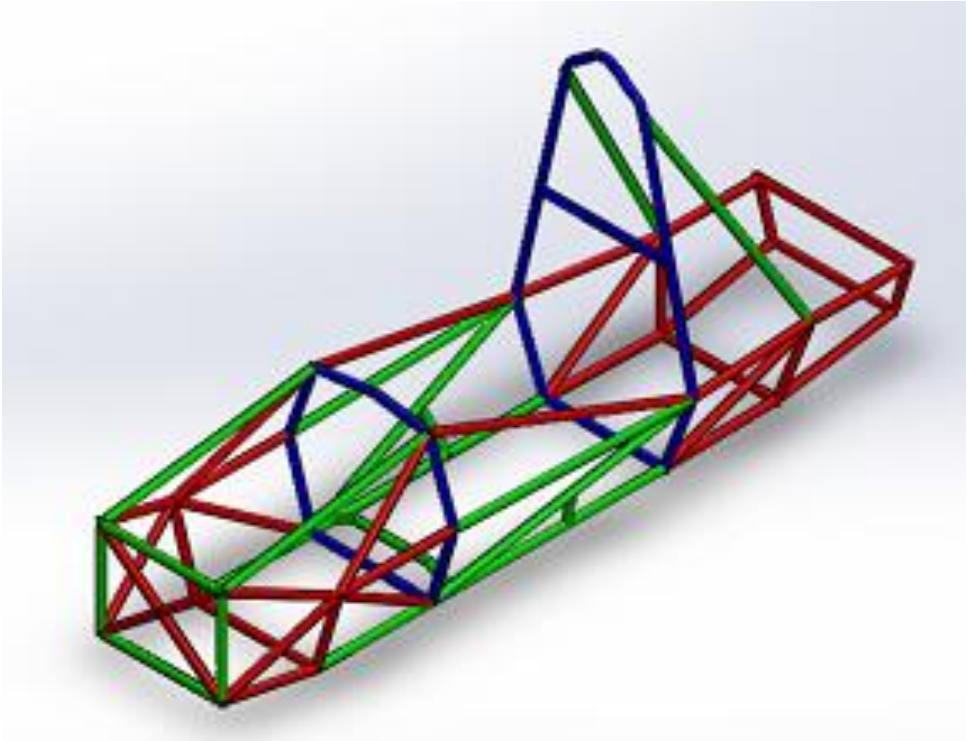
SES Guidance
(Structural Equivalency Spreadsheet)
(等価構造計算書)

F.3.1-4　Tube Chassis



SES : Structural-Equivalency-Spreadsheet

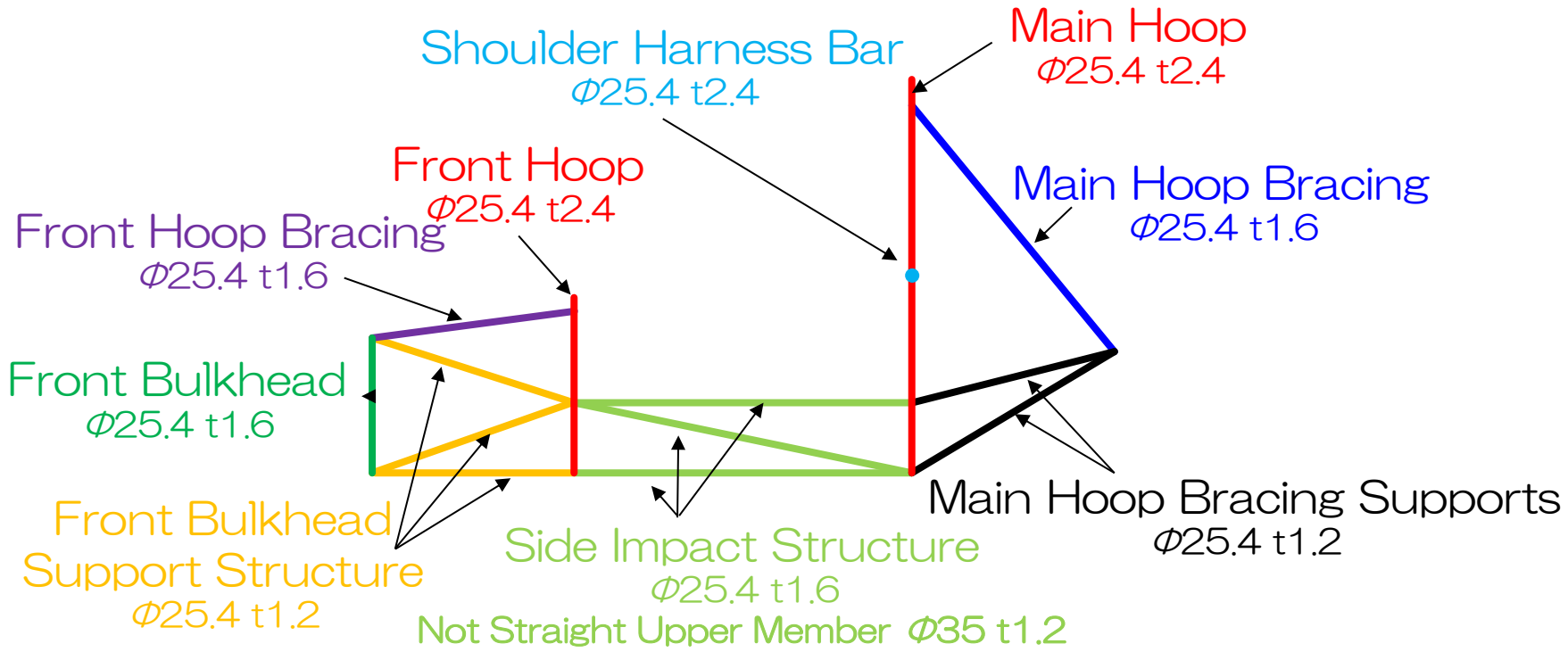
The document that certifies that the Primary Structure designed by you has the same functionality as the Formula SAE Rules is called SES. / 設計した基本構造が Formula SAEのルールに準拠しているかを証明するための資料をSESと呼称

- Regulation / レギュレーション
  - F.2.1 Structural Equivalency Spreadsheet - SES
  - F.2.1.2 The SES provides the means to:
    a. Document the Primary Structure and show compliance with the Formula SAE Rules
    SESで基本構造を文書化し、SAE Rulesに準拠していることを示す。
    b. Determine Equivalence to Formula SAE Rules using an accepted basis
    SAE Rulesとの同等性を証明する。

- The Purpose / 目的
  - To ensure driver safety by meeting the Formula SAE Rules / Formula SAE Rulesを満足することでドライバーの安全を確保すること
  - To detect violations of regulations early and increase the passing rate of vehicle inspections at competitions / 早期にレギュレーション違反を摘出し、大会での車検合格率を上げること

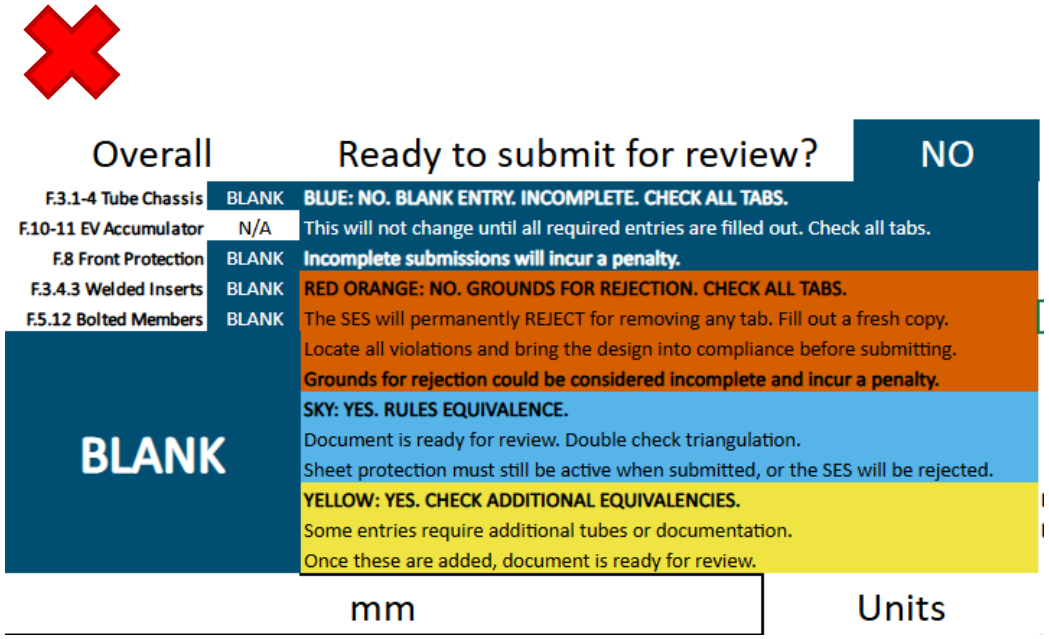
What is SES?/SESって何？

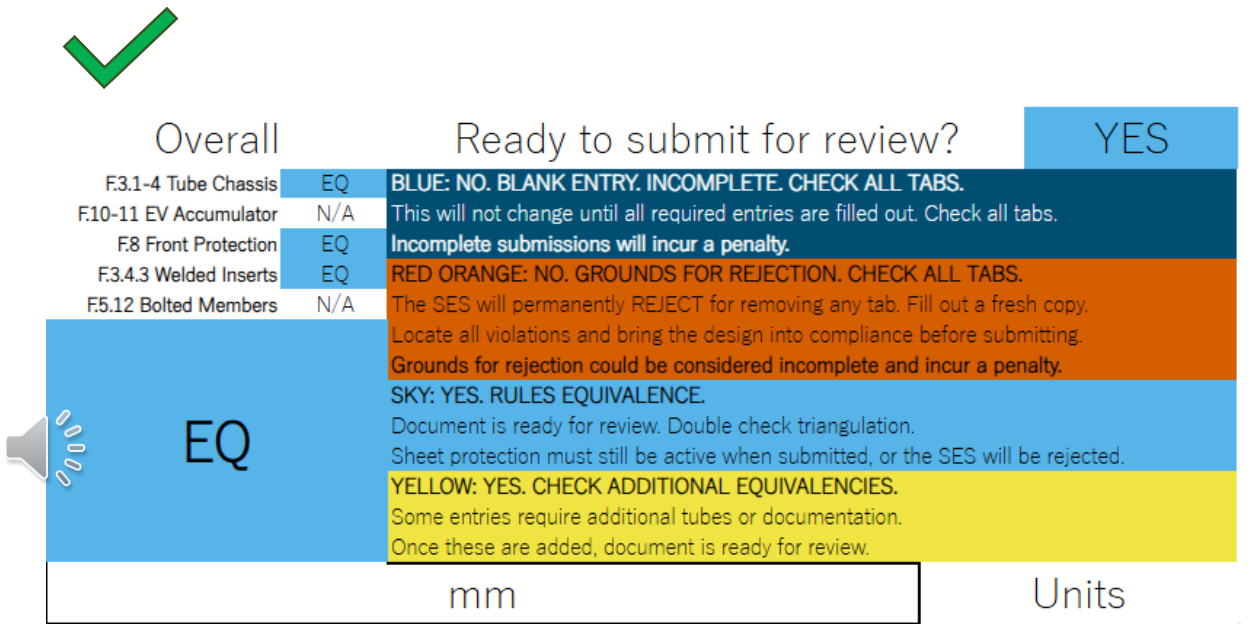
- Primary Structure / 基本構造



Use SES to check whether the above structure has the same or higher level of safety.
上記の構造に対して同等以上の安全が確保されているかSESを使って審査

Introduction / 初めに

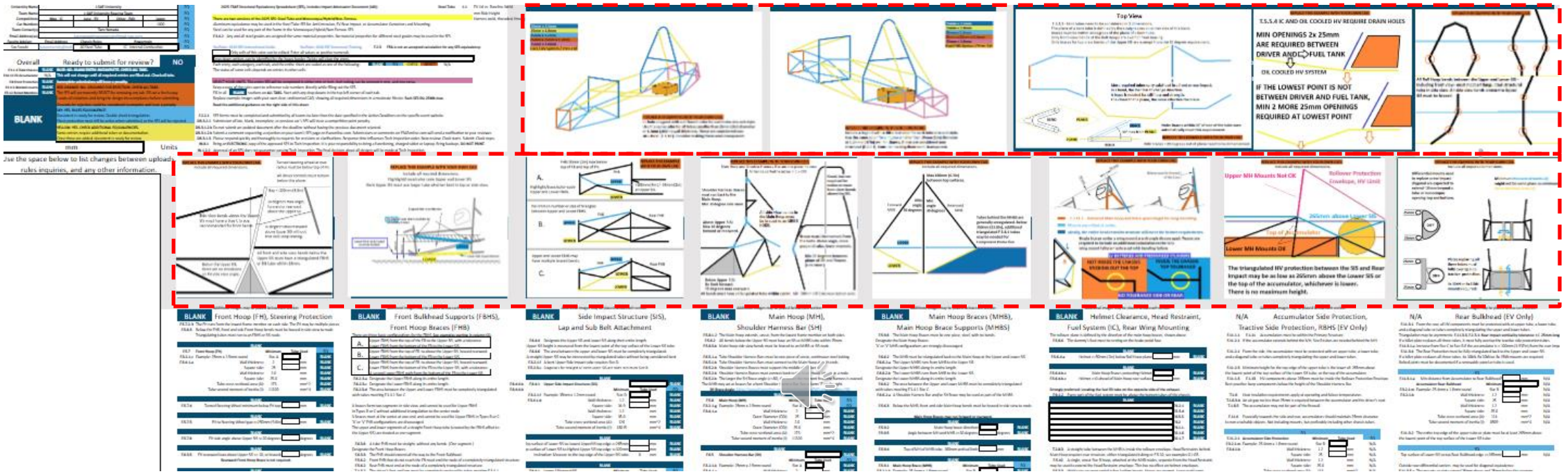




If everything is filled out correctly, the BLANK will change to EQ as shown in the figure on the right, so be sure to check before submitting. Note: There are some exceptions.

すべてが正しく記入できていると右図のようにブランクがEQに変わるので、提出前に必ず確認すること。※一部例外あり

Introduction / 初めに



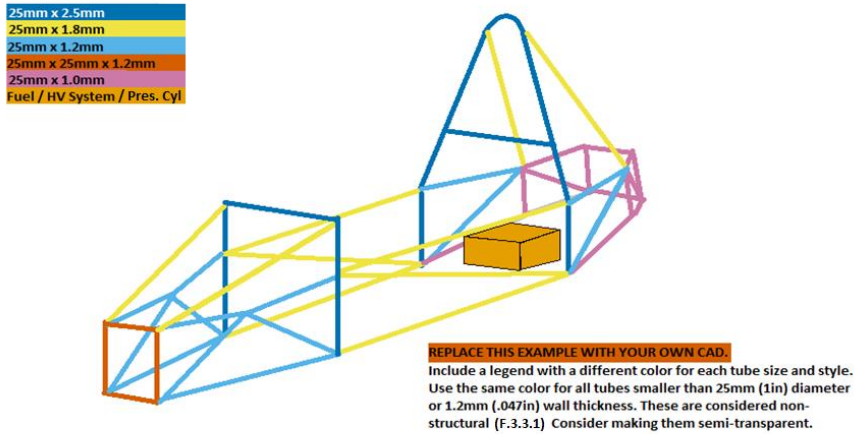
Replace the example entries within the red frame with your own CAD data. There are frequent careless mistakes where the dimensions entered in the SES differ from those in the CAD, or where the illustrations are unclear and the dimensions are unreadable.

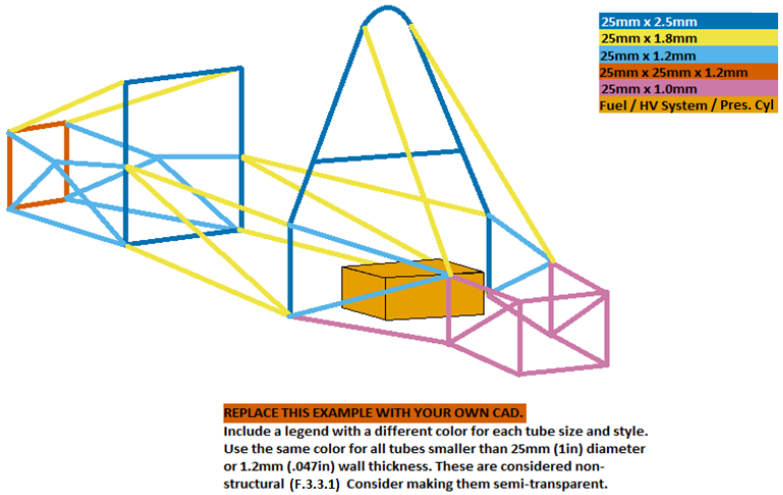
赤枠内の記載例を自身のCADに置き換えること。

SESに記入した寸法とCADの寸法が異なっていたり、

図示が不鮮明で寸法が読めないなどのケアレスミスが非常に多い。

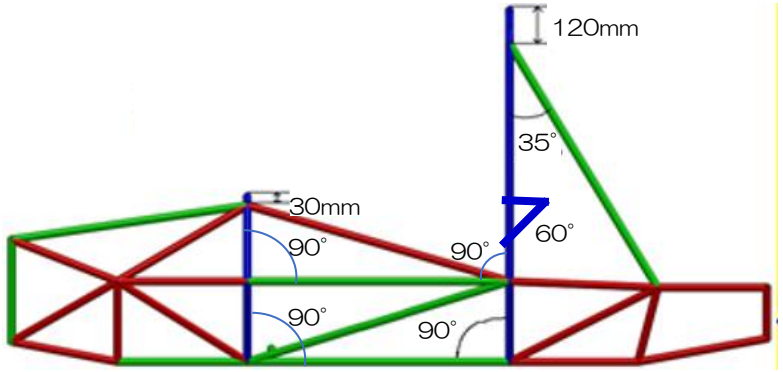
Introduction / 初めに





1. For ICVs, illustrate the fuel tank, and for EVs, illustrate the accumulator container.
2. It is recommended that the color coding of the pipes be done in the same way as in the sample.
3. All pipes with an outer diameter of 25 mm or a wall thickness of 1.2 mm or less should be the same color.

1. **ICVでは燃料タンクを、EVではAccumulator Containerを図示する**
2. **パイプの色分けはサンプルと同様な書き方を推奨**
3. **外径25mm、又は肉厚1.2mmより小さいパイプは全て同一色とする**



Example of Dimension Entry / 寸法記載例

Ensure that the dimensions entered in the SES are accurately reflected in the replaced CAD in all instances

全てにおいてSESに記載した寸法が置き換えたCADでも確認できるようにすること

Team Information / チーム情報

University Name					BLANK
Team Name					BLANK
Competitions	May - IC	June - EV	Other - Edit	Other - Edit	EQ
Car Numbers					BLANK
Team Contact(s)					BLANK
Email Address(es)					BLANK
Faculty Advisor	Email Address	Chassis Rules	Powertrain		EQ
		Select Drop Down	Select Drop Down		BLANK

University Name	J-SAE University				EQ
Team Name	J-SAE University Reacing Team				EQ
Competitions	May - IC	June - EV	Other - Edit	Japan	EQ
Car Numbers				1000	EQ
Team Contact(s)	Taro Yamada				EQ
Email Address(es)	taroyamadajsaeuniversity@mail.jsae.co.jp				EQ
Faculty Advisor	Email Address	Chassis Rules	Powertrain		EQ
Sae Suzuki	jsaeuniversity@mail.	All Steel Tube	IC - Internal Combustion		EQ

Example / 記入例

This section is prone to frequent omissions, so please be careful.

記入漏れが多発する箇所なので注意すること

Front Hoop（FH）

BLANK **Front Hoop (FH), Steering Protection**

F.5.7.2-3 The FH runs from the lowest frame member on each side. The FH may be multiple pie
F.5.6.2.b Front view FH bends below the Upper SIS must meet a triangulated FBHS or SIS nod
F.5.6.2 All FH side view bends must meet a triangulated FBHS or SIS tube end.

BLANK

	F.5.7 Front Hoop (FH)	Minimum	Tube Used		EQ
F.3.2.1.c	Example: 25mm x 2.5mm round	Size A			BLANK
F.3.4.1.a	Wall thickness:	2		mm	BLANK
	Square side:	25		mm	BLANK
	Wall thickness:	2.0		mm	BLANK
	Square side:	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.5.7.4	Turned Steering Wheel minimum below FH top:		mm	BLANK

BLANK

F.5.7.5	FH to Steering Wheel gap <=250mm (9.8in)		mm	BLANK

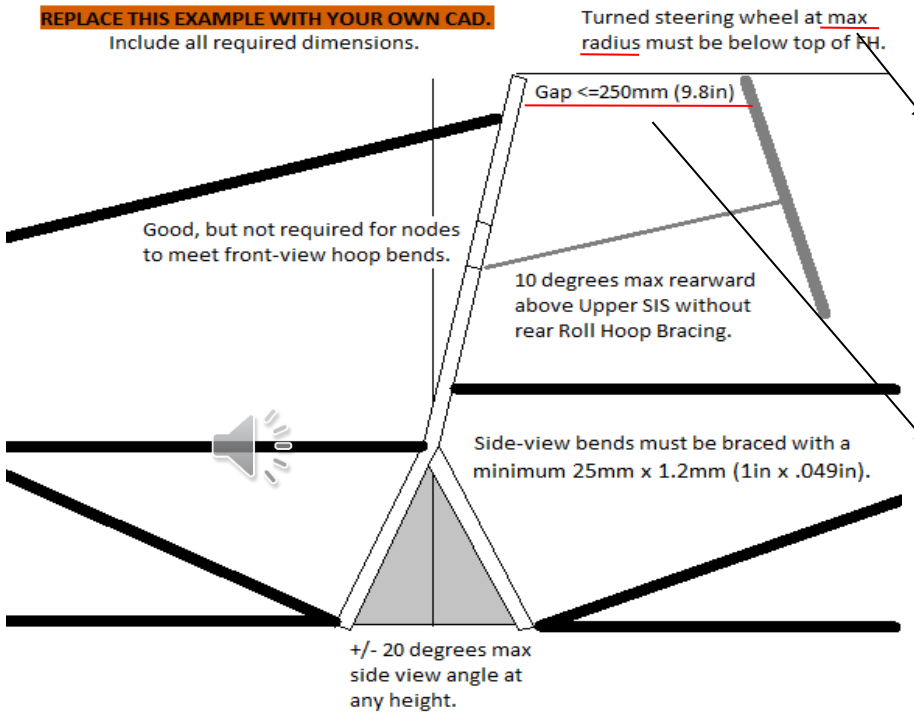
BLANK

F.5.7.6	FH side angle above Upper SIS <=20 degrees:		degrees	BLANK

BLANK

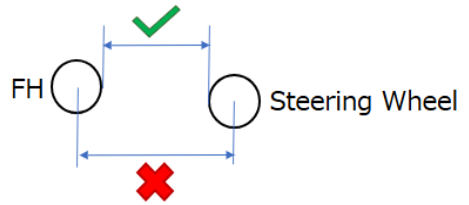
F.6.3.5	FH rearward lean above Upper SIS <= 10, or braced:		degrees	BLANK

Rearward Front Hoop Brace is not required.



Indicate the shape of the steering wheel. For steering wheels that are not perfectly round, measure by turning the steering wheel until the gap between the FH and the steering wheel in the height direction is the smallest.
ステアリングの形状を示すこと。また、真円ではないステアリングはFHとステアリングの高さ方向のギャップが最も小さくなる状態までハンドルを切った状態で測定すること

How to measure FH and Steering Wheel FH
FHとステアリングの測定方法

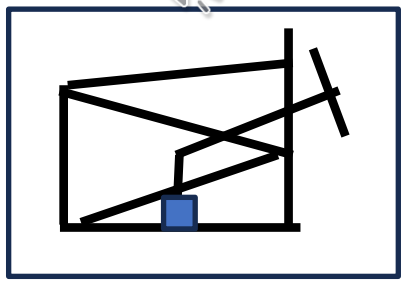


Do not measure the center distance
中心距離を測らないこと

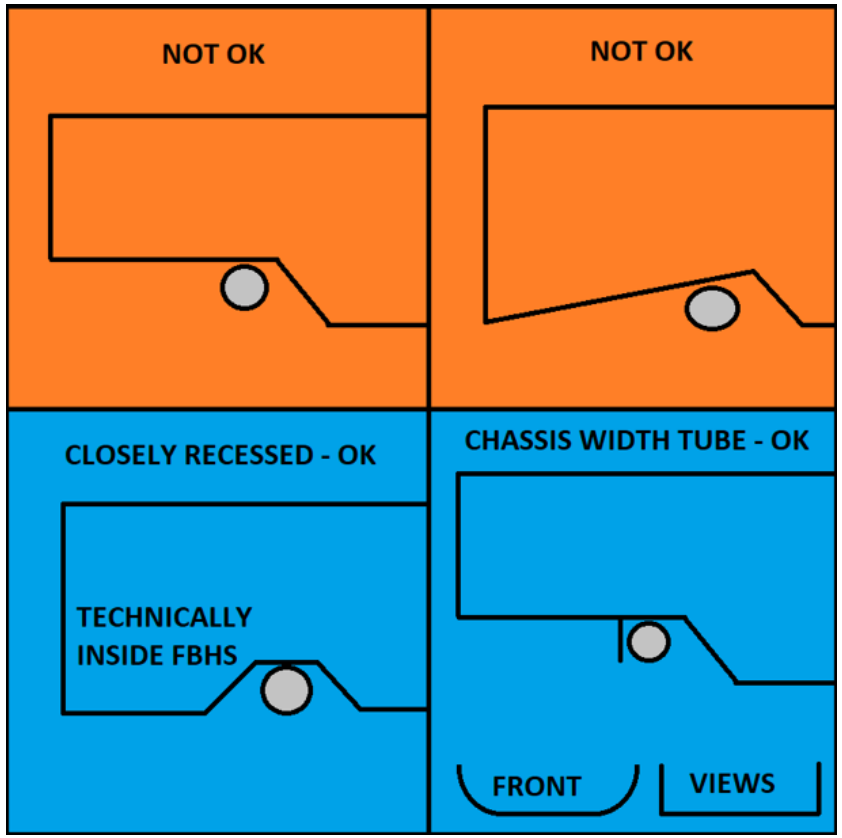
Be sure to attach illustrations that show the measurement positions and dimensions.
計測の位置や寸法の証明ができているかに注意して図示を添付すること

Steering Protection

	EQ			
F.5.14	Steering rack is inside the FBHS?	Below		EQ
	Additional steering protection required Belo	Inside		EQ
F.5.14	**Steering Protection**	Above	**ed**	EQ
F.3.2.1.n	Example: 25.4mm x 1.2mm round	Below		BLANK
F.3.4.1.c	Wall thickness:	1.2		BLANK
	Square side:	25	mm	BLANK
	Wall thickness:	1.2	mm	BLANK
	Square side:	25.0	mm	BLANK
	Tube cross sectional area (A):	91	mm^2	BLANK
	Tube second moment of inertia (I):	6695	mm^4	BLANK



Illustrated example

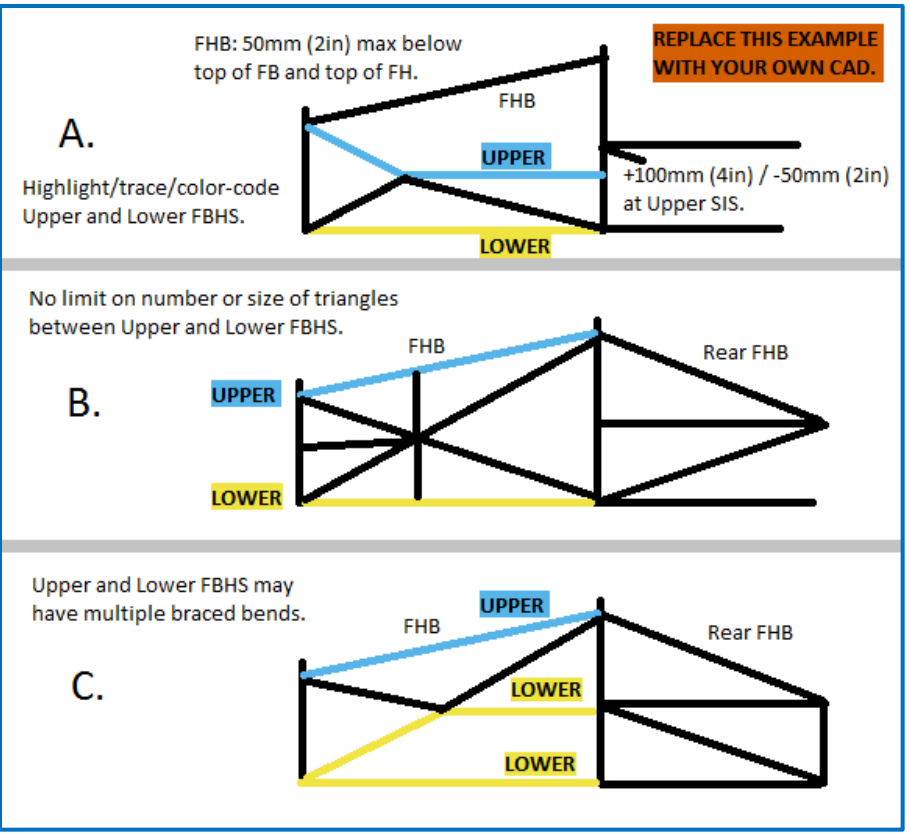


If the steering rack is located outside the primary structure, please attach a diagram and indicate the size of the Steering Protection Tube.

ステアリングラックがプライマリストラクチャーの外側にくる場合は、

ステアリング保護に使われるTubeのサイズ記入と図示を添付すること

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



A: The upper and lower parts of the FHB and FBHS are independent and connected to the SIS by a truss structure. If this is met, it is an A type.

A ： FHB と FBHSのUpperとLowerがそれぞれ独立しトラス構造でSISに繋がってる事。これを満たせばAタイプ

B: The upper part of the FBHS is shared with the FHB, so a rear FHB is required! Also, the entire structure from the FBH to the rear FHB must be a truss structure. If this is met, it is a B type.

B ： FBHSのUpperがFHBと共有していることてRear FHBが必要。
またFBHからRear FHBまでは全てトラス構造で有る事。これを満たせばBタイプ

C: The upper FBHS is shared with the FHB, so a Rear FHB is required, and it is connected to the MH and SIS upper nodes. Also, there must be two lower FBHS, one of which is connected to the upper SES. If these are met, it is a C type.

C ： FBHSのUpperがFHBと共有している事でRear FHBが必要かつMHとSIS Upperのノードに繋がってる事。
またFBHSのLowerが2本存在し、1本はSESのUpperに繋がってる事。これを満たせばCタイプ

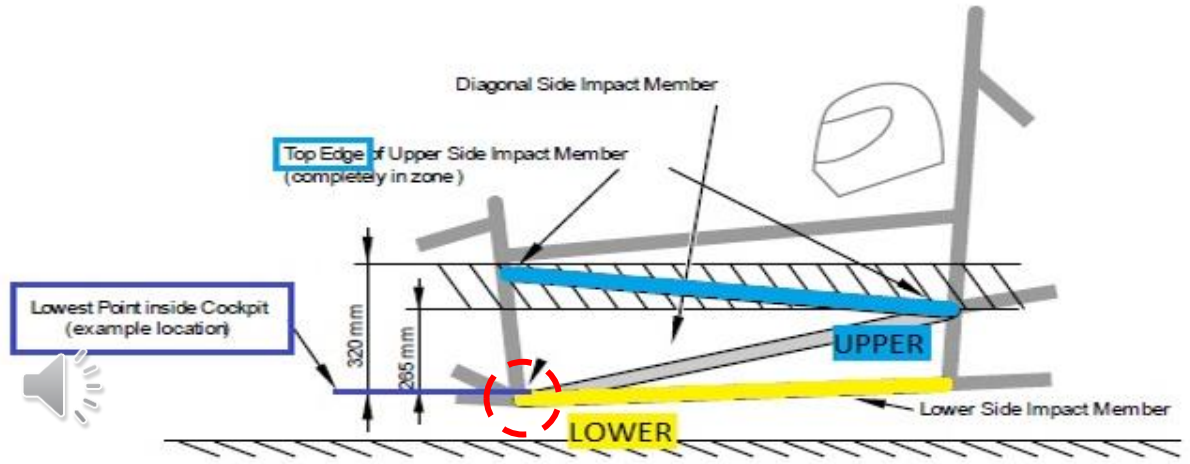
Choose A, B, or C that best suits your team's structure.

A, B, Cそれぞれから自チームの構造と合致するものを選択

Side Impact Structure(SIS)

			EQ			
F.6.4.4.b	F.6.4.1	**Upper Side Impact Structure (SIS)**		Straight		EQ
F.6.4.4.b			**Minimum**	**Tube Used**		EQ
	F.3.2.1.e	Example: 25.4mm x 1.6mm round	Size B	Round		EQ
	F.3.4.1.b	Wall thickness:	1.2	1.2	mm	EQ
		Outer Diameter (OD):	25	35	mm	EQ
		Wall thickness:	1.2	1.2	mm	EQ
		Outer Diameter (OD):	25.0	35.0	mm	EQ
		Tube cross sectional area (A):	114	127	mm^2	EQ
		Tube second moment of inertia (I):	8509	18220	mm^4	EQ
			BLANK			
		Top surface of Lower SIS to Lowest UpperSIS point >=240mm:			mm	BLANK
		Top surface of Lower SIS to Highest UpperSIS point <=320mm:			mm	BLANK
		Highest and lowest are on the top and bottom of the Upper SIS tube.		0	mm	BLANK
ructure.						
			BLANK			
	F.6.4.1	**Lower and Diagonal SIS**	**Minimum**	**Tube Used**		EQ
	F.3.2.1.e	Example: 25.4mm x 1.6mm round	Size B	Round		EQ
	F.3.4.1.b	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

T.2.4.2 **F.3.2.1.j** Lap and sub belts attachments must be located on minimum Size B tubes.



Measure from the top of the Lower Tube Surface
Lower Tube表面の上端から測定する

Be careful as it is easy to make mistakes when measuring points.
測定ポイントを間違えやすいので注意

Belt Attachment

Wrapping lap belts around tubes is not acceptable.
Double shear attachments are preferred, but only one side is measured.

	BLANK			
Lap Belt Attachment:	Lap Only			BLANK
T.2.4.3.a	Lap Only	Harness Test Load:	15000 N	EQ
T.2.5.8	Single Lap/AntiSub	MINOR diameter:	mm	BLANK
		Lap belt fastener rated UTS:	Pa	BLANK
		Fastener shear stregnth 0.577*UTS*A (N):	0 0.00%	REJECT
		Pad Eye/Tab to chassis:		BLANK
		Nut rated UTS:	mm	BLANK
		--Pullout-- Fastener threads engaged, depth:	mm	BLANK
		Thread pullout 0.577*pi*minor_dia*depth*Nut_UTS:	0 0.00%	REJECT

At least 2x 6mm critical fasteners, Welded Inserts, and external Positive Locking required.

	BLANK			
Anti-Submarining Belt Attachment:				BLANK
T.2.4.3.a	Wrapped			EQ
T.2.5.8	Eyebolt Or Bolt Through Tube	Anti-sub belt faster		BLANK
	Clip Through A Pad Eye	Anti-sub be		BLANK
	Bolt Through A Tab	Fastener shear stregr		EJECT
		Pad Eye/Tab to chassis:		BLANK
		Nut rated UTS:	mm	BLANK
		--Pullout-- Fastener threads engaged, depth:	mm	BLANK
		Thread pullout 0.577*pi*minor_dia*depth*Nut_UTS:	0 0.00%	REJECT

At least 2x 6mm critical fasteners. Welded Inserts. and external Positive Locking required.

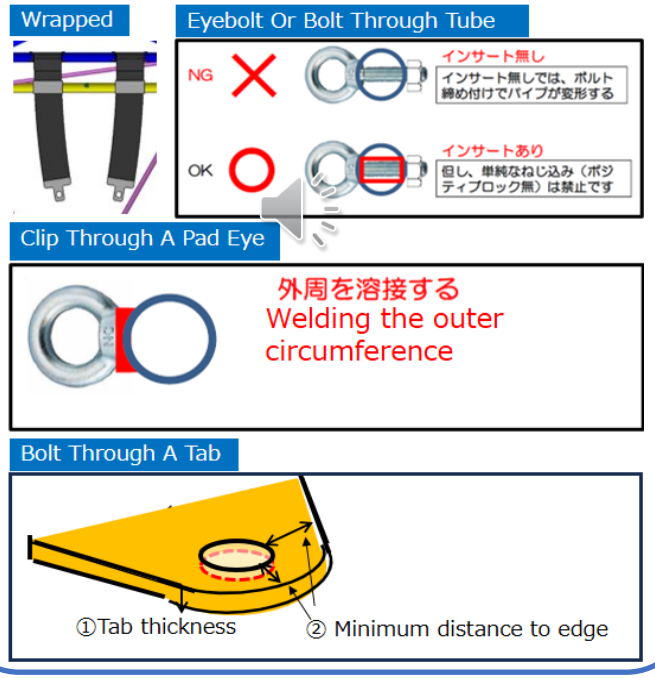
Wrapping shoulder harness belts around the SH bar is strongly preferred.

	BLANK			
Shoulder Harness Attachment:				BLANK
T.2.4.3.a		Harness Test Load:	15000 N	EQ
T.2.5.8		Shoulder belt fastener MINOR diameter:	mm	BLANK
		Shoulder belt fastener rated UTS:	Pa	BLANK
		Fastener shear stregnth 0.577*UTS*A (N):	0 0.00%	REJECT
		Pad Eye/Tab to chassis:		BLANK
		Nut rated UTS:	mm	BLANK
		--Pullout-- Fastener threads engaged, depth:	mm	BLANK
		Thread pullout 0.577*pi*minor_dia*depth*Nut_UTS:	0 0.00%	REJECT

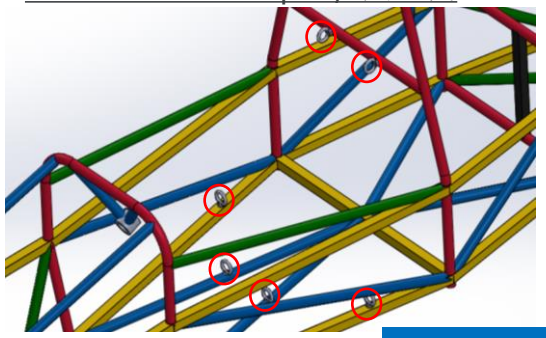
At least 2x 6mm critical fasteners, Welded Inserts, and external Positive Locking required.

Only the lap belt attachment requires you to choose whether to share the attachment with the anti-submarine belt.
ラップベルトアタッチメントだけはアンチサブマリンベルトとアタッチメントを共有するか選択する必要がある。

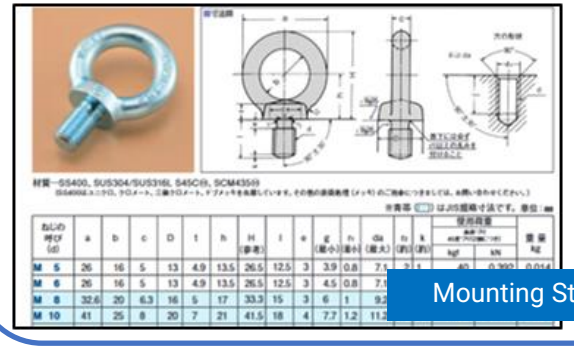
Belt attachment type
ベルトアタッチメントの種類



Illustrated example / 図示例



Mounting location

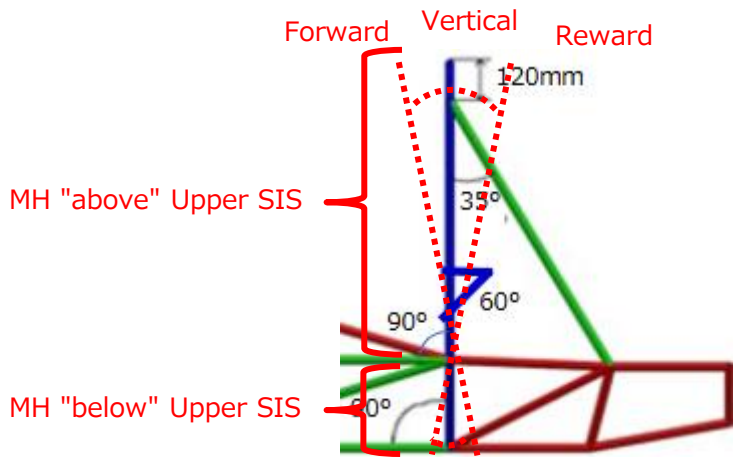


Mounting Structure

Not only the structure selection but also the dimensions and structure are illustrated
構造選択だけでなく、取り付け寸法、取り付け構造を図示で示すこと

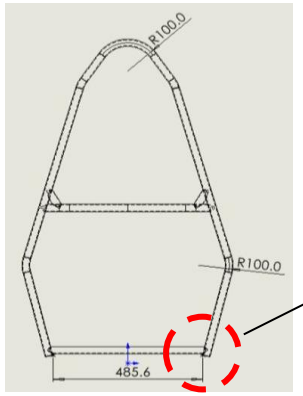
Main Hoop(MH), Shoulder Harness Bar(SH)

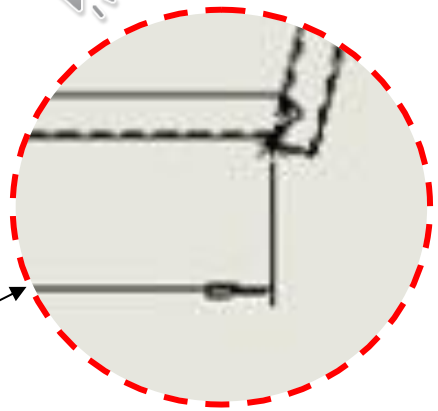
BLANK					
F.5.8.1	Main Hoop (MH)	Minimum	Tube Used		EQ
F.3.2.1.g	Example: 25mm x 2.5mm round	Size A	Round		EQ
F.3.4.1.a	Wall thickness:	2		mm	BLANK
	Outer Diameter (OD):	25		mm	BLANK
	Wall thickness:	2.0		mm	BLANK
	Outer Diameter (OD):	25.0		mm	BLANK
	Tube cross sectional area (A):	173		mm^2	BLANK
	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.k	Example: 25mm x 2.5mm round	Size A	Round		EQ
F.3.4.1.a	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					
F.6.5.2.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.l	Example: 25.4mm x 1.2mm round	Size C	Round		N/A
F.3.4.1.c	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.5.8.3.a	Main Hoop direction above Upper SIS, in side view:		Vertical		EQ
	in Hoop angle from vertical above Upper SIS, in side view, <=10:			degrees	BLANK
F.5.8.2	Main Hoop Braces may run forward or rearward.				
BLANK					
F.5.8.3.c	Main Hoop direction below Upper SIS, in side view:		Vertical		EQ
	Main Hoop side angle from vertical below Upper SIS:			degrees	BLANK
BLANK					
F.5.8.4	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:				



Be careful not to forget to select the MH tilt direction.
MHの傾斜方向の選択を忘れやすいので注意すること

How to measure the dimensions of the Main Hoop End





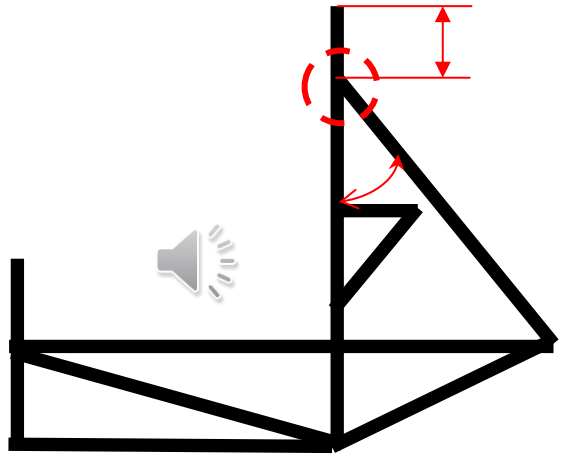
Measure the inside of the left and right tubes, not the center distance between the left and right tubes.
左右のTUBE中心間距離ではなく左右のTUBEの内側を測ること

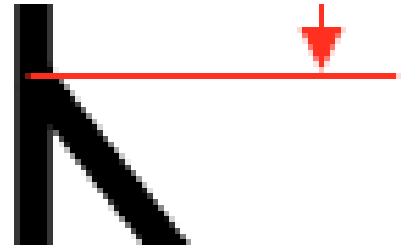
Show the structure of MH and SH using isometric drawings, side views, etc.
アイソメ図や側面視等を使って、MHやSHの構造と寸法を示すこと。

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

	Main Hoop Braces may run forward or rearward.			
	BLANK			
F.5.9.2	Main Hoop brace direction:	Rearward		EQ
F.5.9.5	Angle between MH and MHB >=30 degrees:		degrees	BLANK
	BLANK			
F.5.9.4	Top of MH of MHB tube, 160mm vertical limit:		mm	BLANK
	BLANK			
F.5.9.1	**Main Hoop Brace (MHB)**	**Minimum**	**Tube Used**	EQ
F.3.2.1.h	Example: 25.4mm x 1.6mm round	Size B	Round	EQ
F.3.4.1.b	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.i	Example: 25.4mm x 1.2mm round	Size C	Round	EQ
F.3.4.1.c	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

How to measure from MH top to MHB node



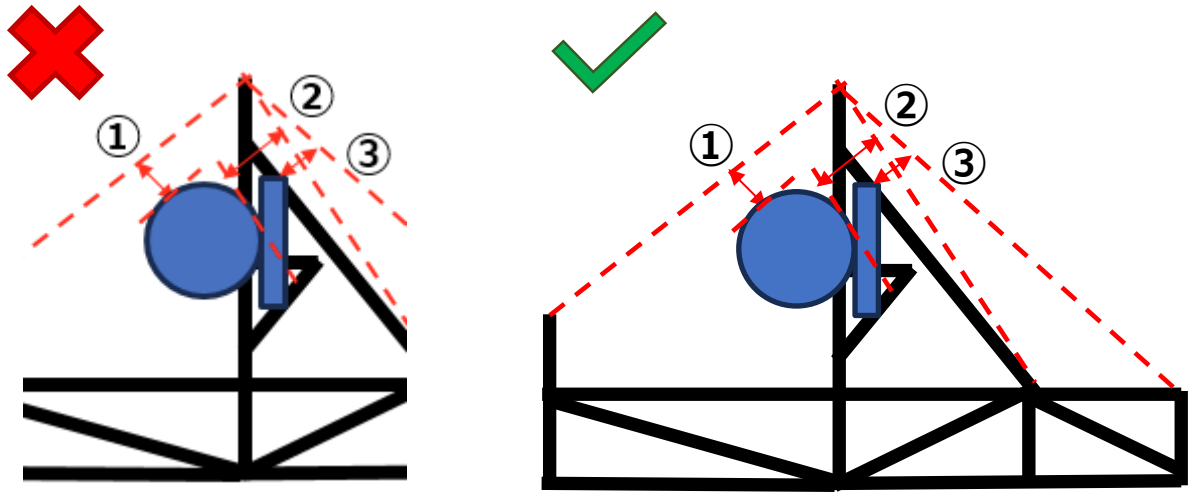


Measure from the top of the tube, not the center.
Tube中心ではなく、チューブの頂点から計測すること

Pay attention to the measurement points
測定ポイントに注意すること

Helmet & Head Restraint Clearance

	BLANK				
F.5.6.3.a	Helmet >=50mm (2in) below Roll Hoop plane:		mm	①	BLANK
	BLANK				
F.5.6.3.bc	Main Hoop Braces protecting Helmet:	Rearward		②	EQ
F.5.6.3.bc	Helmet >=50mm (2in) below MH to bottom of MHB:		mm	②	BLANK
	BLANK				
T.2.8.3	Head Restraint >=0 from rollover envelope:		mm	③	BLANK
F.5.10	**Head Restraint Protection Hoop Used?**				BLANK
F.3.2.1.h	Example: 25.4mm x 1.6mm round	Size B			N/A
F.3.4.1.b	Wall thickness:	1.2	mm		N/A
	Square side:	25	mm		N/A
	Wall thickness:	1.2	mm		N/A
	Square side:	25.0	mm		N/A
	Tube cross sectional area (A):	114	mm^2		N/A
	Tube second moment of inertia (I):	8509	mm^4		N/A

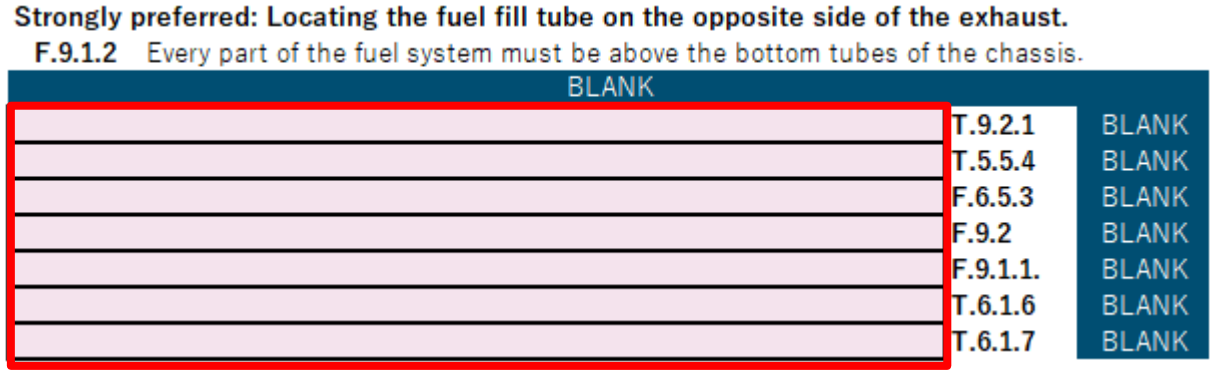


All measurement points should be shown in a diagram.
測定点がすべて見えるように図示で示すこと

Please note that the measurement points on the helmet and headrest will vary depending on the structure.

構造によってヘルメットとヘッドレストの測定箇所が変わるので注意すること

Fuel System (IC)　etc.



Make sure all items are set to "EQ".
全ての項目が「EQ」となるように記入すること

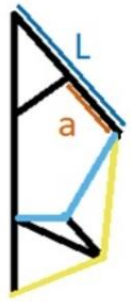
- Select EQ for all items. There is no need to select items marked "N/A" for EV.
- It is assumed that the design of fuel tanks and high-pressure gas cylinders is not complete at the time of creating the SES, so **these questionnaire items are not subject to review in the SES.**

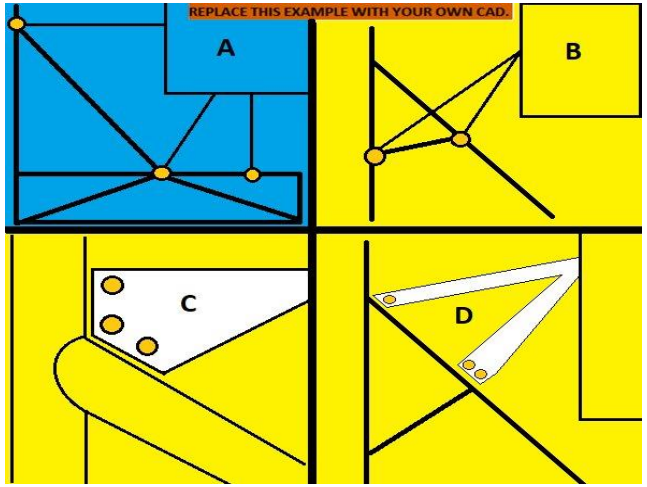
・すべての項目に対して、EQとなるように選択すること。EVで“N/A”の項目は選択不要。
・SES作成時点では燃料タンクや高圧ガスシリンダの設計は未完了と想定し、 **これらの問診項目は、SESでは審査対象外とする。**

Rear Wing Mount

	BLANK				
F.5.11	Rear Wing chassis mounting locations:				BLANK
	Number of fasteners per chassis mount fo	No rear wing.			N/A
F.5.11.2.b	**Wing Mount Braces**	Wing not mounted to MHB or MH.			N/A
F.3.2.1.o	Example: 25.4mm x 1.2mm round	Wing mounted to MHB nodes.			N/A
F.3.4.1.c	Wall thickness:	Mounted on MHB with Brace.			N/A
	Square side:				N/A
	Wall thickness:	1.2	mm		N/A
	Square side:	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.5.11.2.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):	25.4	mm		N/A
	Main Hoop Brace second moment of inertia (I):	8509	mm^4		N/A
	Main Hoop Brace Length (Main Hoop to MHBS) (L):		mm		N/A
	Braced Wing Mount distance to closest MHB end (a):		mm		N/A
	MHB Max Bending Load (Sy*L*I)/(a*(L-a)*OD/2):		N		N/A
	Rear Wing Mount Limit:				N/A
			N		N/A
					N/A
		0.00			N/A

Please enter the dimensions shown in the red box.
赤枠内は右記の寸法を記入すること





F.5.11 Approaches to wing detachment.

A **STRONGLY PREFERRED**
Single fastener at each node, rotationally free.
No failure force required.
Mounts rearward of the MHB assembly are completely unrestricted

B **NOT RECOMMENEDED - ILLEGAL IN AUSTRALIA**
Mounts in the middle of the MHB or MH require a brace between the two.
All fasteners or mounts on a side must fail simultaneously below the MHB buckling force.

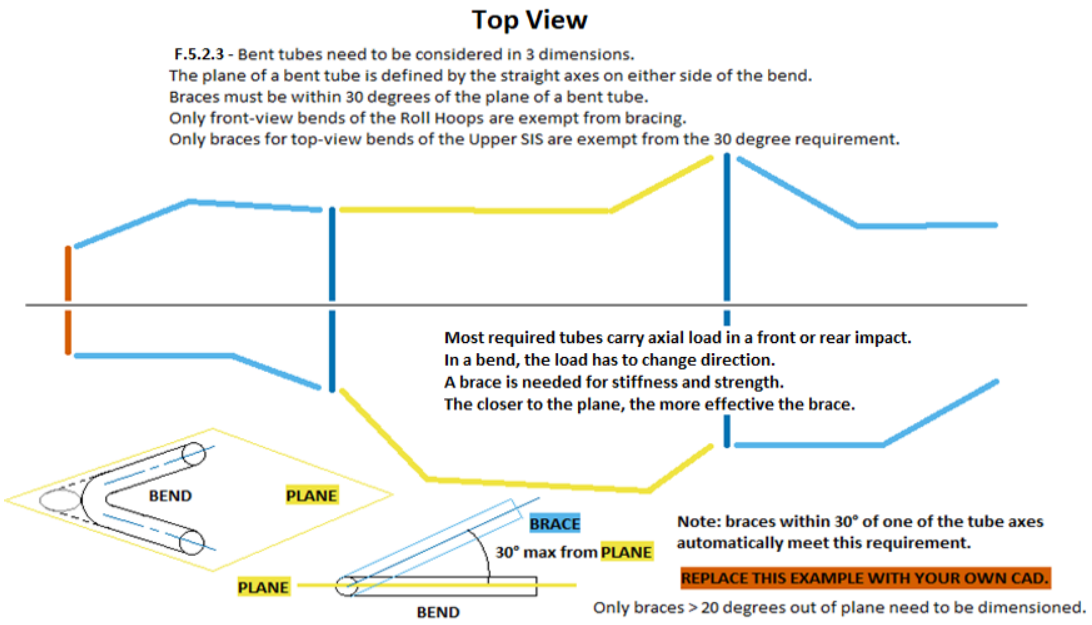
C **NOT RECOMMENEDED - GUSSET MAY BE REQUIRED**
Multiple fasteners within 1x outer diameter of the node.
All but one fastener must fail simultaneously below the MHB buckling force.

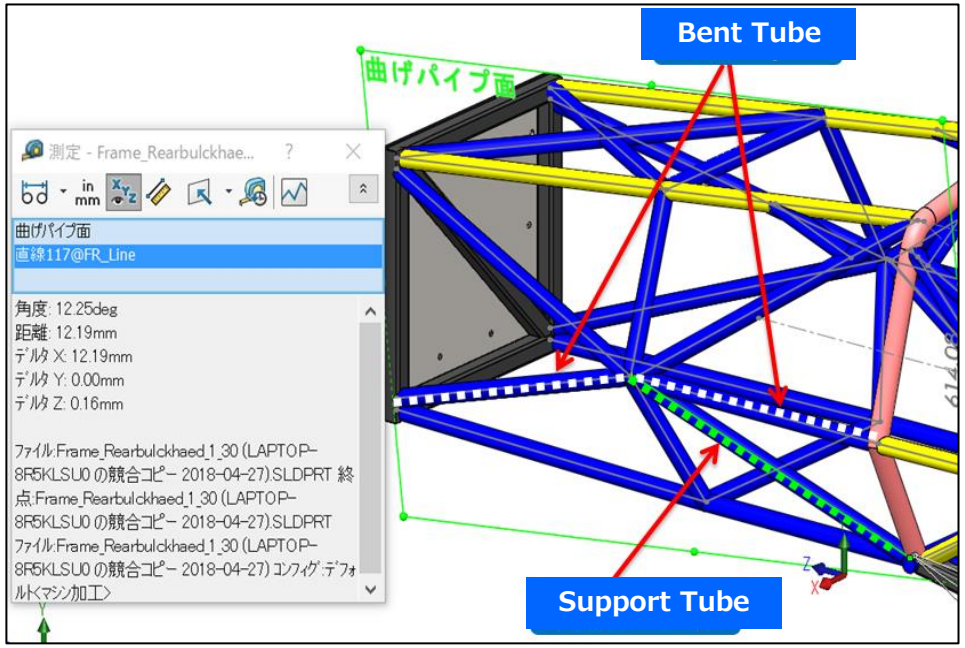
D **NOT RECOMMENEDED - ILLEGAL IN AUSTRALIA**
Multiple fasteners along the MHB.
Brace required between MH and MHB at rearmost fastener.
All fasteners not located at the MH-MHB node must fail simultaneously below the MHB buckling

A is strongly recommended, but if any other structure is used, proof that the fastener will break before the MHB buckles is required.
Aを強く推奨しますが、その他の構造を採用する場合はMHBが座屈する前にファスナーが破断することの証明を要求します。

The position of the Rear Wing Mounting must be clearly indicated with a diagram as shown in the reference diagram.
参考図のようにマウントの位置を明確に図で示すこと

Bent Tube

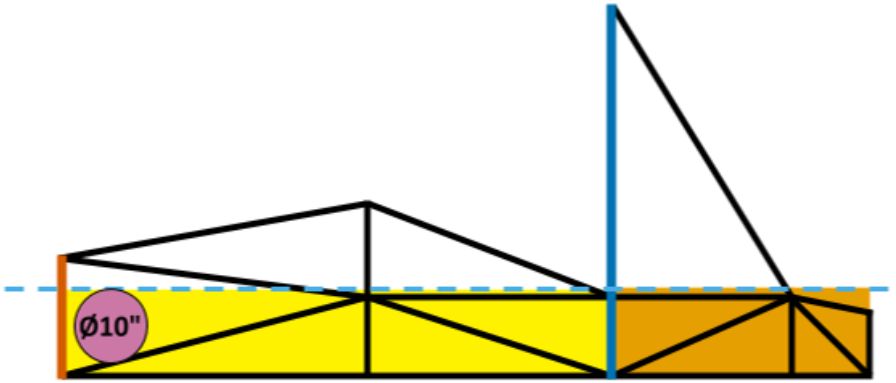




Illustrated example / 図示例

When using bent pipes, support pipes are required. The relative positions of the bent pipes and support pipes must be illustrated as shown in the Illustrated example so that the angle between the surface of the bent pipe and the support pipe is 30 degrees or less.
曲げパイプを使用する場合は、サポートパイプが必要。曲げパイプがなす面とサポートパイプの角度が30度以下であることを、参考図のように曲げパイプとサポートパイプの位置関係を図示すること。

Impactor Check

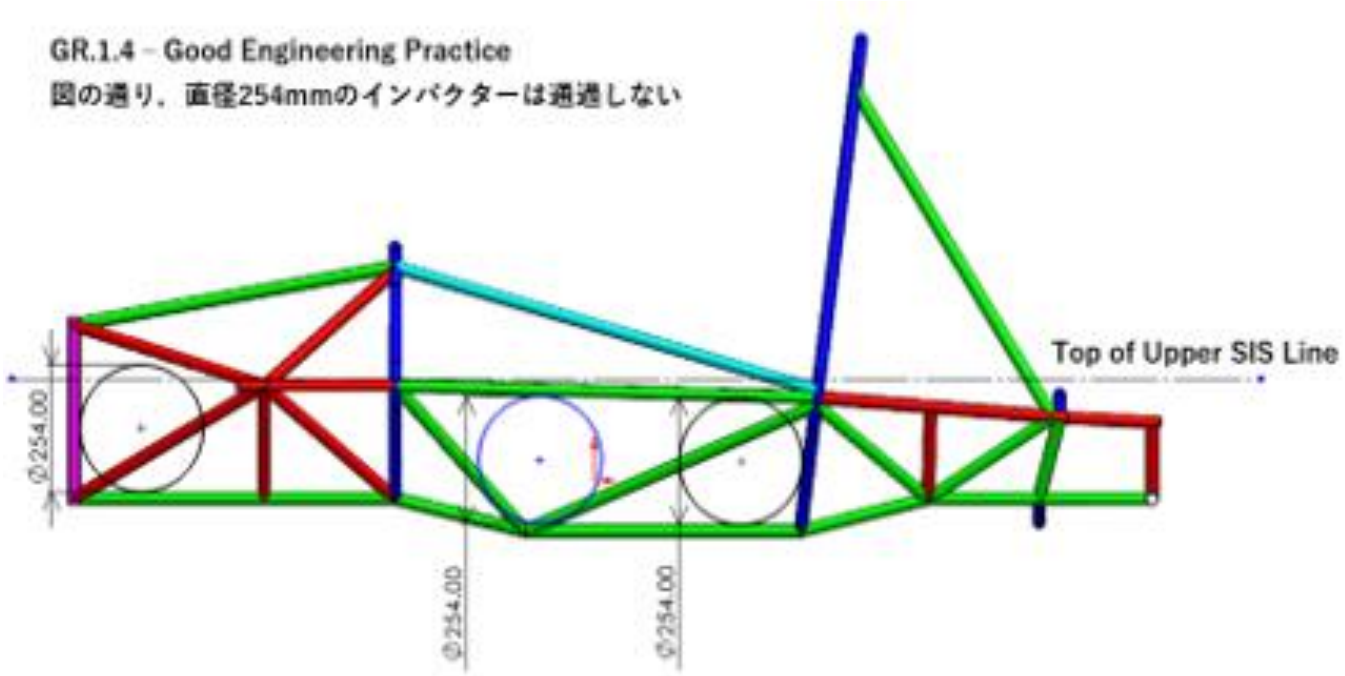


No openings in the region below upper SIS height between the front bulkhead and main roll hoop, or between any tubes used for Fuel, HV, or component protection may allow a 254mm (10in) diameter impactor to pass through.

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.

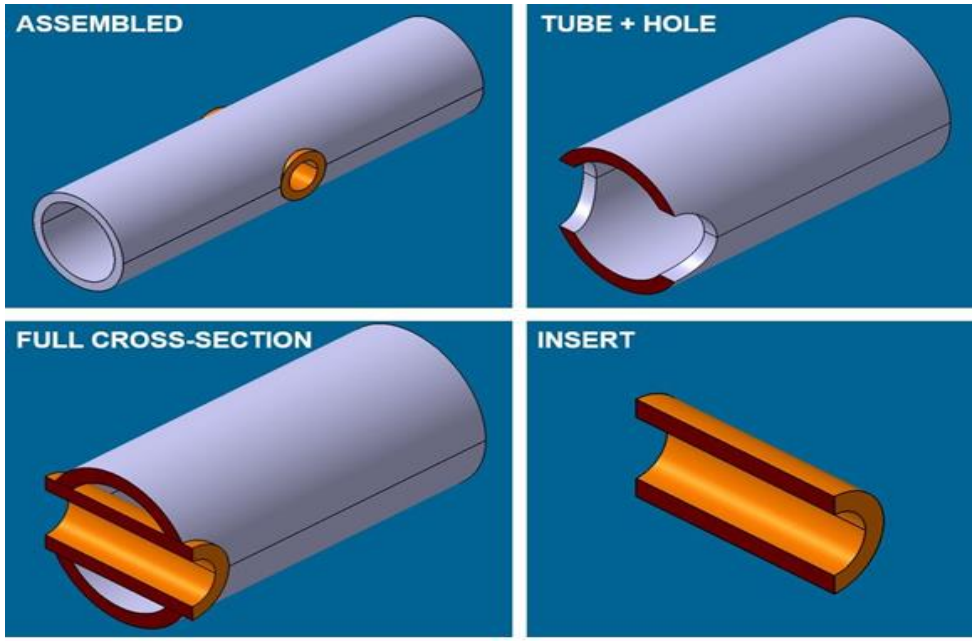


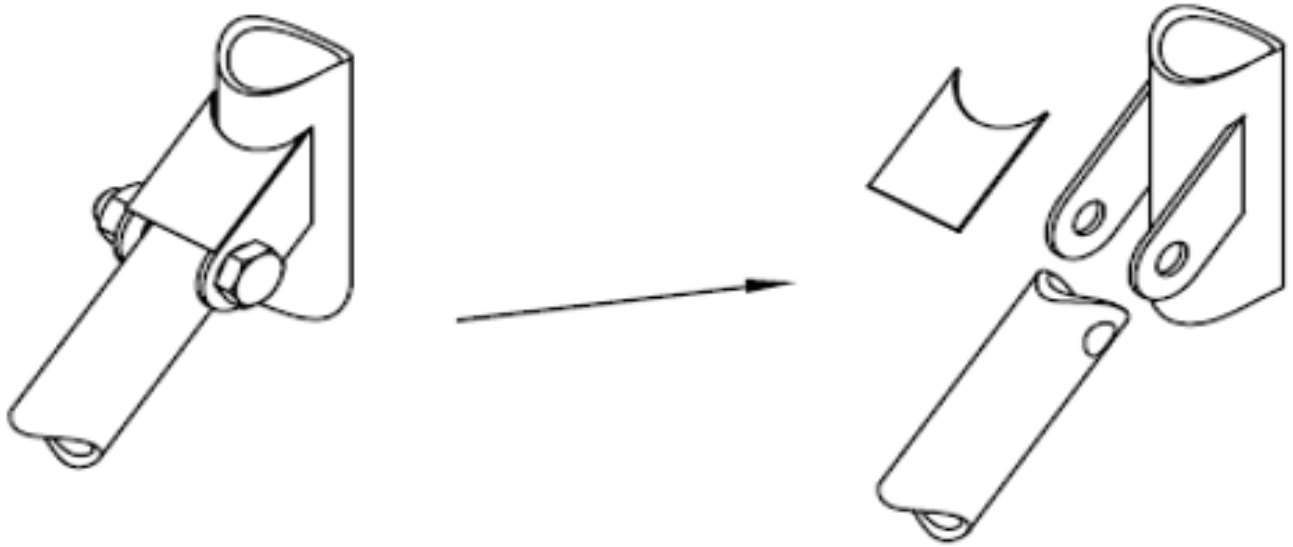
As shown in the reference diagram, the frame opening must not exceed 254 mm (10 inches).
参考図のようにフレームの開口が254mm(10inch)を超えないことを図示すること

SES Guidance
(Structural Equivalency Spreadsheet)
(等価構造計算書)

F.3.4.3　Welded Inserts

F.5.12　Bolted members





Welded Insert

Note: Young's Modulus is given in MPa, not Gpa.

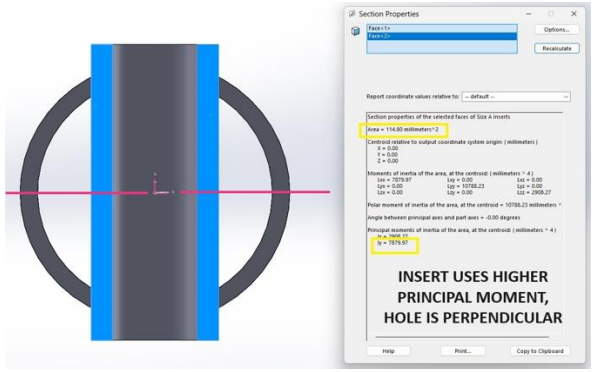
			Minimum F.3.2.1 Tube	Tube With Hole + Insert		
		Material:	Steel	Steel		EQ
		Original tube:	Size A	Round		EQ
F.3.4.1		Wall thickness:	2		mm	BLANK
		Outer Diameter:	25		mm	BLANK
		Tube cross sectional area (A_1):	1.73E+02	-	mm^2	EQ
		Tube second moment of inertia (I_1):	1.13E+04	-	mm^4	EQ
F.3.4.3		Tube with Hole cross sectional area (A_3):			mm^2	BLANK
		Tube with Hole second moment of inertia (I_3):			mm^4	BLANK
		Insert/Collar cross sectional area (A_2):			mm^2	BLANK
		Insert/Collar second moment of inertia (I_2):			mm^4	BLANK
F.3.4.2	F.3.5.3	Young's Modulus (E):	2.00E+11	2.00E+11	Pa	EQ
		Unwelded Yield Strength (Sy):	3.05E+08	3.05E+08	Pa	EQ
		Unwelded Ultimate Strength (Su):	3.65E+08	3.65E+08	Pa	EQ
		Welded Yield Strength (Sy):	N/A	1.80E+08	Pa	EQ
		Welded Ultimate Strength (Su):	N/A	3.00E+08	Pa	EQ
Buckling Modulus		E_1*I_1 <= E_2*I_2 + E_1*I_3:				BLANK
Yield		Sy_1*A_1 <= Sy_2*A_2 + Sy_1*A_3:				BLANK
Ultimate		Su_1*A_1 <= Su_2*A_2 + Su_1*A_3:				BLANK
Bending		I*Su_1*I_1/r <= 4*(Su_2*I_2+Su_1*I_3)/r:				BLANK
Deflection		Bending_1/(48*EI):				BLANK
Energy		0.5*Bending^2/(48*EI):				BLANK

Tube with Hole cross section
穴あけパイプ断面

Tube with Hole second moment of inertia
穴あけパイプ断面2次モーメント

Insert/Collar Cross Section Area
インサートパイプ断面積

Insert/Collar second moment of inertia
インサートパイプ断面2次モーメント



Note：Drilled tubes and insert pipes have different strengths that are applied in the calculation.

穴があけられたパイプとインサートでは、計算に適応される強度が変わるので注意

Enter the total moment of inertia of the drilling tube and the insert tube, and the smaller value in either the X or Y direction.
穴あけされたパイプとインサートの合計の断面二次モーメントかつX方向とY方向いずれかの小さい値を記入すること。

Bolted Members

REPLACE THIS EXAMPLE WITH YOUR OWN CAD

Figure – Double Lug Joint

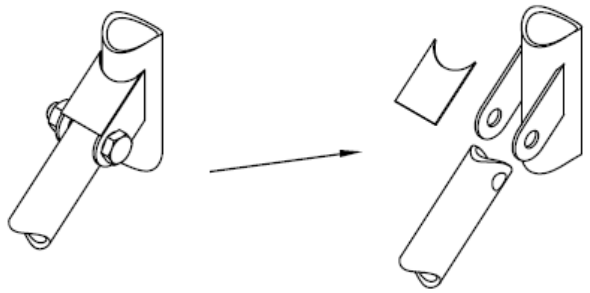
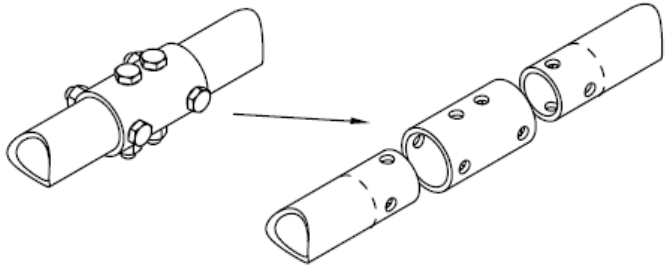


Figure – Sleeved Butt Joint



REPLACE THIS EXAMPLE WITH YOUR OWN CAD

Figure – Double Lug Joint

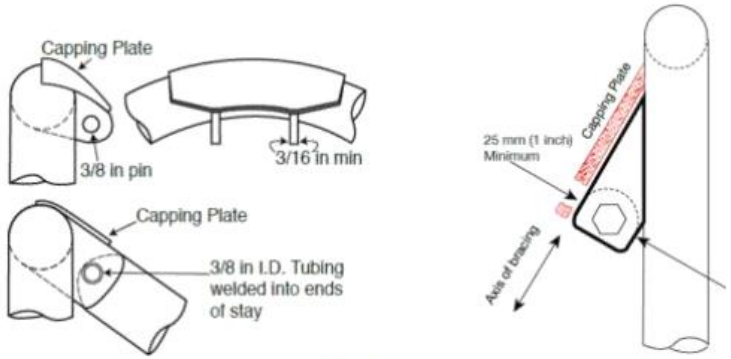
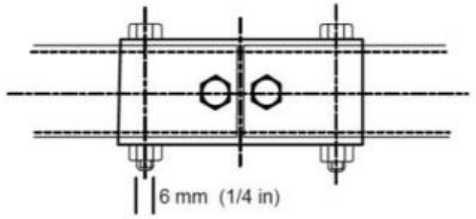


Figure – Sleeved Butt Joint



When connecting the Main Hoop Brace with a bolt, follow the legend above to prove that the rigidity is equal to or greater than that of a single tube.
Main Hoop Brace を Bolt 接続する場合、上記の凡例に従い、
一本のパイプと同等以上の剛性が保たれていることを証明すること。