteners (8 required):	<input type="text"/>
Minimum distance between bolt centers:	<input type="text"/> mm

注意: AIP Attachment

EQ

Bolting AIP to tube Front Bulkhead

EQ

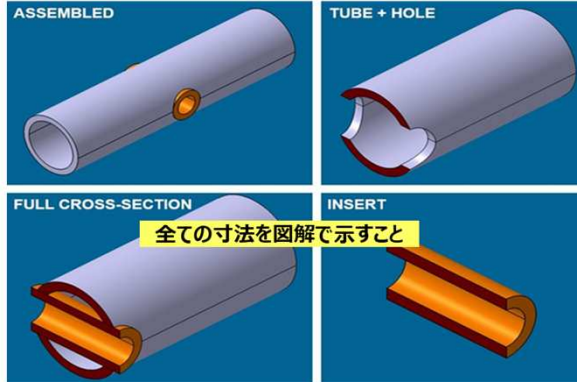
F.8.2.3.b Locate AI bolts through FB tube inserts or on tabs:

Centerline Inserts

EQ

該当する場合、Yesにすること

BLANK	
Any removable members along required tubes?	
Select Drop Down	
BLANK	
Any holes over 4mm drilled in F.3.2.1 required tubes?	
Select Drop Down	
AIP Inserts:	No
Removable Tubes:	No
EV Accumulator:	No
BLANK	
Does the steering rack interrupt any required tubes?	
Select Drop Down	



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

EQ

Bolting AIP to tube Front Bulkhead

EQ

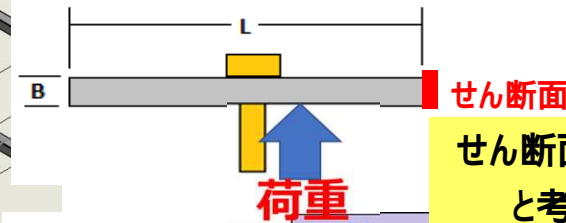
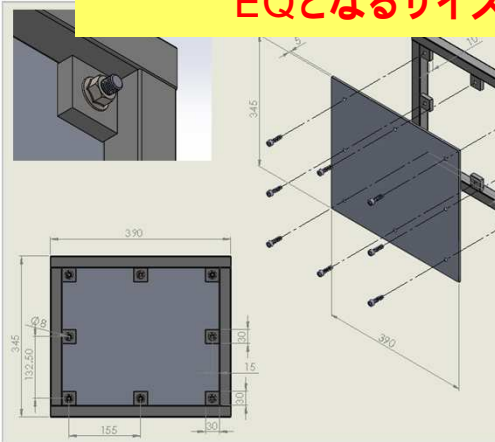
F.8.2.3.b Locate AI bolts through FB tube inserts or on tabs:

Offset Mounts

EQ

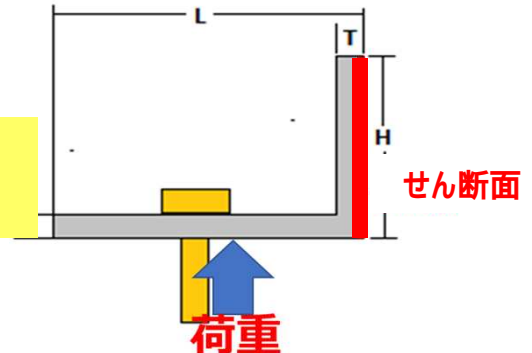
左図のような取り付け方は「Single Layer」
EQとなるサイズを考案すること

右図は「L-Shape」の固定方法
EQとなるサイズを考案すること



せん断面 = 溶接面
と考えること

CROSS SECTION	SINGLE LAYER
MOUNT THICKNESS (B)	B
MOUNT LENGTH (L)	L
MINIMUM GUSSET THICKNESS (T)	L
MINIMUM GUSSET HEIGHT (H)	B



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

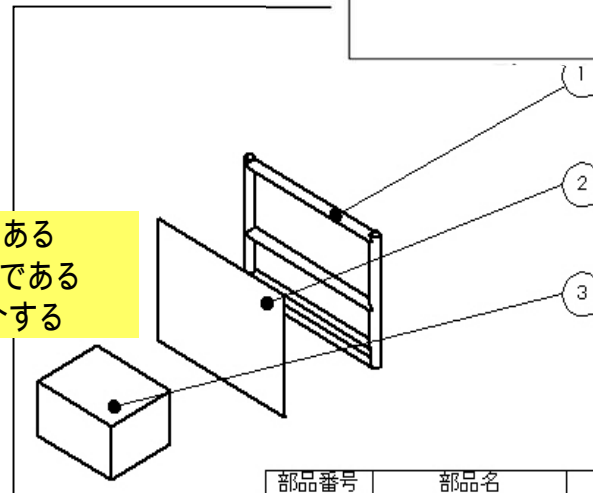
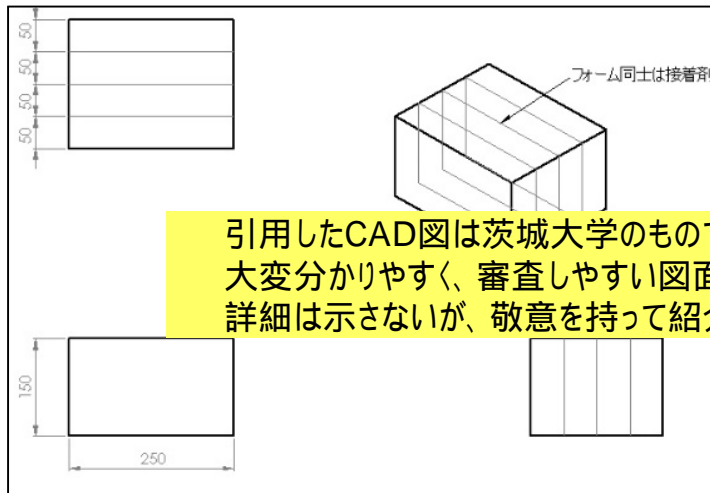
Physical Test Fixture Guidance

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

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

200mm以上確認

50mm以上再現



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 for

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

Physical Tests

要求されたエビデンスを添付すること

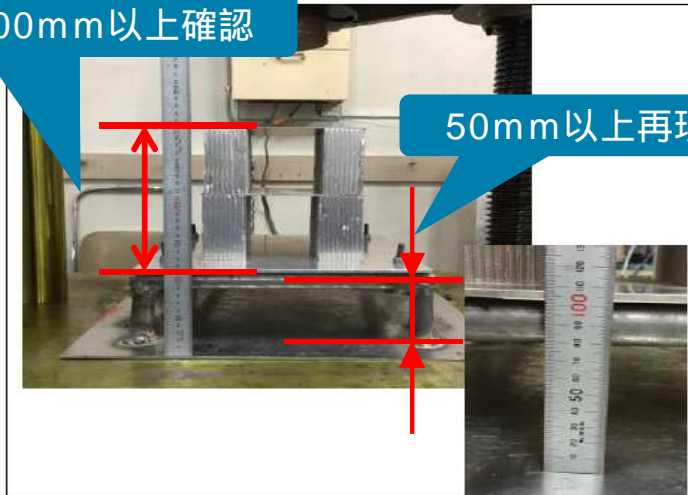
Insert Test Pictures - may be added below:

- (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

メジャーを入れて、試験前後の写真を記載すること

200mm以上確認

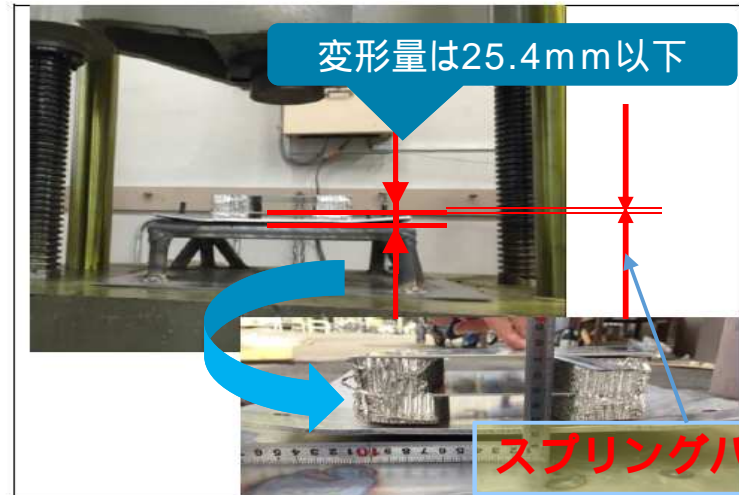
50mm以上再現



インパクトアッテネータ試験前の写真
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



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

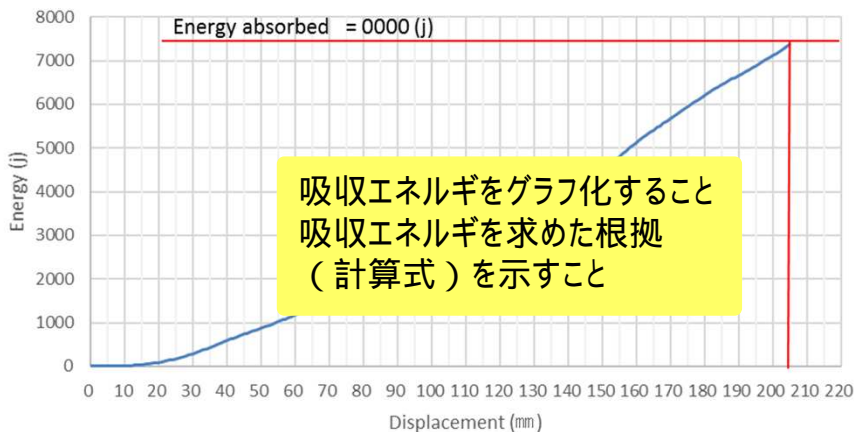
Physical Tests

Force Displacement Curve (kN)

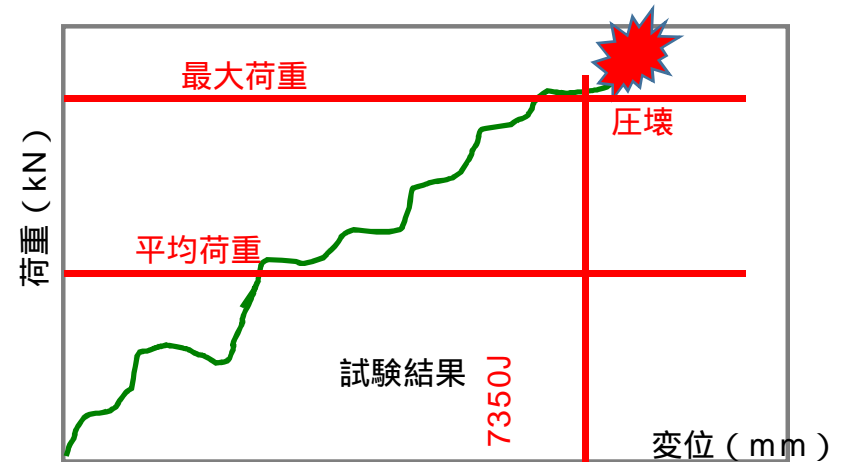


試験時のデータをグラフ化すること
ピーク G / 平均 G を求めた根拠
(計算式) を示すこと

Energy Displacement Curve (j)



吸収エネルギーをグラフ化すること
吸収エネルギーを求めた根拠
(計算式) を示すこと



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.

Disp. mm	Force N	Weighted Average Force	Energy J
MAX	MAX		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		5.234
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。

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

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

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*	(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

