SES（等価構造計算書）

TUBEフレームの場合

SESガイダンス：初めに

初めに、ココの注意事項を理解すること

2021 FSAE Structural Equivalency Spreadsheet (SES), includes Impact Attenuator Document (IAD) **Steel Tube** **1.8** EV tab To N/A For IC

There are two versions of the 2020-2021 SES: Steel Tube and Monocoque/Hybrid/Non-Ferrous.
Aluminum equivalance may be used in the Steel Tube SES for Anti-Intrusion, EV Rear Impact, or Accumulator Containers and Mounting.
Steel can be used for any part of the frame in the Monocoque/Hybrid/Non-Ferrous SES.
F.3.4.2 - Any and all steel grades are assigned the same material properties. No material properties for different grades may be used in the SES.
Teams using multiple chassis in one season: Comment below the SES submission with a link to the SES for the second chassis, before the Action Deadline.

Only cells of this color can be edited. Enter all values as positive numerals.
Drop down options can be identified by the heavy border. Delete will clear the entry.
Each entry, each category, each tab, and the entire sheet are coded as one of the following: BLANK EQ CHECK REJECT N/A
The status of some cells depends on entries in other cells.

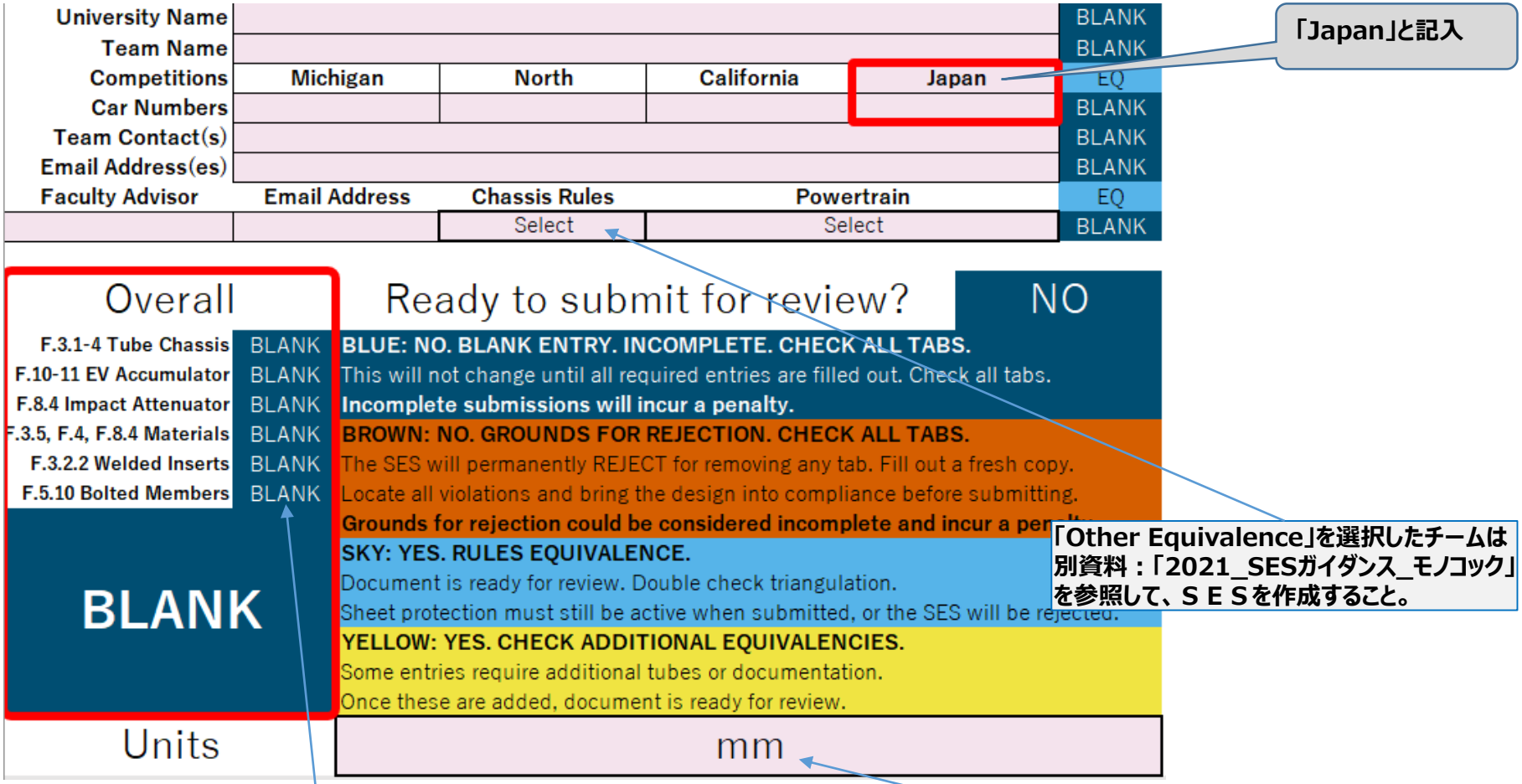
SELECT YOUR UNITS. The entire SES will be completed in either mm or Inch. Inch tubing can be entered in mm, and vice versa.
Keep a copy of the rules open to reference rule numbers directly while filling out the SES.
Read the additional guidance on the right side of the sheet.
Fill in all **BLANK** sections on **ALL TABS.** Start with any drop downs in the top left corner of each tab.
Replace example images with your own clear, undistorted CAD, showing all required dimensions in a moderate filesize. **Each SES file 25Mb max.**

F.2.2.1 SES forms must be completed and submitted by all teams no later than the date specified in the Action Deadlines on the specific event website.
DR.3.2.1 Submission of late, blank, incomplete, or previous car's SES will incur a competition point penalty.
DR.3.1.2b Do not submit an updated document after the deadline without having the previous document rejected.
DR.3.1.2b Submit a comment requesting a rejection on your team's SES page on fsaeonline.com.
DR.3.1.3 Please respond quickly to requests for revisions or clarifications. Submissions or comments on FSAEonline.com will send a notification to your reviewer.
IN.8.1 Bring an **ELECTRONIC** copy of the approved SES to Tech Inspection. It is your responsibility to bring a functioning, charged tablet or laptop. Bring backups.
IN.1.4 Approval of an SES does not guarantee passing Tech Inspection. The final decision about all designs will be made at Tech Inspection.

・入力項目はピンク色のセル
・太枠のセルは、ドロップダウンから選択
・入力項目は「ＥＱ」になっていること

Cover

基本条項を入力する



Anti-Intrusion and Front Bulkhead

BLANK Anti-Intrusion and Front Bulkhead

BLANK				
F.8.2.1	Anti-Intrusion Plate (AI) material:	Steel		EQ
	Steel: 1.5mm (0.060in), Aluminum: 4.0mm (.157in):		mm	BLANK
BLANK				
F.8.2.3	AI Attachment:	Welded		EQ
	AI 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
BLANK				
F.6.1	**Front Bulkhead (FB)**	**Minimum**	**Tube Used**	EQ
F.3.2.1	Example: 25.4mm x 1.6mm round	Size B	Round	EQ
F.3.4.1	Wall thickness:	1.2		mm BLANK
	Outer Diameter (OD):	25		mm BLANK
	Wall thickness:	1.2		mm BLANK
	Outer Diameter (OD):	25.0		mm BLANK
	Tube cross sectional area (A):	114		mm^2 BLANK
	Tube second moment of inertia (I):	8509		mm^4 BLANK
F.8.2.3b	Locate AI bolts through FB tube inserts or on tabs:		Centerline Inserts	N/A
	Maximum Fastener centerline offset from tube surface:			mm N/A
	Brace web thickness parallel to fastener shear plane:			mm N/A
F.3.4.2	Fastener shear plane brace length:			mm N/A
3.00E+08	15kN Bending M*y / I <= UTS:			N/A
1.73E+08	Parabolic shear 3*Test Load/2*b*h <= Shear:			N/A
	Brace web thickness parallel to fastener axis:			mm N/A
F.3.4.2	Fastener axis brace length:			mm N/A
3.00E+08	15kN Bending M*y / I <= UTS:			N/A
1.73E+08	Parabolic shear 3*Test Load/2*b*h <= Shear:			N/A

F.8.2.3.b Anti Intrusion Plates bolted through welded inserts on the centerline of Size B tubes automatically meet the 15kN load requirement.
Offset tabs must be thick enough or have large enough braces to react the bending load.
In the front view, measure the distance from the tube centerline to the tube surface.
It's not a 3D measurement.
See the diagrams on the EV Accumulator tab in cells AY28 and BI28 for brace entries.

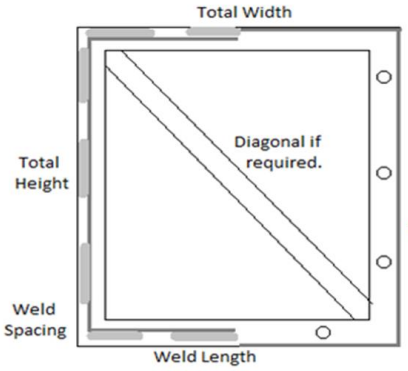
F.8.4.3 A Standard Impact Attenuator may be oriented horizontally or vertically.
The outside profile of the Bulkhead must be no more than 25mm (1in) from the edge.
Otherwise, testing or a diagonal will be required.

F.8.4.3.b Teams may use quasi-static or dynamic testing on the Impact Attenuator tab to prove the AI plate deflects less than 25mm without a diagonal.

BLANK				
F.8.4.3	Impact Attenuator (IA) used:	Standard		EQ
	Standard Impact Attenuator Height:	304mm (12in)		EQ
	Standard Impact Attenuator Width:	355mm (14in)		EQ
	Front Bulkhead Outside to Outside Height:		mm	BLANK
	Front Bulkhead Outside To Outside Width:		mm	BLANK
	No diagonal or test required.			

EQ				
F.8.4.3	**Diagonal Tube or Impact Attenuator Test**		Tube	N/A
	Example: 25.4mm x 1.2mm round	**Minimum**	**Tube Used**	N/A
F.3.2.1		Size C	Round	N/A
F.3.4.1	Wall thickness:	1.2		mm N/A
	Outer Diameter (OD):	25		mm N/A
	Wall thickness:	1.2		mm N/A
	Outer Diameter (OD):	25.0		mm N/A
	Tube cross sectional area (A):	91		mm^2 N/A
	Tube second moment of inertia (I):	6695		mm^4 N/A

REPLACE THIS EXAMPLE WITH YOUR OWN CAD.
Include all required dimensions.
The Front Bulkhead shape may be more complex than this example.



A bolted Anti Intrusion plate reaches the perimeter of the bulkhead. At least 8 x 8mm (5/16in) **T.8.2** bolts are used. Minimum spacing 50mm (2in).

If using tabs for mounting, see EV tab for brace web & length diagram.

If not matched to the outside perimeter of the bulkhead, a welded Anti Intrustion 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.

・FBHとAIPの各サイズ
・FBHとAIPの締結方法
Boltedの場合は、ボルト本数、ボルト間の距離
Weldedの場合は、溶接長、溶接間の距離
・AIPの板厚、材質

これらを適切に明記し、以下の各セルに入力した数値が正しいことを確認できる図面を添付すること。

Bolted、Offset Tabを選択した場合は、これらセルにも数値を入力すること

Standard IAで、Diagonalを要する場合は、これらセルにも数値を入力すること

Front Hoop (FH)

BLANK

Front Hoop (FH)

F.5.6.3 The FH runs from the lowest frame member on each side.
F.5.6.2 The FH may be multiple pieces.
F.5.5.2 Side view bends must be met with a triangulated FBHS or SIS tube.

BLANK

	Front Hoop (FH)	Minimum	Tube Used		EQ
F.5.6					
F.3.2.1	Example: 25mm x 2.5mm round	Size A	Round		EQ
F.3.4.1	Wall thickness:	2		mm	BLANK
	Outer Diameter (OD):	25		mm	BLANK
	Wall thickness:	2.0		mm	BLANK
	Outer Diameter (OD):	25.0		mm	BLANK
	Tube cross sectional area (A):	173		mm^2	BLANK
	Tube second moment of inertia (I):	11320		mm^4	BLANK

BLANK

F.5.6.4	Turned Steering Wheel minimum below FH top:	mm	BLANK

BLANK

F.5.6.5	FH to Steering Wheel gap <=250mm (9.8in)	mm	BLANK

BLANK

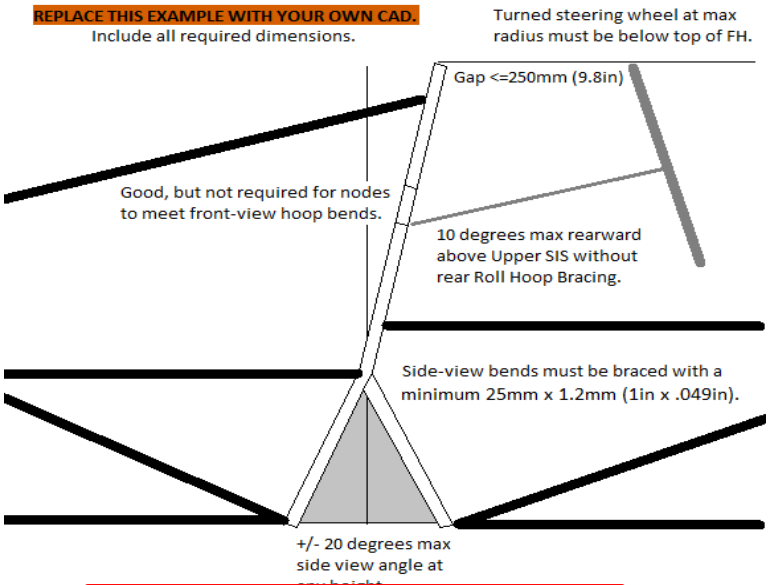
F.5.6.6	Maximum Front Hoop side angle <=20 degrees:	degrees	BLANK

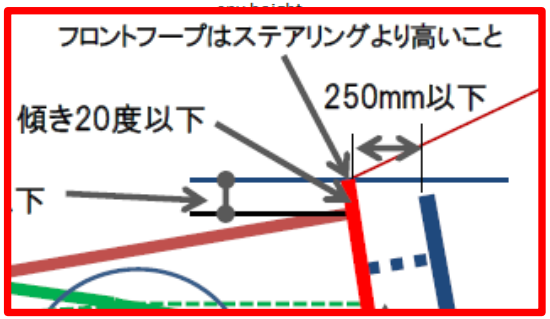
BLANK

F.6.3.5	FH rearward lean above Upper SIS <= 10, or braced:	degrees	BLANK

Rearward Front Hoop Brace is not required.

これらに記入した数値が正しいことを確認できる図面を添付すること





・FHとステアリング間の距離
・FH頂点とステアリング上端の距離
・FHの角度

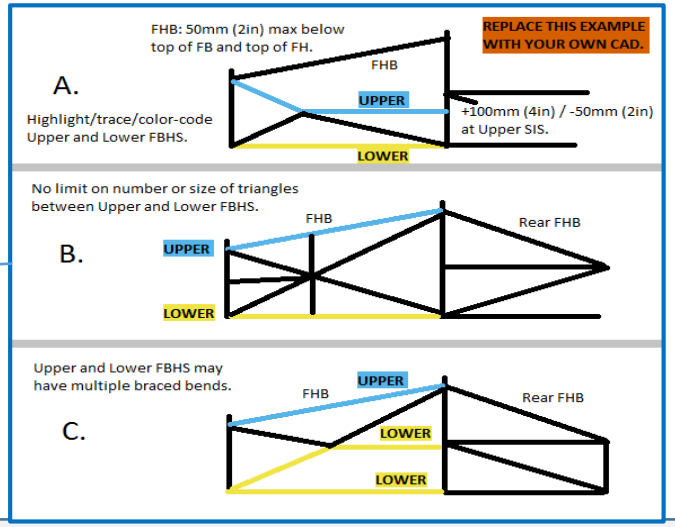
これらを適切に明記し、以下の各セルに入力した数値が正しいことを確認できる図面を添付すること。

Front Bulkhead Supports (FBHS) and Front Hoop Braces (FHB)

BLANK				
F.6.2	**Front Bulkhead Support (FBHS)**	**Minimum**	**Tube Used**	EQ
F.3.2.1	Example: 25.4mm x 1.2mm round	Size C	Round	EQ
F.3.4.1	Wall thickness:	1.2	mm	BLANK
	Outer Diameter (OD):	25	mm	BLANK
	Wall thickness:	1.2	mm	BLANK
	Outer Diameter (OD):	25.0	mm	BLANK
	Tube cross sectional area (A):	91	mm^2	BLANK
	Tube second moment of inertia (I):	6695	mm^4	BLANK
BLANK				
F.6.2.3.a	Top of FB to Upper FBHS tube, 50mm vertical limit:		mm	BLANK
BLANK				
F.6.2.3.ab	FBHS configuration:		A	EQ
	Top of Upper FBHS tube relative to top of Upper SIS tube:		Above	EQ
	Without Rear FHB, vertical limit 100mm above:		mm	BLANK
	Rearward Front Hoop Brace is not required.			
BLANK				
F.6.3.4	Top of FH to top of FHB tube, 50mm vertical limit:		mm	BLANK
BLANK				
F.6.3	**Forward Front Hoop Braces (FHB)**	**Minimum**	**Tube Used**	EQ
F.3.2.1	Example: 25.4mm x 1.6mm round	Size B	Round	EQ
F.3.4.1	Wall thickness:	1.2	mm	BLANK
	Outer Diameter (OD):	25	mm	BLANK
	Wall thickness:	1.2	mm	BLANK
	Outer Diameter (OD):	25.0	mm	BLANK
	Tube cross sectional area (A):	114	mm^2	BLANK
	Tube second moment of inertia (I):	8509	mm^4	BLANK

Rearward Front Hoop Brace is not required.

EQ				
F.6.2.3.b	**Rear Front Bulkhead Support (FBHS)**	**Minimum**	**Tube Used**	N/A
F.3.2.1	Example: 25.4mm x 1.2mm round	Size C	Round	N/A
F.3.4.1	Wall thickness:	1.2	mm	N/A
	Outer Diameter (OD):	25	mm	N/A
	Wall thickness:	1.2	mm	N/A
	Outer Diameter (OD):	25.0	mm	N/A
	Tube cross sectional area (A):	91	mm^2	N/A
	Tube second moment of inertia (I):	6695	mm^4	N/A



間違いが多い。
以下の中から、自チームの構造に適するパターン（A,B,C）を選択すること。

これらに記入した数値が正しいことを確認できる図面を添付すること

Side Impact Structure (SIS)

BLANK				
	Tube frame Upper SIS compliance:		2020 SIS Height	EQ
F.6.4.4.b - Lowest UpperSIS point above lowest LowerSIS point >=240mm:			mm	BLANK
F.6.4.4.b - Highest UpperSIS point above lowest LowerSIS point <=320mm:			mm	BLANK
Highest and lowest are on the top and bottom of the Upper SIS tube.		0	mm	BLANK
BLANK				
F.6.4.1	Upper Side Impact Structure (SIS)		Straight	EQ
		Minimum	Tube Used	EQ
F.3.2.1	Example: 25.4mm x 1.6mm round	Size B	Round	EQ
F.3.4.1	Wall thickness:	1.2		mm BLANK
	Outer Diameter (OD):	25		mm BLANK
	Wall thickness:	1.2		mm BLANK
	Outer Diameter (OD):	25.0		mm BLANK
	Tube cross sectional area (A):	114		mm^2 BLANK
	Tube second moment of inertia (I):	8509		mm^4 BLANK
BLANK				
F.6.4.1	Lower and Diagonal SIS	Minimum	Tube Used	EQ
F.3.2.1	Example: 25.4mm x 1.6mm round	Size B	Round	EQ
F.3.4.1	Wall thickness:	1.2		mm BLANK
	Outer Diameter (OD):	25		mm BLANK
	Wall thickness:	1.2		mm BLANK
	Outer Diameter (OD):	25.0		mm BLANK
	Tube cross sectional area (A):	114		mm^2 BLANK
	Tube second moment of inertia (I):	8509		mm^4 BLANK

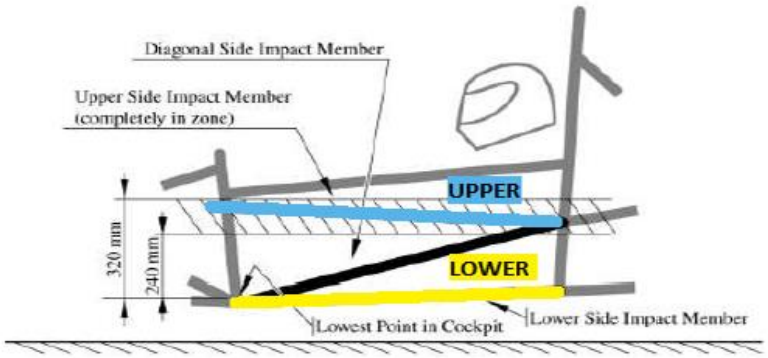
これらに記入した数値が正しいことを確認できる図面を添付すること

REPLACE THIS EXAMPLE WITH YOUR OWN CAD.

Include all required dimensions.

Highlight/trace/color code Upper and Lower SIS.

Bent Upper SIS must use larger tube whether bent in top or side view.



・コックピットの最も低い点とUpper SISの最も低い点の距離
・コックピットの最も低い点とUpper SISの最も高い点の距離

これらを適切に明記し、以下の各セルに入力した数値が正しいことを確認できる図面を添付すること。

Main Hoop (MH) and Shoulder Harness Bar (SH)

	BLANK				
F.5.7.1	**Main Hoop (MH)**	**Minimum**	**Tube Used**		EQ
F.3.2.1	Example: 25mm x 2.5mm round	Size A	Round		EQ
F.3.4.1	Wall thickness:	2		mm	BLANK
	Outer Diameter (OD):	25		mm	BLANK
	Wall thickness:	2.0		mm	BLANK
	Outer Diameter (OD):	25.0		mm	BLANK
	Tube cross sectional area (A):	173		mm^2	BLANK
	Tube second moment of inertia (I):	11320		mm^4	BLANK

	BLANK				
F.6.5	**Shoulder Harness Bar (SH)**		Straight		EQ
		Minimum	**Tube Used**		EQ
F.3.2.1	Example: 25mm x 2.5mm round	Size A	Round		EQ
F.3.4.1	Wall thickness:	2		mm	BLANK
	Outer Diameter (OD):	25		mm	BLANK
	Wall thickness:	2.0		mm	BLANK
	Outer Diameter (OD):	25.0		mm	BLANK
	Tube cross sectional area (A):	173		mm^2	BLANK
	Tube second moment of inertia (I):	11320		mm^4	BLANK

Shoulder Harness Bar does not require braces.

	EQ			
T.4.5.3.b	Brace angle to plane of SH side view >= 30:		degrees	N/A

F.5.2.3 The plane of a bent tube is defined by the straight axes on either side of the bend.

Shoulder Harness Bar does not require braces.

	EQ				
F.6.5.1	**Shoulder Harness Braces**	**Minimum**	**Tube Used**		N/A
F.3.2.1	Example: 25.4mm x 1.2mm round	Size C	Round		N/A
F.3.4.1	Wall thickness:	1.2		mm	N/A
	Outer Diameter (OD):	25		mm	N/A
	Wall thickness:	1.2		mm	N/A
	Outer Diameter (OD):	25.0		mm	N/A
	Tube cross sectional area (A):	91		mm^2	N/A
	Tube second moment of inertia (I):	6695		mm^4	N/A

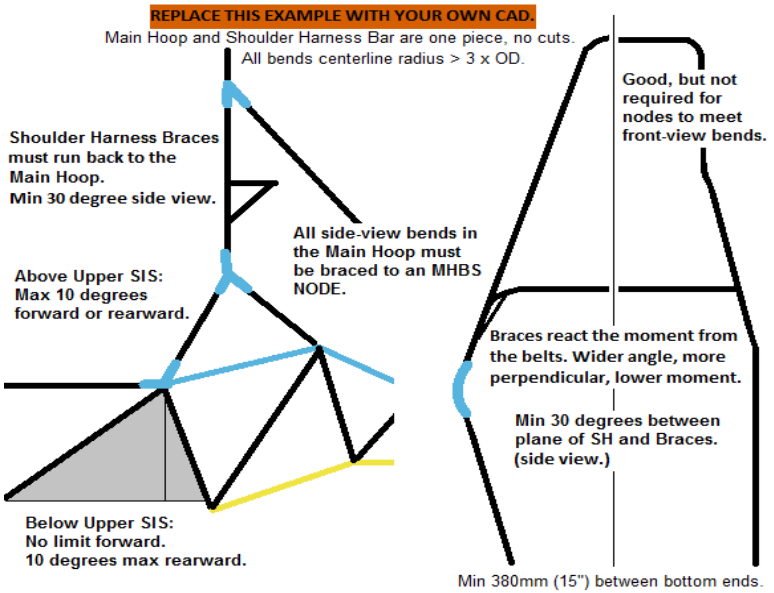
	BLANK				
F.5.7.3.a	Main Hoop side view direction from Upper SIS up:		Rearward		EQ
	Main Hoop side angle from vertical above Upper SIS <=10:			degrees	BLANK
F.5.8.2	**Main Hoop Braces may run forward or rearward.**				

	BLANK			
F.5.7.3.c	MH side view direction from Upper SIS down:	Rearward		EQ
	Main Hoop <=10 degrees in the rearward direction:		degrees	BLANK

	BLANK			
F.5.7.4	Distance between Main Hoop ends >=380mm (15")		mm	BLANK

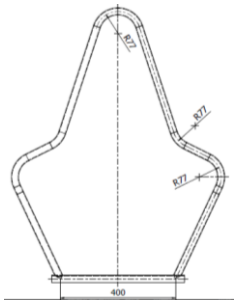
F.5.2.1 - Enter the tightest bend on any **T.5-6** tube in the chassis (usually in the MH or SH.)

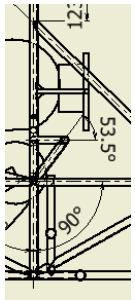
	BLANK			
F.5.2.1	Minimum tube centerline radius:		mm	BLANK
	Outer Diameter (OD):		mm	BLANK
	Minimum radius::diameter ratio >=3:			



・MHの角度
・MH下端の端部間距離
・曲げR（曲げた箇所はすべて）
・SHをBend Tubeにした場合は、側面から見たBraceの角度

これらを適切に明記し、以下の各セルに入力した数値が正しいことを確認できる図面を添付すること。（以下、一例）



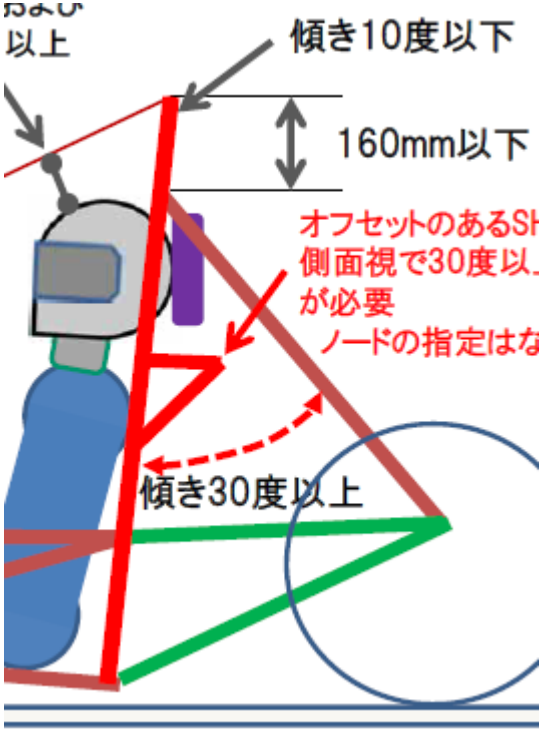


Main Hoop Braces (MHB) and Main Hoop Brace Supports (MHBS)

Main Hoop Braces may run forward or rearward.

	BLANK			
F.5.8.2	Main Hoop brace direction:	Rearward		EQ
F.5.8.5	Angle between MH and MHB >=30 degrees:		degrees	BLANK
	BLANK			
F.5.8.4	Top of MH of MHB tube, 160mm vertical limit:		mm	BLANK
	BLANK			
F.5.8.1	**Main Hoop Brace (MHB)**	**Minimum**	**Tube Used**	EQ
F.3.2.1	Example: 25.4mm x 1.6mm round	Size B	Round	EQ
F.3.4.1	Wall thickness:	1.2	mm	BLANK
	Outer Diameter (OD):	25	mm	BLANK
	Wall thickness:	1.2	mm	BLANK
	Outer Diameter (OD):	25.0	mm	BLANK
	Tube cross sectional area (A):	114	mm^2	BLANK
	Tube second moment of inertia (I):	8509	mm^4	BLANK
	BLANK			
F.6.6	**Main Hoop Brace Support (MHBS)**	**Minimum**	**Tube Used**	EQ
F.3.2.1	Example: 25.4mm x 1.2mm round	Size C	Round	EQ
F.3.4.1	Wall thickness:	1.2	mm	BLANK
	Outer Diameter (OD):	25	mm	BLANK
	Wall thickness:	1.2	mm	BLANK
	Outer Diameter (OD):	25.0	mm	BLANK
	Tube cross sectional area (A):	91	mm^2	BLANK
	Tube second moment of inertia (I):	6695	mm^4	BLANK

これらに記入した数値が正しいことを確認できる図面を添付すること



・MHとMHB間の角度
・MH頂点とMHB接続点の距離
これらを適切に明記し、以下の各セルに入力した数値が正しいことを確認できる図面を添付すること。

Helmet Clearance, Head Restraint, and Rear Wing Mounting

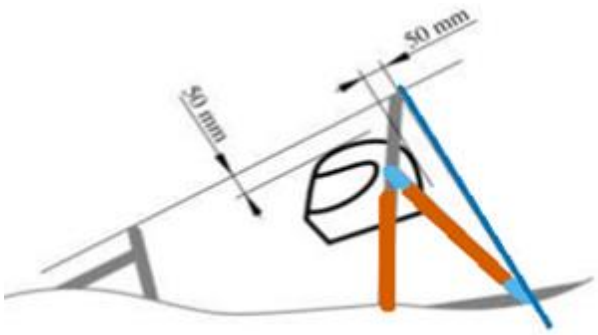
	BLANK			
F.5.5.3.a	Helmet >=50mm (2in) below Roll Hoop plane:		mm	BLANK
	BLANK			
F.5.5.3.bc	Main Hoop Braces protecting Helmet:	Rearward		EQ
F.5.5.3.bc	Helmet >=50mm (2in) below MH to bottom of MHB:		mm	BLANK
	BLANK			
T.2.8.4	Head Restraint >=0 from F.1.13 envelope:		mm	BLANK

Note: A straight tube between the MHB tubes as part of the Head Restraint does not form part of the rollover envelope. A Head Restraint protruding behind the MHB tubes risks becoming part of the rollover envelope, and is strongly discouraged.

	BLANK				
F.5.9	Rear Wing chassis mounting locations:	Select drop down:			BLANK
F.5.9.2.b	**Wing Mount Braces**	**Minimum**	**Tube Used**		N/A
F.3.2.1	Example: 25.4mm x 1.2mm round	Size C	Round		N/A
F.3.4.1	Wall thickness:	1.2		mm	N/A
	Outer Diameter (OD):	25		mm	N/A
	Wall thickness:	1.2		mm	N/A
	Outer Diameter (OD):	25.0		mm	N/A
	Tube cross sectional area (A):	91		mm^2	N/A
	Tube second moment of inertia (I):	6695		mm^4	N/A
F.5.9.2.b	**Calculation of buckling strength of MHB tube.**				N/A
F.3.4.2	Yield Strength (Sy):	3.05E+08		Pa	N/A
	Main Hoop Brace Outer Diameter (OD):	0		mm	N/A
	Main Hoop Brace second moment of inertia (I):			mm^4	N/A
	Main Hoop Brace Length (Main Hoop to MHBS) (L):			mm	N/A
	Wing Mount distance to closest MHB end (a):			mm	N/A
	Pinned MHB Buckling Force (Sy*L*I)/(a*(L-a)*OD/2):			N	N/A
F.5.9.2.b	Rear Wing Detachment Force (On One Side):			N	N/A

Rear Wingのマウント方法を適切に選択すること。

Mounted on MHB with Braceを選択した場合は、ここにも数値を記入すること。



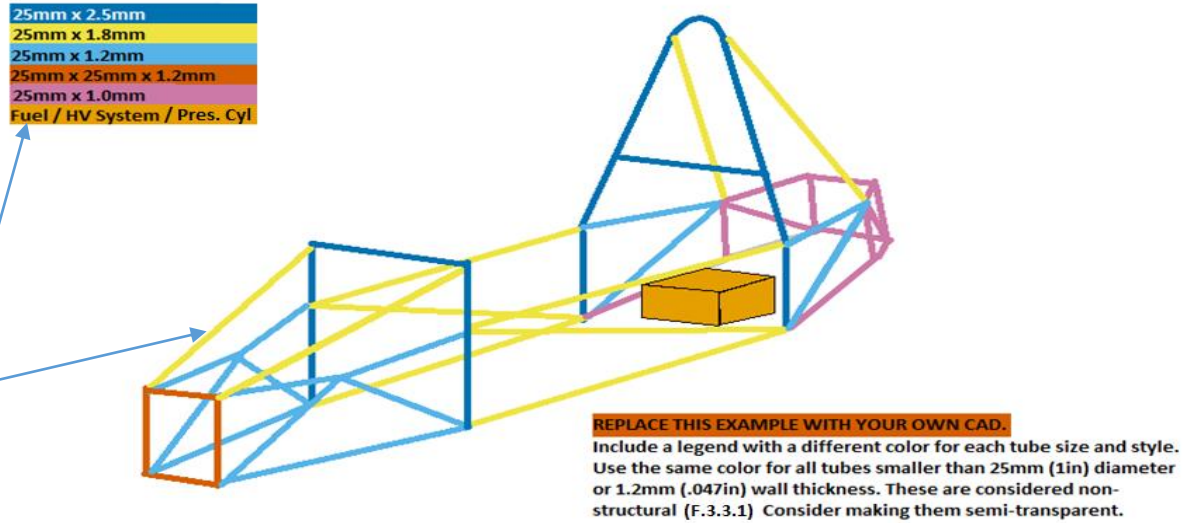
・MH頂点とFH頂点を結んだ線とヘルメットとのクリアランス
・MH頂点とMHBの包絡線に対するヘルメット後方のクリアランス
・ヘッドレストはMH頂点とMHBの包絡線内に入っていること
これらを適切に明記し、以下の各セルに入力した数値が正しいことを確認できる図面を添付すること

Front & Rear 3/4 3D CAD

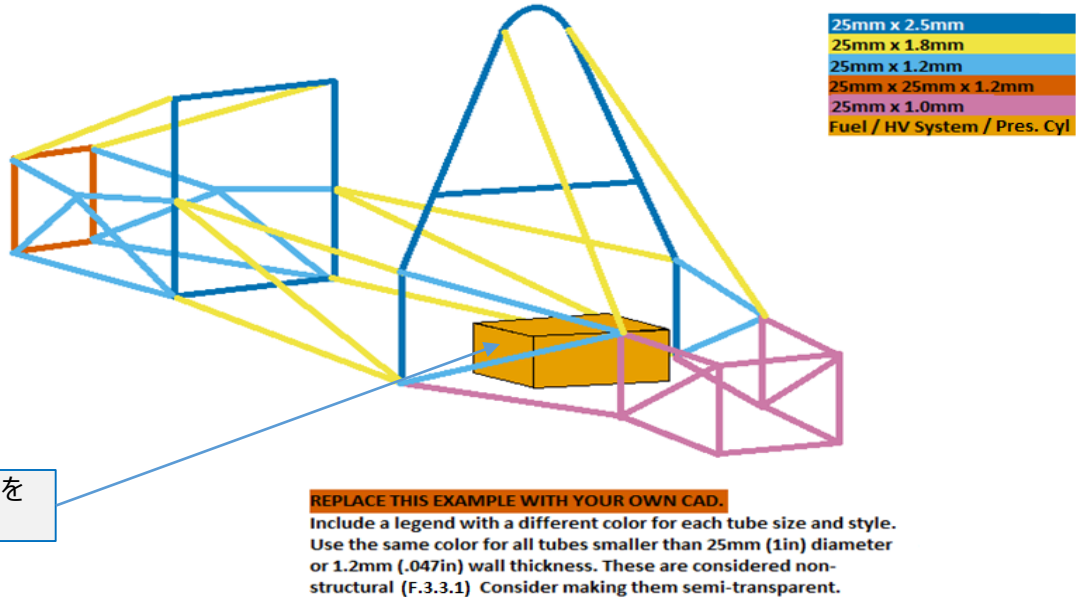
以下3枚の図を添付すること。
・前方からのアイソメ図
・後方からのアイソメ図
・側面図

パイプ外径、肉厚、RoundかSquare、これらが分かるような凡例を添える。

パイプは色分けして表現し、凡例との整合を取ること

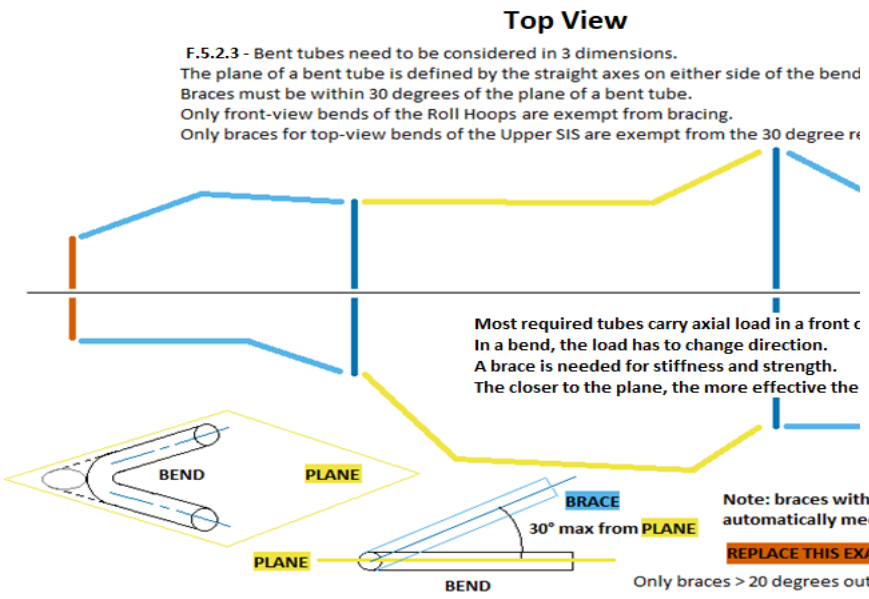


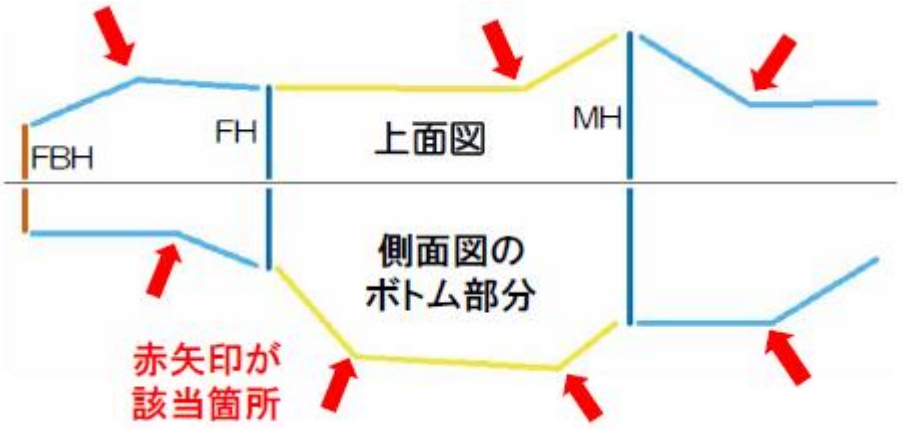
燃料タンク（もしくはアキュムレータコンテナ）を図示すること。



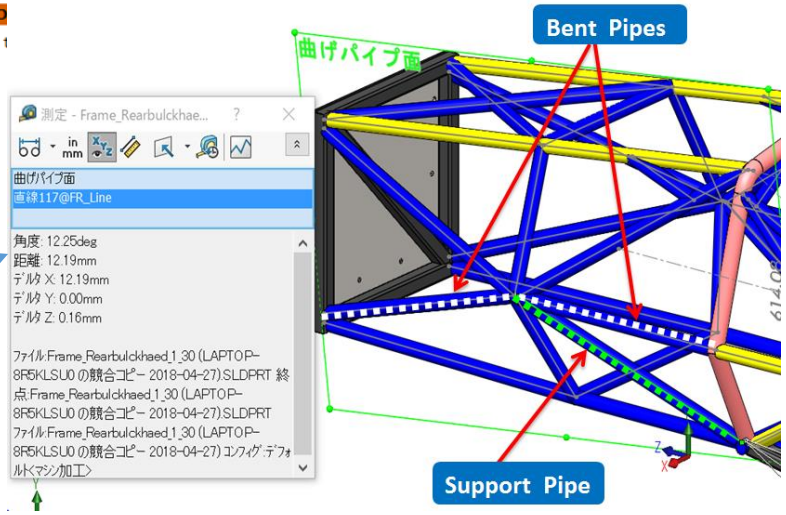
Bent Tubes

フレームの曲がりパイプに対して、「曲げパイプがなす面とブレースの角度が30度以下であること」を証明すること。
対象となる箇所、すべての図を添付しなければならない。



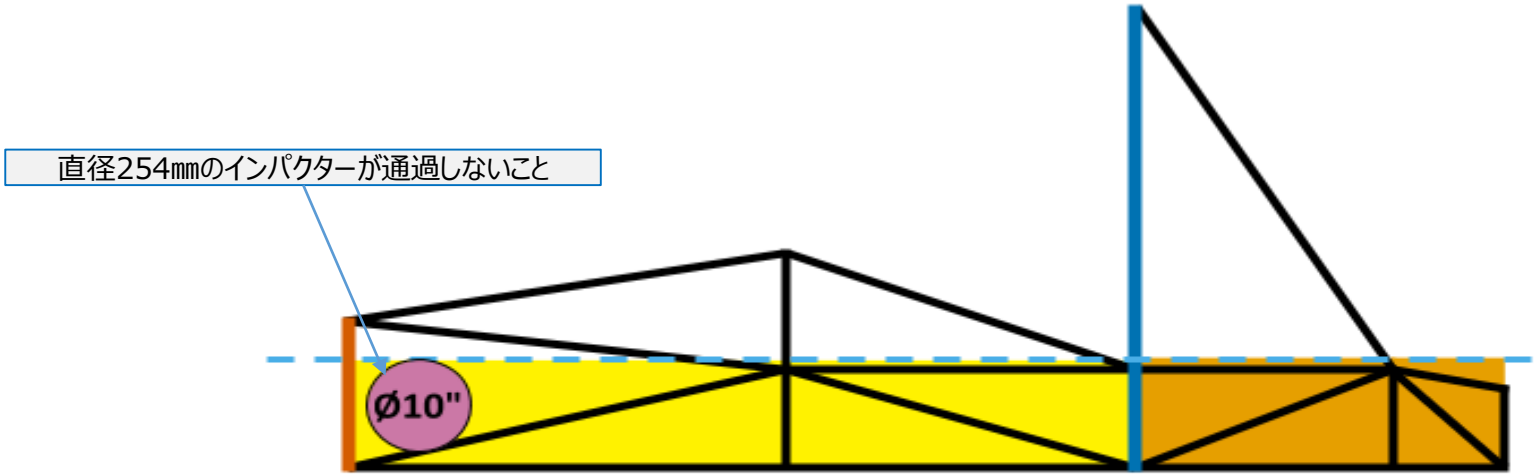


30度以下を証明する一例



GR.1.4 - Good Engineering Practice

フレームの開口部が大きい場合は、インパクターチェックを行うこと（証明のこと）



No openings in the region below upper SIS height between the front bulkhead and main roll hoop, or between any tubes used for Fuel, HV, or component protection may allow a 254mm (10in) diameter impactor to pass through.

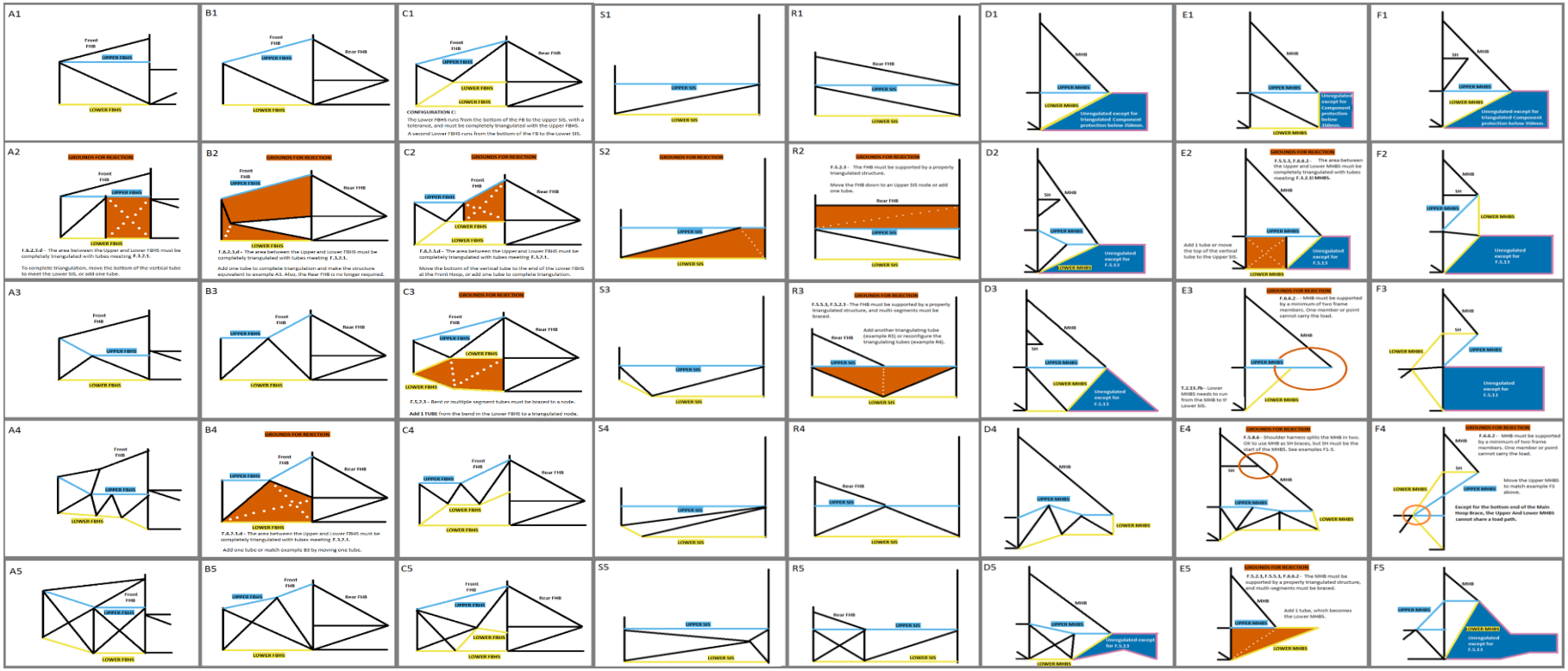
The impactor will be held vertically and seek to intrude into the frame horizontally between the ground and the maximum upper SIS height per rule F.6.4.4.

The top of the impactor will not be raised above the maximum upper SIS Height per rule F.6.4.4.

Any non-structural tubes per F.3.3 will be ignored.

フレーム構成例

下記例（ＦＢＨＳ･ＳＩＳ･ＭＨＢＳ･ＳＨ）を参考にフレーム構成を検討のこと

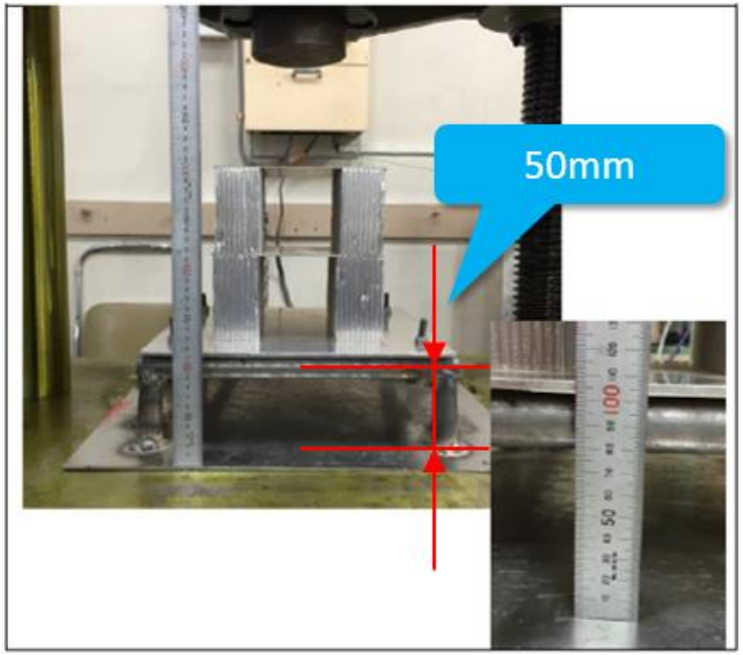


Impact Attenuator

	BLANK		
	Impact Attenuator Material:		BLANK
	Description of form/shape:		N/A
F.8.4.2b	Min LATERAL width over 200mm length >= 200mm:	mm	N/A
F.8.4.2b	in VERTICAL height over 200mm length >= 100mm:	mm	N/A
	Type of test used?:		N/A
	Name of Test Facility:		N/A

Custom ＩＡ：
インパクトアッテネータ試験前の写真をココに貼り付ける。
写真には、下記に記入した寸法を証明できていること
特に、F.8.7.5が満足されていることが証明されていること。
・ＡＩＰから後方50㎜が再現されていること

標準ＩＡ：
標準ＩＡにおいてもの場合も写真を張り付ける

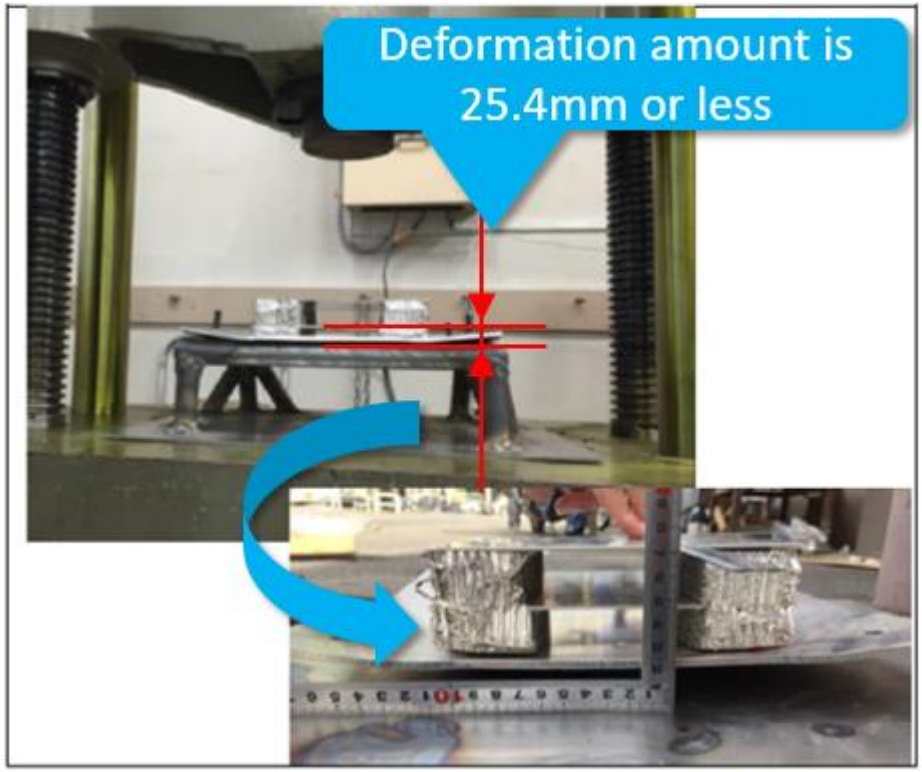


Crushed Attenuator

EQ			
	Maximum crushed displacement:	mm	N/A
	Post crush displacement, demonstrating any springback:	mm	N/A
F.8.7.5d	Al plate deformation:	mm	N/A

これらに記入した数値が正しいことを確認できる
写真を添付すること

インパクトアッテネータ試験後の写真をココに貼り付ける。
写真には、下記に記入した寸法を証明していること
スペースが不足する場合は、下の空きスペースを利用すること

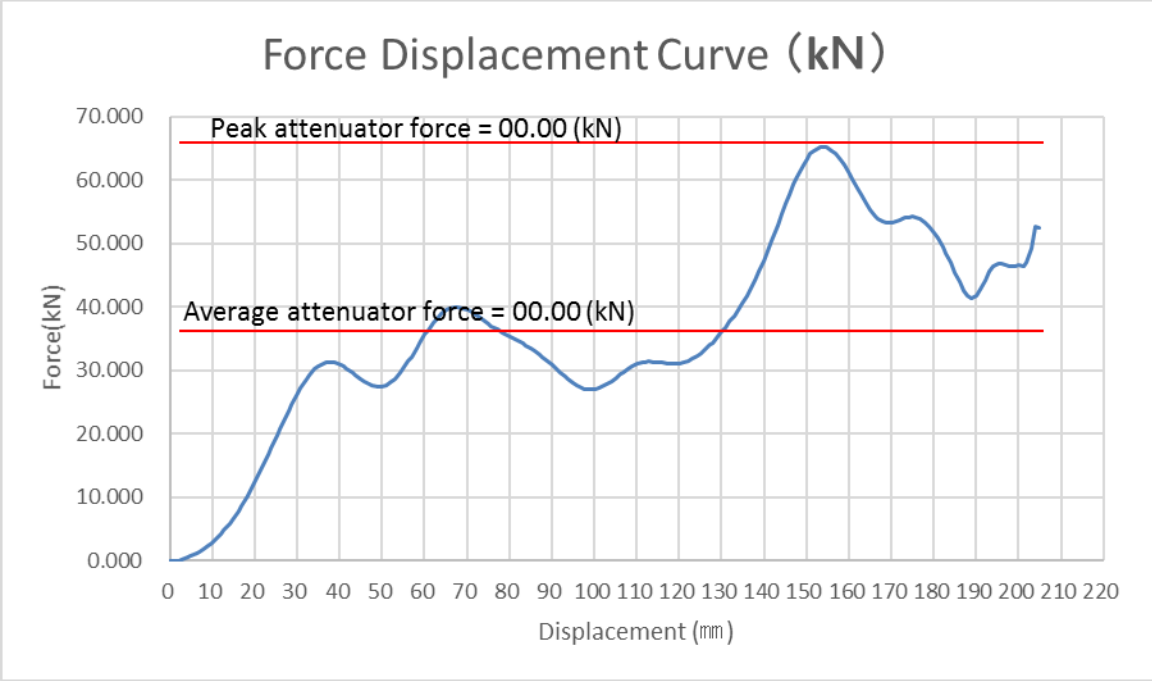


Attenuator Test

EQ			
Test type:	Example: Barrier Impact, Drop Test, Quasi-static Crush		N/A
F.8.7.2a	Peak attenuator force:	N	N/A
	Peak attenuator only deceleration <= 40g:	g	N/A
	Average attenuator force:	N	N/A
	Average attenuator only deceleration <= 20g:	g	N/A

これらに記入した数値が正しいことを確認できる根拠を添付すること

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



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

Disp. mm	Force N	Weighted Average Force	Energy J
MAX	MAX	N	MAX
15	6511		12.386
0	0		0
1	4		0.004
9	2421		4.153
10	2813		5.234
11	3694		6.507
12	4186		7.88
13	4713		8.899
14	5875		10.588
15	6511		12.386

1㎜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。

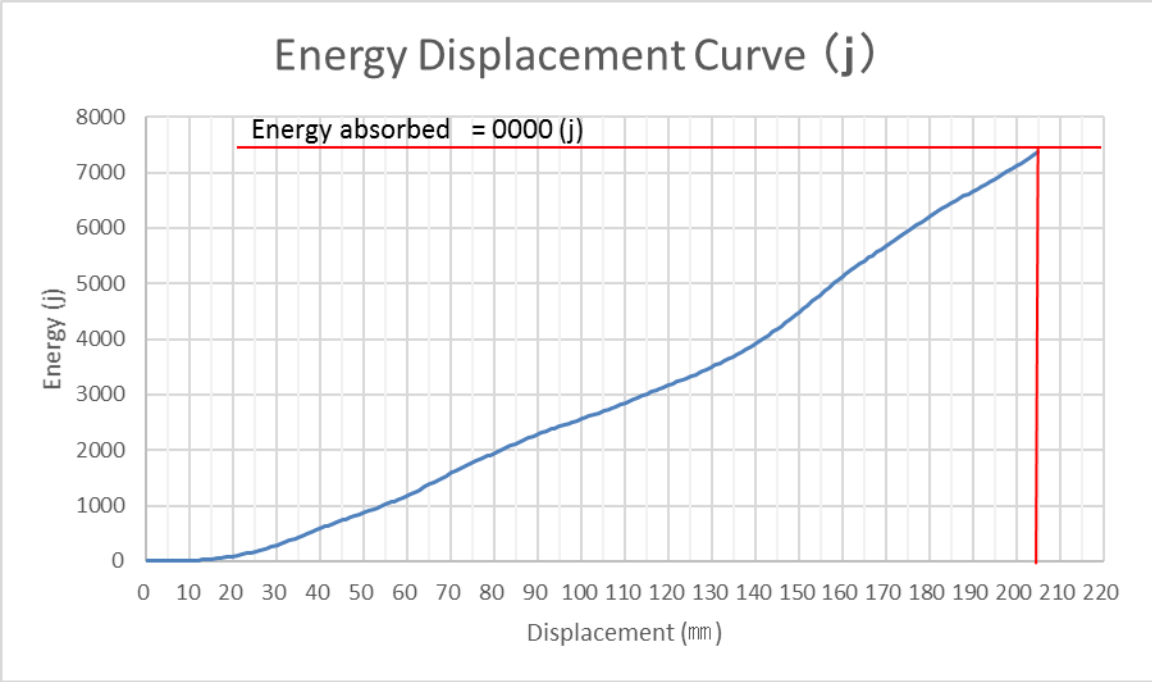
最大変位量までデータを示す。

Energy Calculation

EQ		
F.8.7.2b	Energy absorbed >= 7350J: [ ] J	N/A

これらに記入した数値が正しいことを確認できる根拠を添付すること

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



Front Wing Calculation

BLANK			
Front Wing Status:			BLANK
Wing detachment force:		N	N/A
Peak Attenuator Force:	95000	N	EQ
Peak deceleration force <= 120000N	95000	N	EQ
Peak deceleration remains <= 40g:	32.28	g	EQ
Energy absorption check:	7350	J	EQ

これらに記入した数値が正しいことを確認できる
根拠を添付すること

Ｆ-Ｗｉｎｇの諸元が分かる図（ＣＡＤ）を示す

計算で求める場合は以下の要件を満たすこと
・F・Wingがどのように破壊されるのか？その形態を説明する。

・破壊される部分の強度計算過程&結果をしめす。
（どのようにして結果を導いたのかを示す）

Adhesive Shear Calculation

BLANK				
	Attenuator material:	0		EQ
	Al plate material:	Steel		EQ
F.8.5.2	IA to Al plate mounting method:			BLANK
F.8.5.2b	Is adhesive used in the IA to Al plate mounting?:			BLANK
What is the brand name of the adhesive?:				BLANK
F.8.5.2bc	Baseline number of fasteners:	4		EQ
	Shear capability of 1x 8mm Metric 8.8 (5/16in Grade 5):		N	BLANK
	Number of above fasteners used:			BLANK
	Shear strength of adhesive:		N/mm^2	BLANK
	Minimum bond area:		mm^2	BLANK
	Minimum bond strength >= baseline x bolts in shear:			EQ

計算で求める場合は以下の要件を満たすこと

・<u>ボルト1本のせん断応力　⇒　ボルトのトータルせん断力</u>
※どのように求めたのか？根拠を明確に示すこと

・<u>接着剤のせん断応力　⇒　接着剤のトータルせん断力</u>
※どのように求めたのか？根拠を明確に示すこと
・使用した接着剤の銘柄
・接着剤のせん断応力の根拠が明確（仕様書などで証明）

※それぞれの計算過程を明確に示すこと