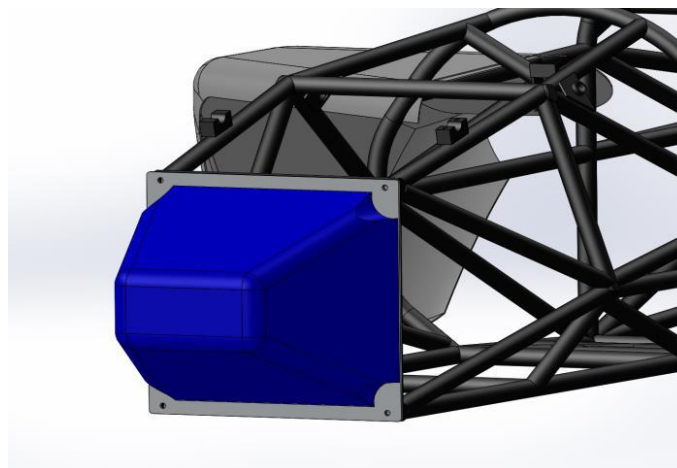


2024 SES（等価構造計算書）ガイドンス

F.8 Front Protection

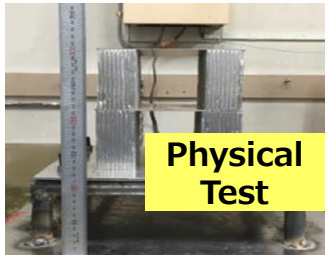
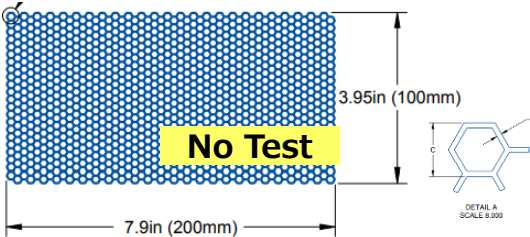


IAは4択 テスト方法はそれぞれのタイプに従うこと

BLANK Attenuator and Diagonal			
No Test: +			
BLANK			
F.8.4.1	Impact Attenuator Type:	4択	BLANK
	Standard Foam Attenuator Height:	304mm (12in)	N/A
	Standard Foam Attenuator Width:	355mm (14in)	N/A
F.8.4.3	Front Bulkhead Outside to Outside Height:	mm	BLANK
	Front Bulkhead Outside To Outside Width:	mm	BLANK
BLANK			
F.8.4.3	Diagonal Tube, Attenuator Test, or Composite	BLANK	BLANK
	Minimum Tube Used	EQ	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	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):	9.10E-05 m^2	EQ
	Tube second moment of inertia (I):	6.70E-09 m^4	EQ
F.3.4.2	Young's Modulus (E):	2.00E+11 0.00E+00 Pa	BLANK
F.3.5	Critical Buckling Modulus	Sy: 3.05E+08 0.00E+00 Pa	BLANK
	Sy:	E_1*I_1/L_1 <= E_2*I_2/L_2: 1.34E+03	EQ
	Bending Deflection	S_1*A_1/L_1 <= S_2*A_2/L_2: 2.78E+04	EQ
	Energy	4*S_1*I_1/L_1 <= 4*S_2*I_2/L_2/r: 6.43E+02	EQ
		Bending_1/(48*EI): 1.00E-02	EQ
		0.5*Bending^2/(48*EI): 3.22E+00	EQ

- 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



それぞれの項目を選択すること

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)

これらは凡例であり、
形式は問わない

Invoice

BSCI Inc.
170 Balfour Park Lane
Mooreville, NC 28115 USA
Phone: (704) 664-3005
Fax: (704) 660-1540

PAID
12-19-2017

Ship To:
TOKYO UNIVERSITY OF SCIENCE YAMAGUCHI
TAKAO KIJIMA
111 TAMAKUCHI SANYOONDA-SHI YAMAGUCHI
SANYOONDA 754884 JAPAN

Ship Via: UPS World Exp.

Tracking #: 535 861006

WO #	PO #	Terms	Rep	Ship Date	Ship Via	Tracking #
8891		CRA		12/20/2017	UPS World Exp.	535 861006

Item	Description	Backordered	Qty	Rate	Amount
FXM Attenuator	STANDARD IMPACT ATTENUATOR, MATERIAL: DOW IMPACT 700, SHIPPING CHARGES: UPS, INSURANCE EXPENSED, MULTIPLE PACK, AND LAST AVAILABLE, WILL TAKE 5-7 BUSINESS DAYS FOR DELIVERY.		1	1,870.00	1,870.00

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

TECHNICAL SHEET CEMEDINE

二液常温硬化型エポキシ系接着剤
セメダイン EP-007 (クリアタイプ)
セメダイン EP-008 (クリア止めタイプ)

SG-EPOシリーズは、全く新しいタイプの二液常温硬化型エポキシ系接着剤です。SG (Second Generation=第二世代) エポキシの名前のとおり、従来のエポキシ系接着剤の欠点(たとえば、はく離層強さ、耐熱性)を改良し、構造用に加熱硬化型接着剤に匹敵する性能を有しています。

特 性

- ① はく離層強さが大きい。
- ② 耐熱性が良い。
- ③ 耐熱化性性が良好である。
- ④ オープンタイプをとっても、強度が低下しない。
- ⑤ 接着性が良好である。

用 途

樹脂、プラスチック、ガラスなどの成形品に接着剤を塗布して、接着させる。

性 状 EP-007

項目	単位	数値
粘度 (25℃)	Pa·s	0.01
硬化時間 (25℃)	分	10
硬化温度 (25℃)	℃	25
硬化率 (%)	%	100

性 状 EP-008

項目	単位	数値
粘度 (25℃)	Pa·s	0.01
硬化時間 (25℃)	分	10
硬化温度 (25℃)	℃	25
硬化率 (%)	%	100

三愛ケミカル株式会社
MITSUBISHI CHEMICAL CORPORATION

プリブレグ検査表
CERTIFICATE OF CONFORMITY

検査日: 2019.11.25
検査場所: INSPECTION DATE

品名: CSテープ
品番: TR 350G100SB4ZFWS

SIZE: W: 1000mm L: 125m (125㎡)

LOT NO: MA958B
CASE NO: MA958B-03

項目 (ITEM) 測定値 (LOT AV.)

プリブレグ目付 (g/㎡) (PAW) 151.0

乾燥目付 (g/㎡) (PAW) 100.6

乾燥含有率 (wt%) (SC) 33.4

APPEARANCE INSPECTION

欠陥名 (DEFECT TYPE)	欠陥個数 (NO OF DEFECT)	補償長 (m)
その他 (OTHER)	1	0.5

合計 (TOTAL) 1 0.5

検査員 (INSPECTOR) 合格

要求されたエビデンスを添付すること

BLANK				
F.8.4.3	Diagonal Tube, Attenuator Test, or Composite	Minimum	Tube Used	BLANK
F.3.2.1	Example: 25.4mm x 1.2mm round	Steel		N/A
F.3.4.1	Diagonal Minimum Tube:	Size C		N/A
	Wall thickness:	1.2	mm	N/A
F.3.4.1	Square side:	25	mm	N/A

F.8.4.3.a Tube frame teams should weld a diagonal to the Front Bulkhead.
F.8.4.3.a Monocoque teams should install diagonals with 2 * 30kN attachment to reduce testin
The structure must go across the entire front bulkhead opening on the diagonal.
If a front bulkhead or removable panel with no openings is not feasible, preferably a s
tube is welded or bonded to the AIP. Round tubes may not be welded or bonded to th

- 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。

Diagonal, AIP, and FB material must be entered in cells J57, J59, T37, AN35, and AN37.

Diagonal	Composite		to		Steel	BLANK
						N/A
	mm				mm	N/A
						N/A

Composite AIP の場合はPhysicalテストが必須

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
F.4.3.2.d	50% < Core < 100%:	Type Core thickness:	mm N/A
Scaling option, layup repeats:		Outer skin thickness:	Layup mm N/A
Scaling option, layup repeats:		Inner skin thickness:	Type mm N/A
		Thickness of panel:	#VALUE! 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:	Type	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

Physicalテスト必須 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.			

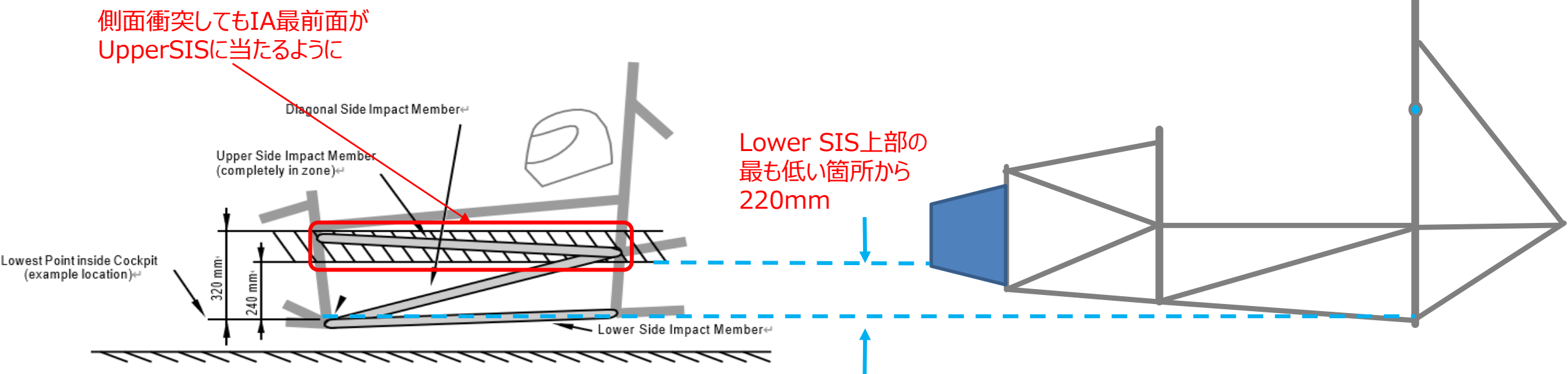
F.8.3.2 AI plates made of any material besides steel or aluminum must either:
F.8.3.2.a Be physically tested on a replica bulkhead up to 120kN, with the load distributed over the 200 mm x 100mm minimum IA area.
F.8.3.2.b Show F.8.3.4 120kN equivalence from F.4.3.1 laminate testing.

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
F.4.3.2.d	50% < Core < 100%:	Type Core thickness:	mm BLANK
Scaling option, layup repeats:		Outer skin thickness:	Layup mm EQ
Scaling option, layup repeats:		Inner skin thickness:	Type mm EQ
		Thickness of panel:	#VALUE! 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	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:	Type	Pa BLANK
	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

2024追加
コアの厚みに関するルール追加

「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

BLANK			
F.6.4.4.b F.8.5.6.a F.8.5.2	Ground clearance under lowest part of Lower SIS, setup ride height:	<input type="text"/>	mm
	IA lower leading edge < 220mm above lower SIS:	<input type="text"/>	mm
	IA to AI plate mounting method:	Bonded	EQ
		<input type="text"/>	N/A
		<input type="text"/>	mm
What is the brand name of the adhesive?:			<input type="text"/>
F.8.5.3.b	Minimum Bond Shear Requirement:	9.50E+04 N	EQ
F.5.5.3 F.8.5.3.c	Minimum shear / peel strength of adhesive:	<input type="text"/>	N/mm^2
	50% adhesive reduction for safety factor:	0	N/mm^2
	Minimum bond area:	<input type="text"/>	mm^2
Calculated bond strength:			EQ



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)

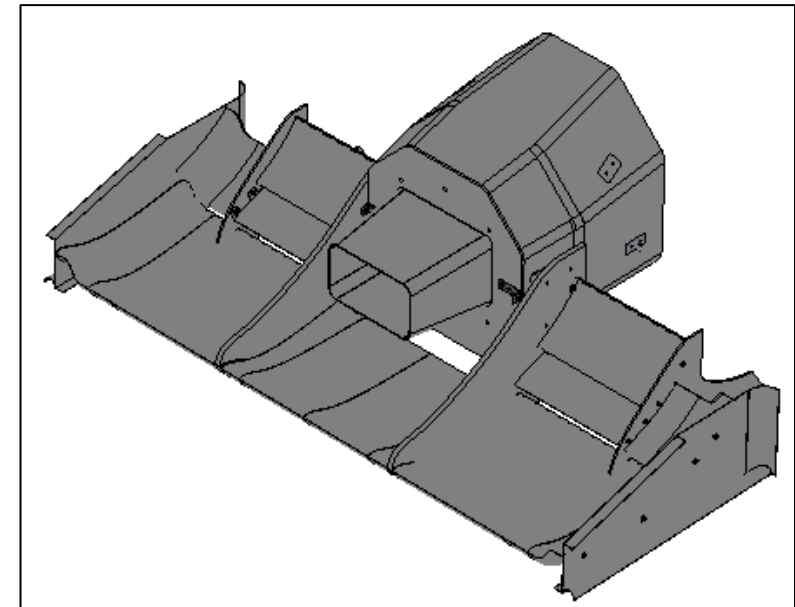
Insert measurement of IA front top edge height.

Shear Dimensions

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

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

Front Wing を含む場合の考え方は従来と同様

Front Wing Mount Limit は5種類あり入力項目が違うので要注意

BLANK

Front Wing Mount Limit:

BLANK

No Front Wing

Front Wing Physically Tested With IA

Front Wing Physically Tested Without IA

Fastener Shear Dialogue

Wing Support Hand Calc

N/A

N/A

N/A

EQ

EQ

EQ

F.8.8.2.a

Peak deceleration force <= 120000N

95000

N

EQ

Peak deceleration remains <= 40g

32.3

g

EQ

Front Wingが無い場合とIAと共に物理テストをした場合は項目選択以外の入力不要

EQ

Front Wing Mount Limit:

No Front Wing

N

N/A

N/A

N/A

0

N

N/A

Peak Attenuator Force:

95000

N

EQ

Peak deceleration force <= 120000N

95000

N

EQ

Peak deceleration remains <= 40g

32.3

g

EQ

IA無しで物理テストをした場合、ファスナーの剪断力で計算する場合、その他独自の計算をする場合は、計算結果 + IAのピーク負荷で算出

BLANK

Front Wing Mount Limit:

Fastener Shear Dialogue

EQ

Shear Diameter:

mm

Fastener UTS (Screenshot):

MPa

BLANK

Total number of fasteners:

BLANK

BLANK

Number_of_fasteners * 0.577 * UTS * pi * OD^2 / 4:

0

N

BLANK

Peak Attenuator Force:

95000

N

EQ

Peak deceleration force <= 120000N

95000

N

EQ

Peak deceleration remains <= 40g

32.3

g

EQ

F.8.8.2.a

BLANK

Physical Tests

Insert Test Pictures - may be added below:

(a.) IA and FB test fixture before the test (F.8.7.4.d) method of spacing

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.) 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

Paste in IA data from test below:

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

MAX	MAX	AVERAGE	MAX
0	0	0	0
Disp.	Force	Weighted	Energy
mm	N	N	J
0	0	0	0
		#DIV/0!	0
		#DIV/0!	0
		#DIV/0!	0
		#DIV/0!	0
		#DIV/0!	0
		#DIV/0!	0

Paste in COMPOSITE AIP

data from test below:
It is acceptable to resample the data at a lower frequency.

MAX	MAX
0	0
Disp.	Force

Paste in COMPOSITE AIP

data from test below:
It is acceptable to resample the data at a lower frequency.

MAX	MAX
0	0
Disp.	Force

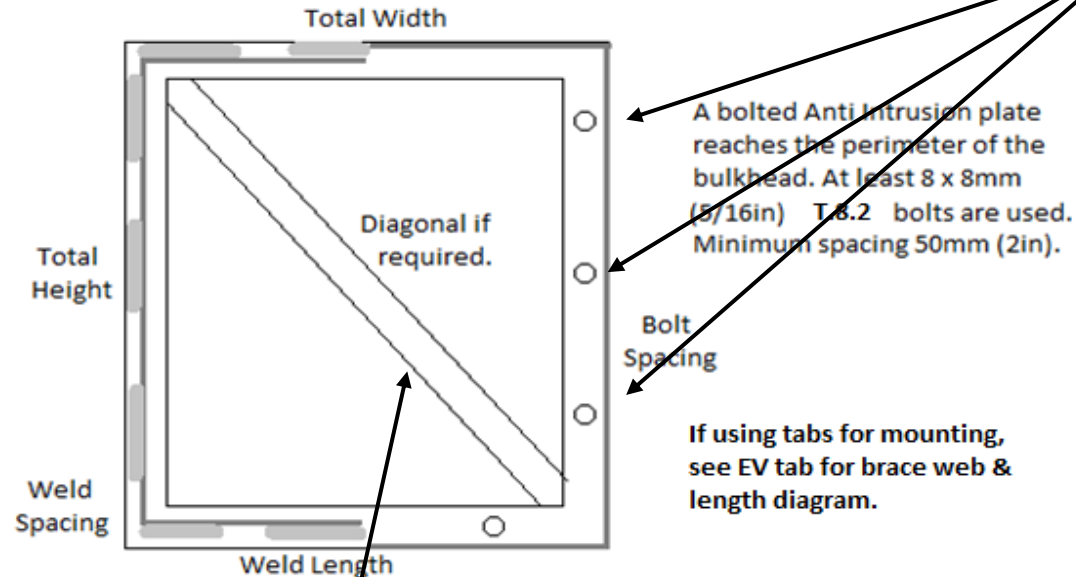
物理テストをした場合
実験結果の生データを
入力する事
※1mm毎の圧縮データを推奨

8

REPLACE THIS EXAMPLE WITH YOUR OWN CAD.

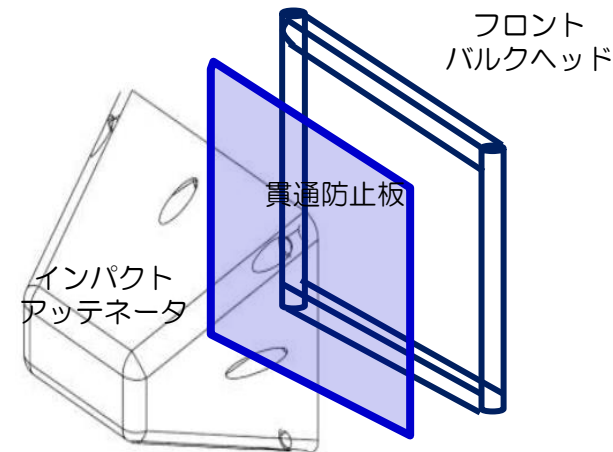
Include all required dimensions.

The Front Bulkhead shape may be more complex than this example.

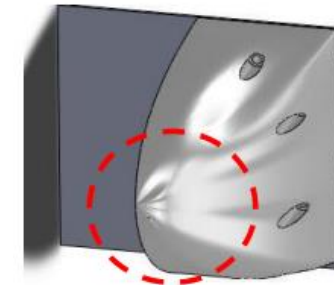


If not matched to the outside perimeter of the bulkhead, a welded Anti Intrusion plate reaches at least to the centerline of the bulkhead tubes. At least 50% of the plate perimeter is welded, with 25mm (1in) minimum welds.

**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)**



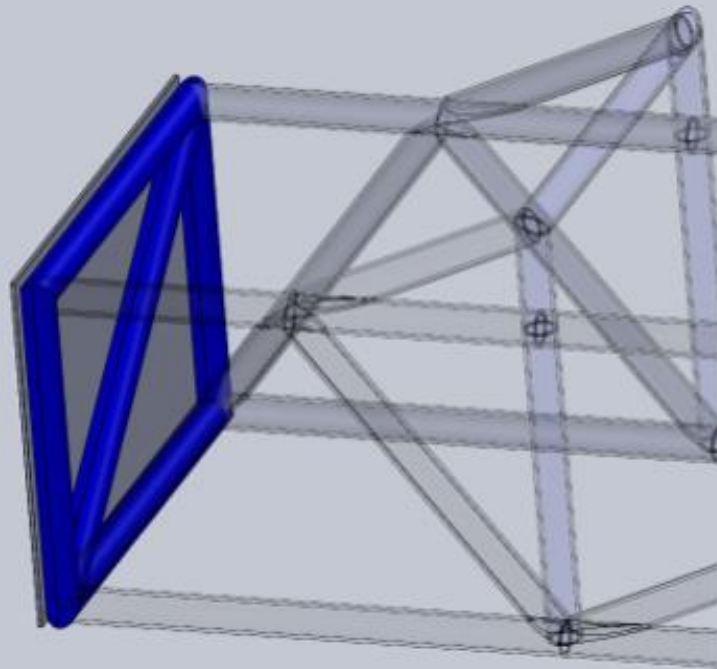
**標準IAは
いかなる加工、形状変更禁止**



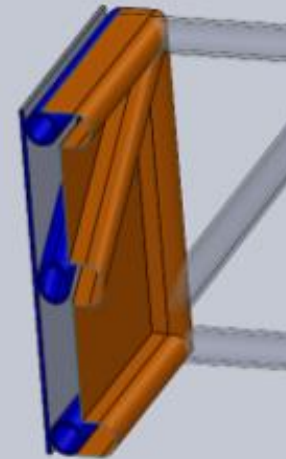
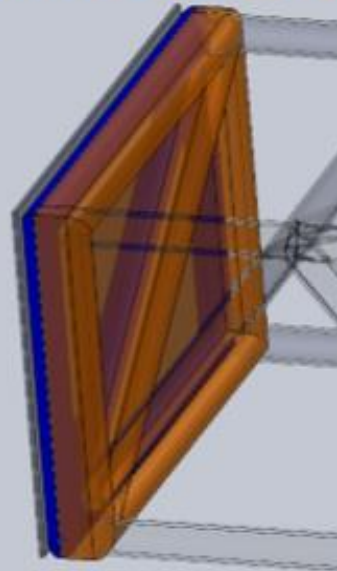
NOT PERMITTED: changed design or dimensions for Standard IA TYPE12

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より大きい場合と、標準IA (Honeycomb) を使用している場合は、Diagonalが必要。



KEEP PEDALS AT FULL TRAVEL AT LEAST 25mm AWAY
FROM REAR SURFACES OF FRONT BULKHEAD AND AIP



Front Bulkhead CAD with dimensions required.

Show 25mm gap to pedal assembly.

Pedal attachments preferably >25mm behind FB.

全ペダルにおいて、フルストローク時に（調整可能範囲の最大条件で）、
上の図のオレンジ色サーフェスの領域に抵触し入らないことを証明する3D図を添付すること。

Tube と Composite で入力項目が違う

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
F.3.2.1	Example: 25.4mm x 1.6mm round	Steel	BLANK
F.3.4.1	Front Bulkhead Minimum Tube:	Size B	BLANK
F.3.4.1	Wall thickness:	1.2 mm	BLANK
F.3.4.1	Square side:	25 mm	BLANK
F.3.4.1	Wall thickness:	0.0012 m	EQ
F.3.4.1	Square side:	0.025 m	EQ
F.3.4.1	Tube cross sectional area (A):	1.14E-04 m ²	EQ
F.3.4.1	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	S_Yield(S):	3.05E+08 0.00E+00 Pa
Buckling Modulus		E_1*I_1 <= E_2*I_2:	1.70E+03
S_Yield(S):		S_1*A_1 <= S_2*A_2:	3.48E+04
Bending		4*S_1*I_1/r <= 4*S_2*I_2/r:	8.17E+02
Deflection		Bending_1/(48*E):	1.00E-02
Energy		0.5*Bending*2/(48*E):	4.09E+00

「Tube」の場合

EQ			
F.7.2	Front Bulkhead Construction:	Tube	0
F.7.2	Front Bulkhead Tubes Replaced Size B:	0	Diagonal Size C: 0
F.7.2	Type SES Tab Name Of Layout Used:		
F.4.3.2.d	50% < Core < 100%:	Type	Core thickness: mm
F.4.3.2.d	Scaling option, layout repeats:		Outer skin thickness: Layup mm
F.4.3.2.d	Scaling option, layout repeats:		Inner skin thickness: Type mm
F.4.3.2.d			Thickness of panel: #VALUE! mm
F.4.3.2.d			Front Bulkhead Height: mm
F.4.3.2.d			Front Bulkhead Width: mm
F.4.3.2.d			Cutout Height: mm
F.4.3.2.d			Cutout Width: mm
F.4.3.2.d			Composite Panel Height: 0 mm
F.3.4.2.a		Young's Modulus (E):	2.00E+11 Layup Pa
F.3.4.2.a		Ultimate Tensile Strength (S):	3.65E+08 Name Pa
F.3.4.2.a		Shear:	2.11E+08 Type Pa
F.7.2.2	25mm FBHS Section		
F.7.2.2	Core thickness:	0	mm
F.7.2.2	Outer skin thickness:	0	mm
F.7.2.2	Inner skin thickness:	0	mm
F.7.2.2	Thickness of panel:	0	mm
F.3.4.2.a		Young's Modulus (E):	2.00E+11 0.00E+00 Pa
F.3.4.2.a		Ultimate Tensile Strength (S):	3.65E+08 0.00E+00 Pa
F.3.4.2.a		Shear:	2.11E+08 0.00E+00 Pa
F.3.2.1	Minimum FB wall thickness:	0.0012	0 m
F.3.4.1	Outer Diameter / Panel Thickness:	0.025	#VALUE! m
F.3.4.1	Additive cross section (A):	0.00E+00	#VALUE! m ²
F.3.4.1	Additive second moment of inertia (I):	0.00E+00	m ⁴
Buckling Modulus		E_1*I_1 <= E_2*I_2+E_3*I_3:	0.00E+00
UTS		S_1*A_1 <= S_2*A_2+S_3*A_3:	0.00E+00
Bending		4*S_1*I_1/r <= 4*(S_2*I_2+S_3*I_3)/r:	0.00E+00
Deflection		Bending_1/(48*E):	0.00E+00
Energy		F.4.3.2.3 comparison:	0.00E+00
F.7.3.3	1.5mm Steel Shear Equivalence:		3.16E+08

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
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
F.3.4.1	Wall thickness:	1.2 mm	N/A
F.3.4.1	Square side:	25 mm	N/A
F.3.4.1	Wall thickness:	0.0012 m	N/A
F.3.4.1	Square side:	0.025 m	N/A
F.3.4.1	Tube cross sectional area (A):	1.14E-04 m ²	N/A
F.3.4.1	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	S_Yield(S):	3.05E+08 0.00E+00 Pa
Buckling Modulus		E_1*I_1 <= E_2*I_2:	1.70E+03
S_Yield(S):		S_1*A_1 <= S_2*A_2:	3.48E+04
Bending		4*S_1*I_1/r <= 4*S_2*I_2/r:	8.17E+02
Deflection		Bending_1/(48*E):	1.00E-02
Energy		0.5*Bending*2/(48*E):	4.09E+00

「Composite」の場合

BLANK			
F.7.2	Front Bulkhead Construction:	Composite	0
F.7.2	Front Bulkhead Tubes Replaced Size B:	2	Diagonal Size C: 0
F.7.2	Type SES Tab Name Of Layout Used:		
F.4.3.2.d	50% < Core < 100%:	Type	Core thickness: mm
F.4.3.2.d	Scaling option, layout repeats:		Outer skin thickness: Layup mm
F.4.3.2.d	Scaling option, layout repeats:		Inner skin thickness: Type mm
F.4.3.2.d			Thickness of panel: #VALUE! mm
F.4.3.2.d			Front Bulkhead Height: mm
F.4.3.2.d			Front Bulkhead Width: mm
F.4.3.2.d			Cutout Height: mm
F.4.3.2.d			Cutout Width: mm
F.4.3.2.d			Composite Panel Height: 0 mm
F.3.4.2.a		Young's Modulus (E):	2.00E+11 Layup Pa
F.3.4.2.a		Ultimate Tensile Strength (S):	3.65E+08 Name Pa
F.3.4.2.a		Shear:	2.11E+08 Type Pa
F.7.2.2	25mm FBHS Section		
F.7.2.2	Core thickness:	0	mm
F.7.2.2	Outer skin thickness:	0	mm
F.7.2.2	Inner skin thickness:	0	mm
F.7.2.2	Thickness of panel:	0	mm
F.3.4.2.a		Young's Modulus (E):	2.00E+11 0.00E+00 Pa
F.3.4.2.a		Ultimate Tensile Strength (S):	3.65E+08 0.00E+00 Pa
F.3.4.2.a		Shear:	2.11E+08 0.00E+00 Pa
F.3.2.1	Minimum FB wall thickness:	0.0012	0 m
F.3.4.1	Outer Diameter / Panel Thickness:	0.025	#VALUE! m
F.3.4.1	Additive cross section (A):	2.28E-04	#VALUE! m ²
F.3.4.1	Additive second moment of inertia (I):	1.70E-08	m ⁴
Buckling Modulus		E_1*I_1 <= E_2*I_2+E_3*I_3:	3.40E+03
UTS		S_1*A_1 <= S_2*A_2+S_3*A_3:	8.32E+04
Bending		4*S_1*I_1/r <= 4*(S_2*I_2+S_3*I_3)/r:	1.96E+03
Deflection		Bending_1/(48*E):	1.20E-02
Energy		F.4.3.2.3 comparison:	*****
F.7.3.3	1.5mm Steel Shear Equivalence:		3.16E+08

要求されたエビデンスを添付すること

選択肢は4種類
それぞれ入力項目が違う

BLANK		
Boltedの場合	AIP to FB Attachment:	Bolted
	Al plate must match entire Front Bulkhead perimeter.	
F.8.2.3.b	Number of 8mm critical fasteners (8 required):	
	Minimum distance between bolt centers:	

ボルトを選択選択した場合、
2種類の選択肢がある
↑2024年追加

Laminatedの場合		BLANK	
F.8.2.3.d	Laminated AIP to composite Front Bulkhead		EQ
	Does the AIP form the front bulkhead of the monocoque?	<input type="checkbox"/>	EQ
	Type SES Tab Name Of Enclosing Layup Used:		BLANK
	Skin used:	<input type="checkbox"/>	BLANK
	AIP Perimeter Length:	<input type="text"/> mm	BLANK
	Scaling option, layup repeats:	<input type="text"/> Laminate thickness: Type mm	EQ
	Skin shear area - centerline x 1 thickness:	#VALUE! m^2	EQ
	Skin shear strength:	Type Pa	EQ
F.8.2.3.d	Single tearout path >=120000N:	0.00%	EQ
	Front Hoop Lamination:	<input type="text"/>	BLANK
	Lap joint strength:	Type Pa	EQ
	Total bond width including both sides of the Front Hoop:	<input type="text"/> mm	BLANK
	Bond shear area:	0 m^2	EQ
F.8.2.3.d	Bond failure >=120000N:	#VALUE! #VALUE!	EQ

Quick Releaseを選択した場合、
入力項目増えるので
見逃さないように注意⇒

BLANK	
Shear Calculation for Positive Locking on Quick Release	
Positive Locking Shear Requirement	95000 N
Shear Diameter: <input type="text"/> mm	Fastener UTS (Screenshot): <input type="text"/> MPa
Number of positive locking diameters in shear:	<input type="text"/>
Number of fasteners * 0.577 * UTS * pi * OD^2 / 4:	0 0.00%

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

EQ

EQ

F.8.2.3.b Bolting AIP to tube Front Bulkhead

Locate AI bolts through FB tube inserts or on tabs:

Nut And Bolt EQ

Centerline Inserts 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 BO124: No

AIP Inserts: Yes

EV Accumulator: No

EQ

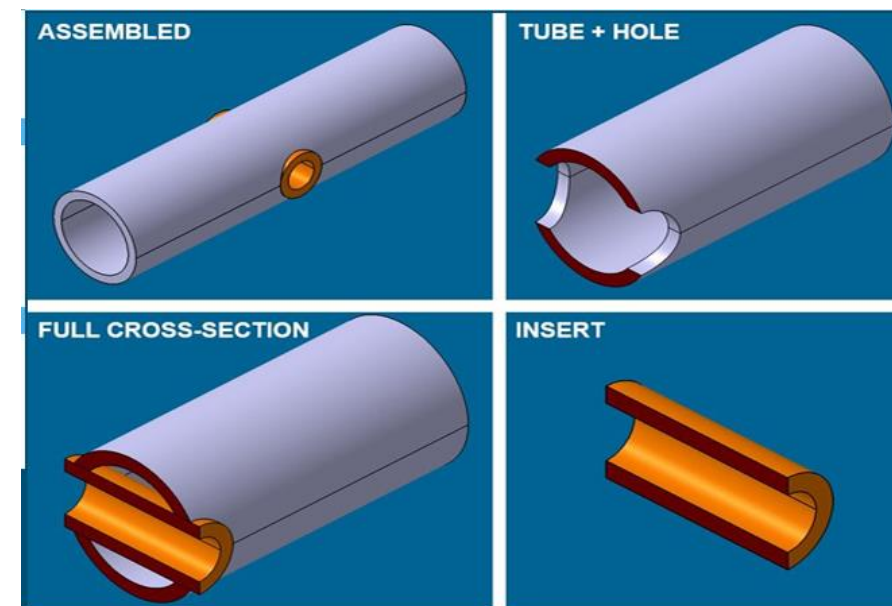
Does the steering rack

interrupt any required tubes?

Tube Chassis BO135: No

FILL OUT THIS TAB.

BLANK



REPLACE THIS EXAMPLE WITH YOUR OWN CAD

F.5.3.1, F.3.4.3 - HOLES OVER 4mm, STEERING RACK PASS THROUGH
INSERT, OUTSIDE COLLAR, OR PLATE REQUIRED

Insert/Collar cross sectional area (A_2): mm²

F.8 Front Protection

F.3.4.3 Welded Inserts

F.5.12 Bolted Members

注意: AIP Attachment

Offset Mountsの場合

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

Maximum Fastener centerline offset from tube surface:

Mount cross section on tube surface:

See diagrams: EV Acc tab AY28-BI28

Mount thickness (B):

Mount length (L):

Minimum gusset thickness (T):

Minimum gusset height normal to mount face (H):

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:

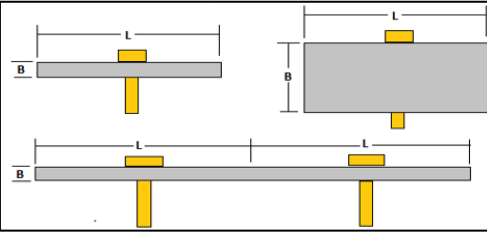
0.00E+00 Parabolic shear $3*Test\ Load/2*area \leq Shear$:

Nut And Bolt	EQ
Centerline Inserts	EQ
mm	N/A
	N/A
Single Layer	N/A
H-Shape	N/A
L-Shape	N/A
U-Shape	N/A
Rectangular Tube	N/A
	N/A

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。



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

The diagram shows an L-shaped object with a horizontal base of length L and a vertical stem of height H . The thickness of the horizontal base is B , and the thickness of the vertical stem is T . A yellow rectangular block is placed on top of the horizontal base. Another yellow rectangular block is placed below the horizontal base, centered under it.

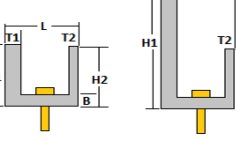
L-SHAPE	
(B)	B
(L)	L
(T)	T
(H)	H

The diagram illustrates an H-shape with the following dimensions and parameters:

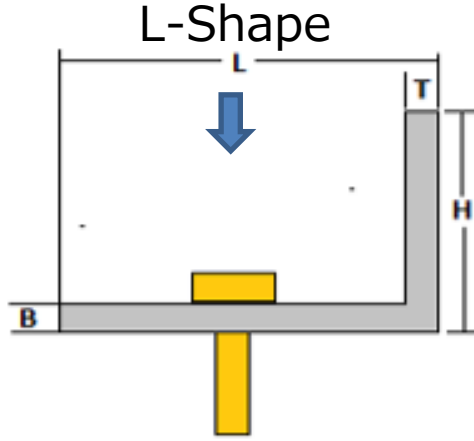
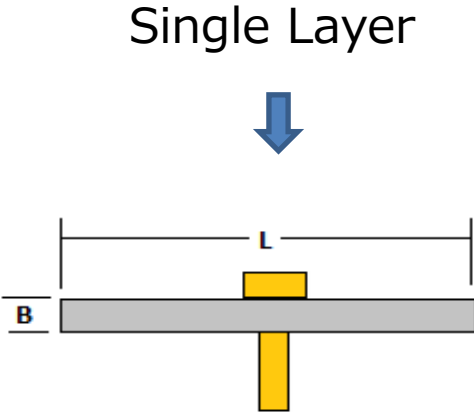
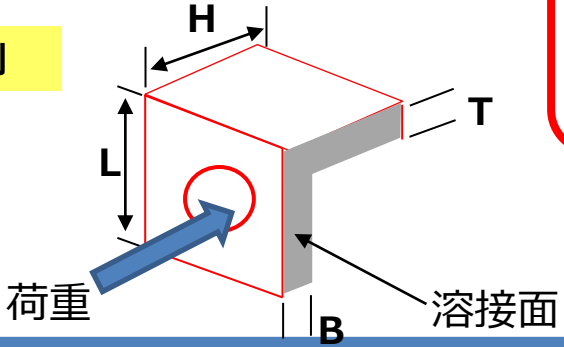
- T1, T2, T3, T4:** Thicknesses of the four vertical legs.
- H1, H2:** Heights of the four vertical legs.
- L:** Length of the horizontal bar.
- B:** Width of the horizontal bar.
- Yellow rectangles:** Two yellow rectangles are shown on the horizontal bar, one on top and one on the bottom, representing a specific feature or load.

	H-SHAPE
(B)	B
(L)	L
(T)	$\min (T1, T2, T3, T4)$
(H)	$\min (H1, H2)$

「L-Shape」の例



	U-SHAPE
(B)	B
(L)	L
(T)	$\min (T1, T2)$
(H)	$\min (H1, H2)$



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

要求されたエビデンスを添付すること

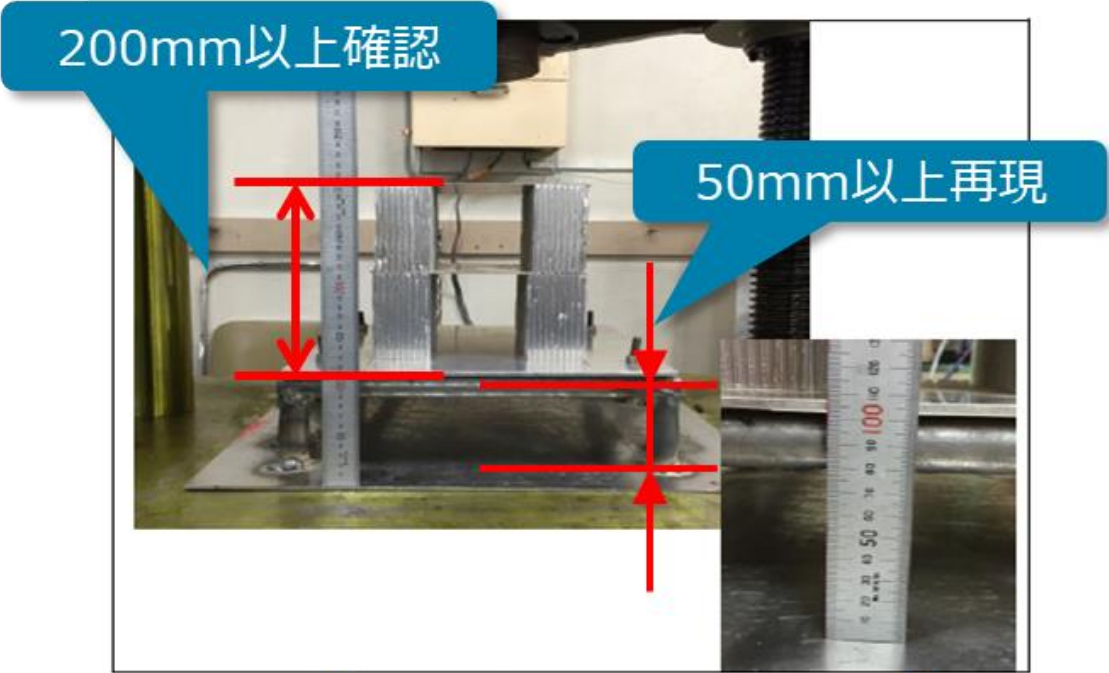
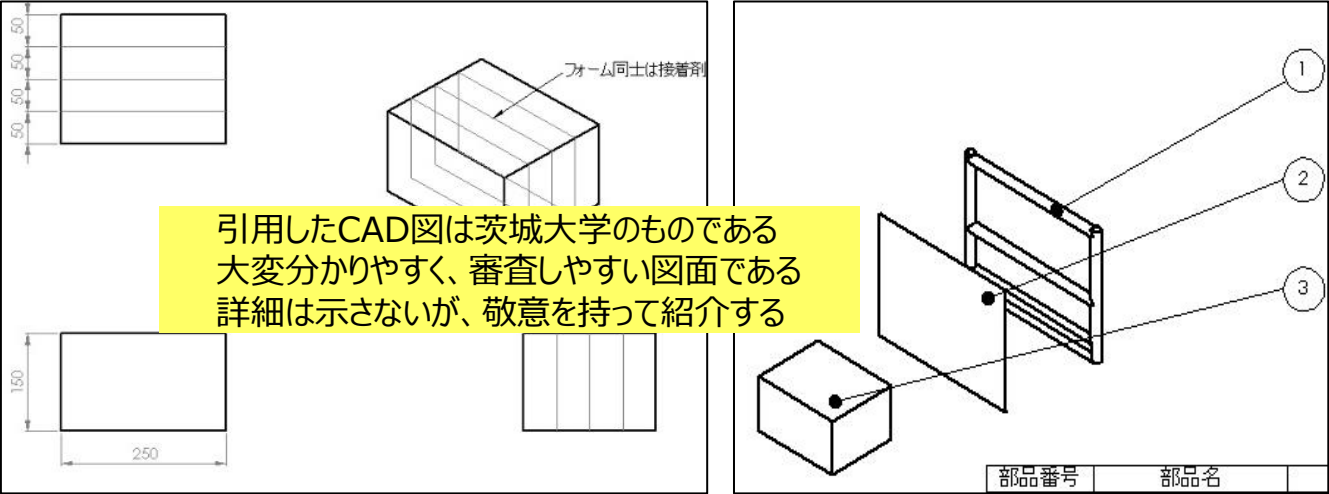
それぞれ空欄で要求される寸法が分かるCAD図や写真を記載すること

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	BLANK
	Front Bulkhead Outside To Outside Width:	0	mm	BLANK
	Fixture Thickness on table ≥ 50 mm:		mm	BLANK
	Tested IA starting length > 200 mm:		mm	BLANK
	Custom IA WIDTH over 200mm length ≥ 200 mm:		mm	N/A
	Custom IA HEIGHT over 200mm length ≥ 100 mm:		mm	N/A



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全てに入力完了し判定が「EQ」とならないといけない

Impact Attenuator And / Or Wing Failure Test

BLANK		
Type of test used?:	<div></div>	BLANK
Name of Test Facility:	Quasi Static	BLANK
Dates of tests:	Dynamic	BLANK
Maximum crushed displacement:	0 mm	REJECT
Post crush displacement, demonstrating any springback:	<div></div> mm	BLANK
Crushed attenuator height:	<div></div> mm	BLANK
AI plate deformation:	<div></div> mm	BLANK

F.8.8.6.d

F.8.8.2.b All calculated values must be based on a mass of 300kg and an initial velocity of 7m/s.
F.8.8.8.a Average deceleration from a dynamic test must be calculated from raw, unfiltered data
F.8.8.8.b Peaks above 40g must not be seen after the application of specific filtering. See rule.

F.8.8.2b 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 force

BLANK				
F.8.8.2a	Peak attenuator force:	0	N	EQ
	Peak attenuator only deceleration <= 40g:	0	g	BLANK
	Average attenuator force:	0	N	EQ
	Average attenuator only deceleration <= 20g:	0	g	EQ
F.8.8.2b	Energy absorbed >= 7350J:	0	J	REJECT
	Energy absorption check:	7350	J	EQ
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?:	<div></div>	N/A
Name of Test Facility:	<div></div>	N/A
Dates of tests:	<div></div>	N/A
Maximum crushed displacement:	<div></div> mm	N/A
Post crush displacement, demonstrating any springback:	<div></div> mm	N/A
AI plate deformation:	<div></div> mm	N/A
F.8.3.1.b	Maximum AIP force > 120kN:	N N/A

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

「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)

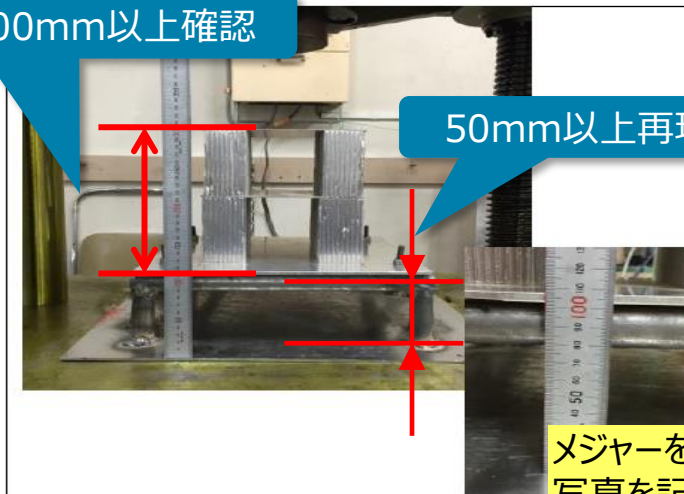
F.8.7.7

Impact Attenuator / Wing Failure Test

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

200mm以上確認

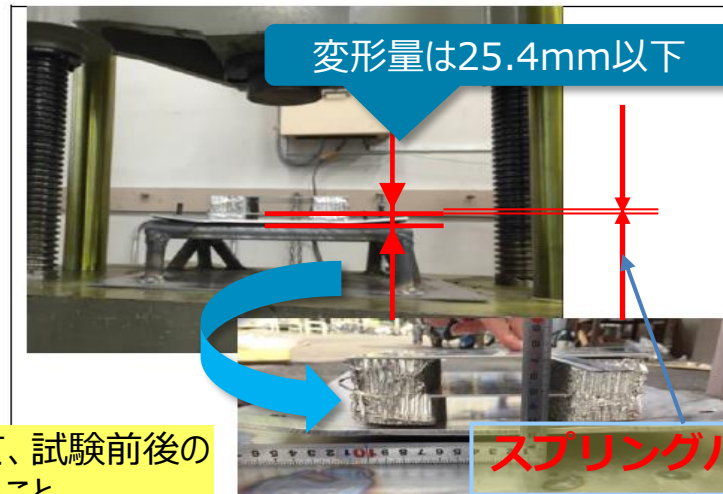
50mm以上再現



メジャーを入れて、試験前後の写真に記載すること

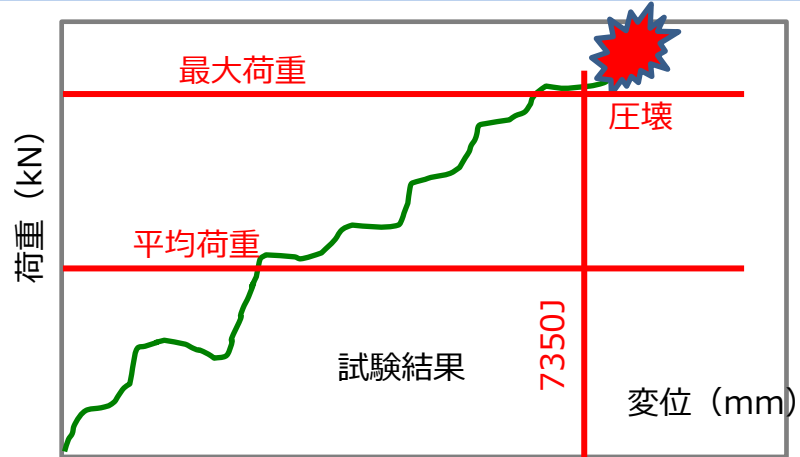
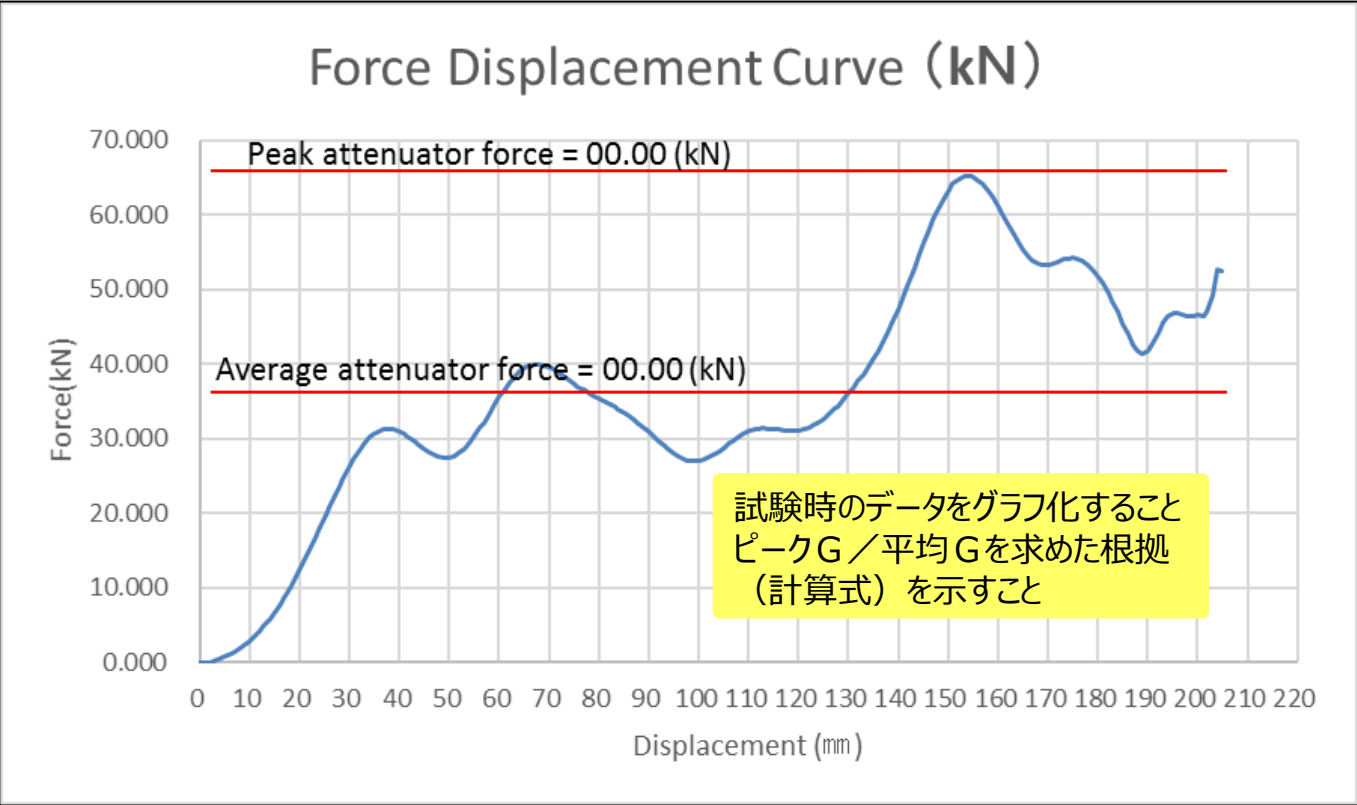
- ①インパクトアッテネータ試験前の写真
 - ②貫通防止板から50mm以上再現し、その上にインパクトアッテネータを載せる
- ※足の先にプレートを置き、溶接を推奨！

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



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		MAX
15	6511	N	12.386
0	0		0
1	4		0.004
2	35		0.039
3	169		0.204
4	497		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

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。

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

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

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	生データを添付すること		
measuring data2			
		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	

