Deutsches Institut für Bautechnik

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European Technical Assessment Body for construction products

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European Technical Assessment ETA-22/0404 of 11 October 2024

English translation prepared by DIBt - Original version in German language

General Part

Technical Assessment Body issuing the European Technical Assessment:	Deutsches Institut für Bautechnik
Trade name of the construction product	Laqnican Joint
Product family to which the construction product belongs	Connectors for tubular sections
Manufacturer	Kubota Corporation Steel pipe planning division 1-3, Kyobashi 2 -Chrome, Chuo-ku TOKYO, 104-8307 JAPAN
Manufacturing plant	Kubota Ichikawa manufacturing plant
This European Technical Assessment contains	27 pages including 23 annexes which form an integral part of this assessment
This European Technical Assessment is issued in accordance with Regulation (EU) No 305/2011, on the basis of	EAD 200345-00-0103

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Specific part

1 Technical description of the product

The product are connectors for tubular sections to connect steel pipes to transfer static loads (in the following referred to as connectors). The connectors are uncoated or treated with an inorganic coating, but not with an organic coating.

The connectors consist of 2 steel parts (referred to as the "box joint" and "pin joint"), which are welded onto pipe sections and inserted into each other. The mechanical connection of the welded-on steel parts is mechanically connected with bolts and ring-shaped steel pins (known as “load transfer key") and steel blocks (referred to as ‘rotation suppression key’).

The components and the system setup of the product are given in Annex A1.

2 Specification of the intended use in accordance with the applicable European Assessment Document

The intended use of the connectors is to connect two tubular sections to each other to transfer static and quasi-static loads. The loads can comprise, e.g., compression forces (in longitudinal direction), tension forces (in longitudinal direction), shear forces, bending moments and torsional moments.

The intended use comprises connected tubular sections that are designed following EN 1993-1-1 and EN 1993-1-6.

The performances given in Section 3 are only valid if the connectors for tubular sections are used in compliance with the specifications and conditions given in Annex A1 to A5.

The verifications and assessment methods on which this European Technical Assessment is based lead to the assumption of a working life of the connectors for tubular sections of at least 100 years. The indications given on the working life cannot be interpreted as a guarantee given by the producer, but are to be regarded only as a means for choosing the right products in relation to the expected economically reasonable working life of the works.

3 Performance of the product and references to the methods used for its assessment

3.1 Mechanical resistance and stability (BWR 1)

Essential characteristic	Performance
Carbon equivalent (weldability) of steel component 1 and steel component 2, CEV [-]	See Annex A3
Charpy impact strength with v-notch of steel component 1 and steel component 2, $\overline{KV}$ [J; °C]	See Annex A4
Yield strength, tensile strength, elongation at fracture of steel component 1 and steel component 2, $R_{p0.2}$ [N/mm²], R_m [N/mm²], A_{gt} [%]	See Annex A3
Tension resistance of the joint, $F_{T,Rk}$ [kN]	NPA
Compression resistance of the joint, $F_{C,Rk}$ [kN]	NPA
Shear resistance of the joint, V_{Rk} [kN]	See Annex B1 to B18
Bending resistance of the joint, M_{Rk} [kNm]	See Annex B1 to B18
Torsional resistance of the joint, $M_{T,Rk}$ [kNm]	See Annex B1 to B18
Resistance for combined acting shear forces and bending moments (interaction), $M_{R,i,k}$ [kNm], $V_{R,i,k}$ [kN]	See Annex A4 and B1 to B18

3.2 Safety in case of fire (BWR 2)

Essential characteristic	Performance
Reaction to fire	Class A1 according to EN 13501-1:2007+A1:2009

4 Assessment and verification of constancy of performance (AVCP) system applied, with reference to its legal base

In accordance with EAD No. 200345-00-0103, the applicable European legal act is: Commission Decision 98/214/EC, as amended by 2001/596/EC.

The system to be applied is: 2+

5 Technical details necessary for the implementation of the AVCP system, as provided for in the applicable EAD

Technical details necessary for the implementation of the AVCP system are laid down in the control plan deposited with Deutsches Institut für Bautechnik.

Issued in Berlin on 11 Ocotber 2024 by Deutsches Institut für Bautechnik

Dr.-Ing. Ronald Schwuchow
Head of Section

beglaubigt:
Bertram

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General description of the joint

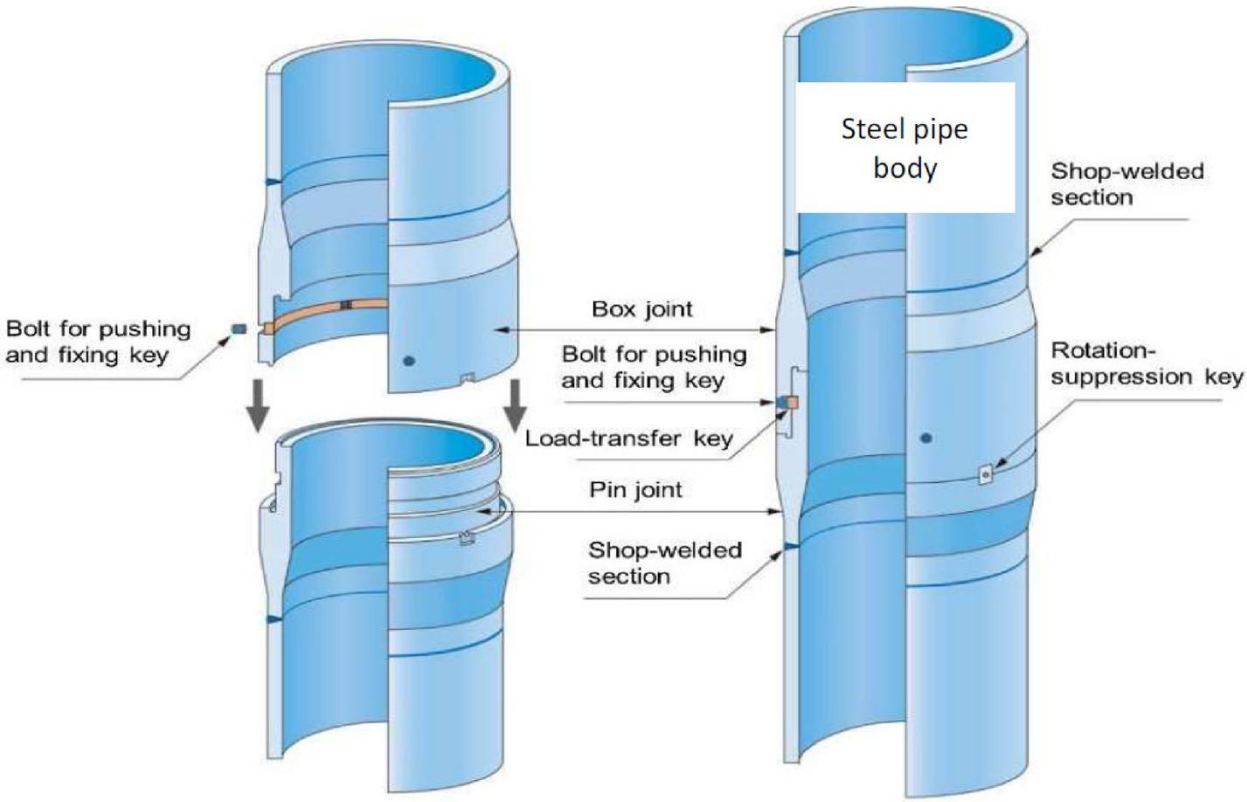

Figure 1: Joints

The joints can be used for joints with tubular steel sections (CHS) with outside diameter from Ø406 mm up to Ø1219 mm. The thickness of the CHS varies from 9,0 mm to 29,0 mm. For the range of possible tubular sections see Annex 5. In total 18 different joint-types are available. Annex 7 summarizes the decisive dimensions of the joints. The geometry of each type is shown in the Annexes. Details and tolerances are deposited with DIBt.

Laqnican Joint	**Annex A1**
General description	

Assembly instructions and description of the functionality of the joint

The installation is only carried out according to the manufacturer's instructions.
To assembly the joint, first both tubular sections of the connection are plugged together. To enable load transmission between both components a radial load transfer key is pushed into prepared grooves. The key is pushed and hold in place by a bolt. All tension forces are transmitted by this key.

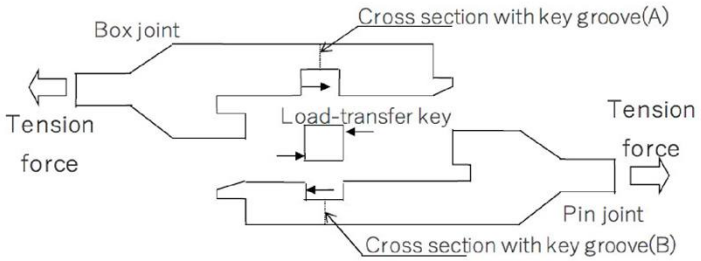

Figure 2: Transmission of tension forces

The compression forces are transmitted by contact between both joint sections.

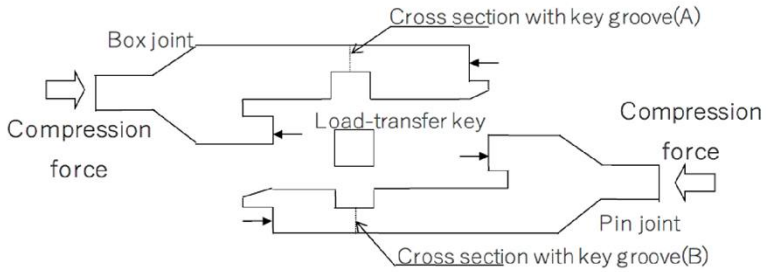

Figure 3: Transmission of compression forces

Shear forces are transmitted by the direct contact of both joint sections. The load transfer key has no influence on the shear load bearing capacity of the connection.

As both tubular sections are plugged together, the principle of the shear load transmission is different compared to a continuous tubular section.

To transmit torsional moments additional rotation-suppression keys are inserted. In dependence of the acting torsional forces up to 24 pieces of the rotation-suppression keys are used. The keys are evenly distributed around the circumference of the joint.

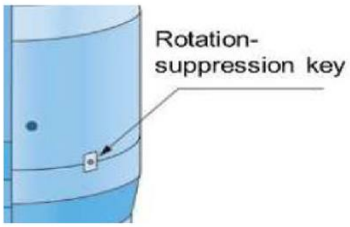

Figure 4: Rotation suppression key

Laqnican Joint	**Annex A2**
Assembly instructions and description of the functionality	

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Material properties of the joints

The tubular sections to be connected to each other are made of steel according to EN 10025-1:2005.

The joints are made of SFCM 880R or POSTEN 780.

The following Table 1 shows the nominal chemical composition of the joints

Material		C	Si	Mn	P	S	Cr	Ni	B	Cu	Mo	Nb	Ti	V
		(%)	(%)	(%)	(%)	(%)	(%)	(%)	(ppm)	(%)	(%)	(%)	(%)	(%)
POSTEN780	MAX	0,16	0,35	1,20	0,03	0,03	0,80	-	-	-	-	-	-	-
	MIN	-	0,15	-	-	-	0,40	-	-	-	-	-	-	-
SFCM880R	MAX	0,28	0,35	0,85	0,03	0,03	1,50	-	-	-	0,30	-	-	-
	MIN	-	0,15	0,30	-	-	0,90	-	-	-	0,15	-	-	-

Table 1: Chemical composition of the base material of the joints (ladle analysis, mass-percentage)

The following Table 2 shows the mechanical properties of the joints.

Material	Yield strength $R_{p0,2}$ [N/mm²]	Tensile strength R_m [N/mm²]	Elongation at fracture A [%]	CEV (acc. EN 10025-1) [-]
POSTEN780	≥ 705	800 - 1030	≥ 16	≤ 0,52
SFCM880R	≥ 705	880 - 1030	≥ 13	≤ 0,78

Table 2: Material properties of the base material of the joints

The charpy impact resistance (v-notch) is $\overline{KV}$ ≥ 27 J -20 °C.

For welding (connection between the joint and the tubular section), the regulations of EN 1090-2 apply. This includes documentation (material certificates), executors' qualification, qualified WPS, selection of preheat temperatures and selection of filler metal.

The manufacturer of the weld must be qualified according to EXC 3.

Laqnican Joint	**Annex A3**
Essential characteristics Material properties of the joint	

Material properties of the rotation suppression key and load transfer key

The rotation suppression key and load transfer key are made of SFCM980S.

The following Table 3 shows the nominal chemical composition of the rotation suppression key and load transfer key

Material		C	Si	Mn	P	S	Cr	Ni	B	Cu	Mo	Nb	Ti	V
		(%)	(%)	(%)	(%)	(%)	(%)	(%)	(ppm)	(%)	(%)	(%)	(%)	(%)
SFCM980S	MAX	0,48	0,35	0,85	0,03	0,03	1,50				0,30			
	MIN		0,15	0,30			0,90				0,15			

Table 3: Chemical composition of rotation suppression key and load transfer key

Component	Material	Yield strength $R_{p0,2}$ [N/mm²]	Tensile strength R_m [N/mm²]	Elongation at fracture A [%]
Rotation suppression key	SFCM980S	min. 755	980 - 1130	≥ 11
Load transfer key				

Table 4: Material properties of rotation suppression key and load transfer key

The charpy impact resistance (v-notch) is $\overline{KV}$ ≥ 27 J -20 °C.

Combined acting shear forces and bending moments

For combined acting shear forces and bending moments, linear interaction values can be determined based on the values $M_{R,i,k}$ and $V_{R,i,k.}$ stated the annexes and the following figure 5.

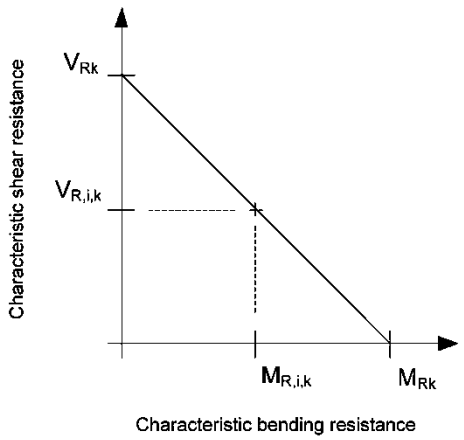


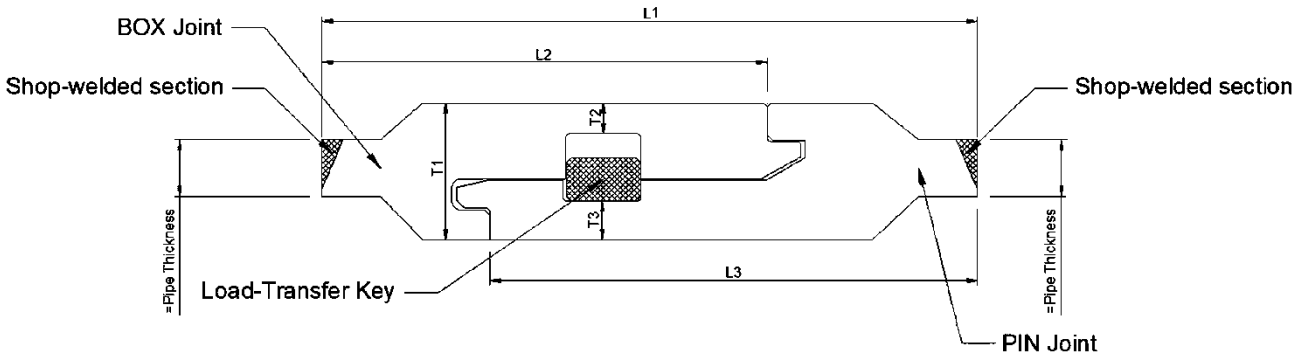
Figure 5: Linear interaction for combined acting shear forces and bending moments

Laqnican Joint	**Annex A4**
Essential characteristics Material properties of the rotation suppression key and load transfer key	

Summary of joints

The following table summarizes the joints assessed within this ETA.

Figure 6: Shape of the mechanical joint



Type	Outer Diameter [mm]	Thickness T1 [mm]	Thickness T2 [mm]	Thickness T3 [mm]	L1 [mm]	L2 [mm]	L3 [mm]
1	406,4	33,55	7,5	9,5	156	106	116
2	406,4	38,65	9,5	12,6	156	106	116
3	508	33,15	7,5	9,1	156	106	116
4	508	38,05	9,5	12	156	106	116
5	609,6	32,75	7,5	8,7	156	106	116
6	609,6	37,65	9,5	11,6	156	106	116
7	711,2	32,65	7,5	8,6	162	112	122
8	711,2	40,65	11,1	13	162	112	122
9	812,8	32,45	7,5	8,4	162	112	122
10	812.8	40,45	11,1	12,8	162	112	122
11	914,4	32,35	7,5	8,3	166	116	126
12	914,4	40,25	11,1	12,6	187	137	147
13	1016	32,35	7,5	8,3	166	116	126
14	1016	40,05	11,1	12,4	187	137	147
15	1117,6	32,35	7,5	8,3	177	127	137
16	1117,6	40,05	11,1	12,4	222	172	182
17	1219,2	32,25	7,5	8,2	177	127	137
18	1219,2	39,95	11,1	12,3	222	172	182

Table 5: Variation of joints

Laqnican Joint	**Annex A5**
Variations of joints	

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Essential characteristics – Joint Type 1

Figure 7: Dimensions

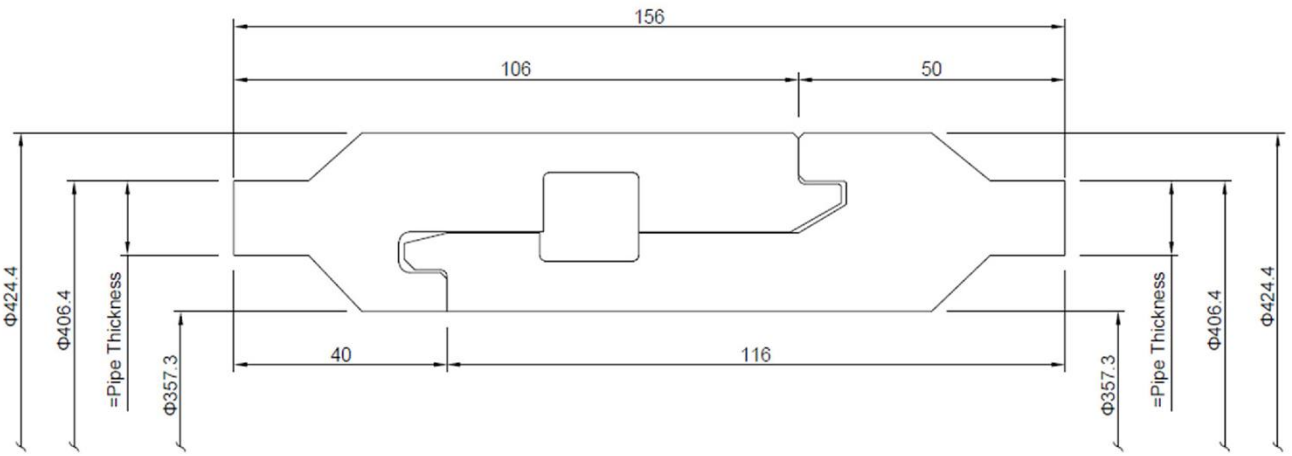

Table 6: Characteristic values of load bearing capacity

Characteristic values for joint Type 1				
Characteristic	Number of rotation keys			
	2	4	6	8
V_{Rk} [kN]	2418,0			
M_{Rk} [kNm]	733,0			
$M_{T,Rk}$ [kNm]	66,0	132,0	199,0	265,0
For interaction				
$V_{R,i,k}$ [kN]	1411,0			
$M_{R,i,k}$ [kNm]	309,0			

For combined acting shear forces and bending moments, linear interaction values can be determined using $M_{R,i,k}$ and $V_{R,i,k}$ based on figure 5 in annex A4.

Laqnican Joint	**Annex B1**
Essential characteristics - Joint Type 1	

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Essential characteristics – Joint Type 2

Figure 8: Dimensions

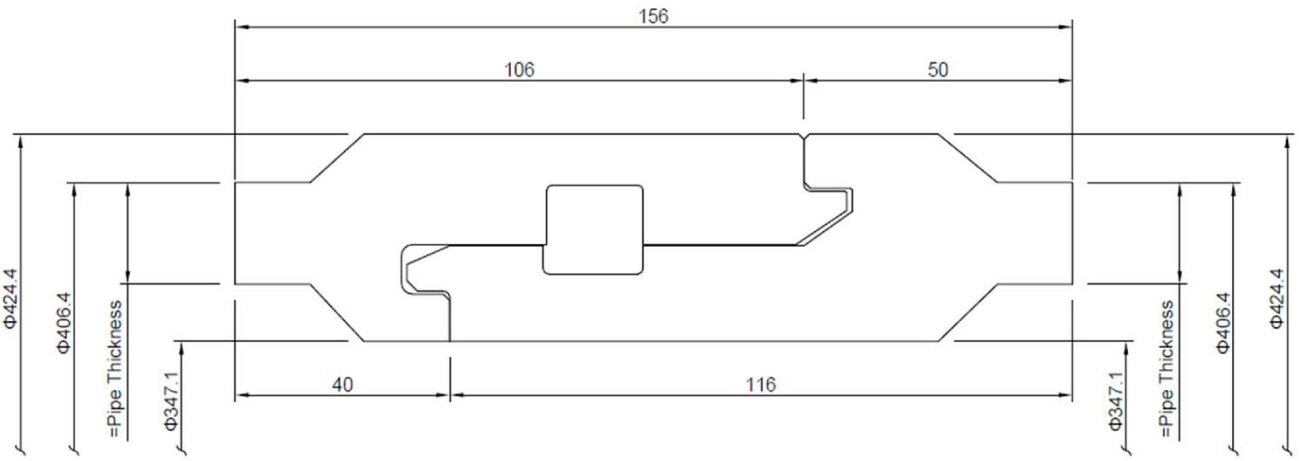

Table 7: Characteristic values of load bearing capacity

Characteristic values for joint Type 2				
Characteristic	Number of rotation keys			
	2	4	6	8
V_{Rk} [kN]	2550,0			
M_{Rk} [kNm]	781,0			
$M_{T,Rk}$ [kNm]	66,0	132,0	199,0	265,0
For interaction				
$V_{R,i,k}$ [kN]	1562,0			
$M_{R,i,k}$ [kNm]	307,0			

For combined acting shear forces and bending moments, linear interaction values can be determined using $M_{R,i,k}$ and $V_{R,i,k}$ based on figure 5 in annex A4.

Laqnican Joint	**Annex B2**
Essential characteristics - Joint Type 2	

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Essential characteristics – Joint Type 3

Figure 9: Dimensions

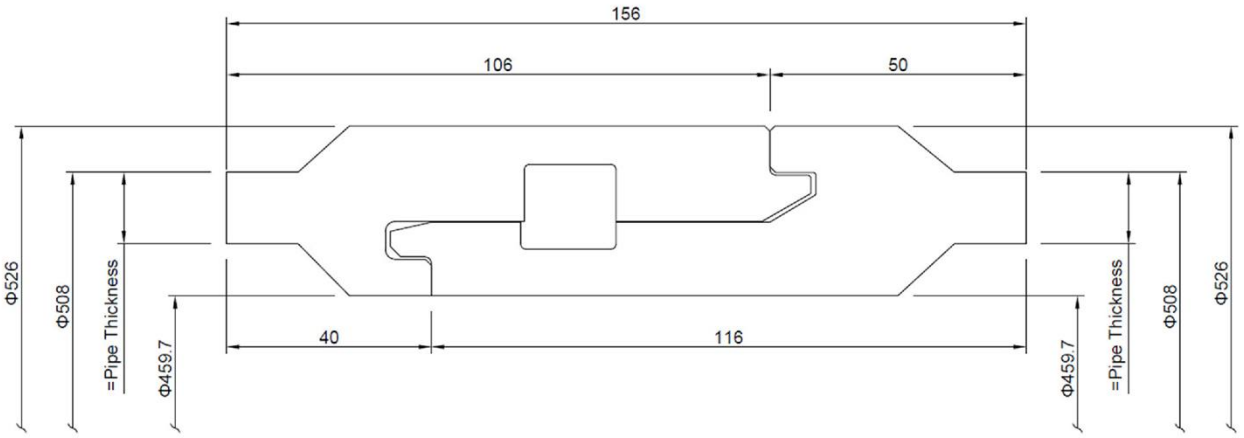

Table 8: Characteristic values of load bearing capacity

Characteristic values for joint Type 3					
Characteristic	Number of rotation keys				
	2	4	6	8	10
V_{Rk} [kN]	2797,0				
M_{Rk} [kNm]	1080,0				
$M_{T,Rk}$ [kNm]	83,0	166,0	248,0	331,0	414,0
For interaction					
$V_{R,i,k}$ [kN]	1450,0				
$M_{R,i,k}$ [kNm]	525,0				

For combined acting shear forces and bending moments, linear interaction values can be determined using $M_{R,i,k}$ and $V_{R,i,k}$ based on figure 5 in annex A4.

Laqnican Joint	**Annex B3**
Essential characteristics - Joint Type 3	

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Essential characteristics – Joint Type 4

Figure 10: Dimensions

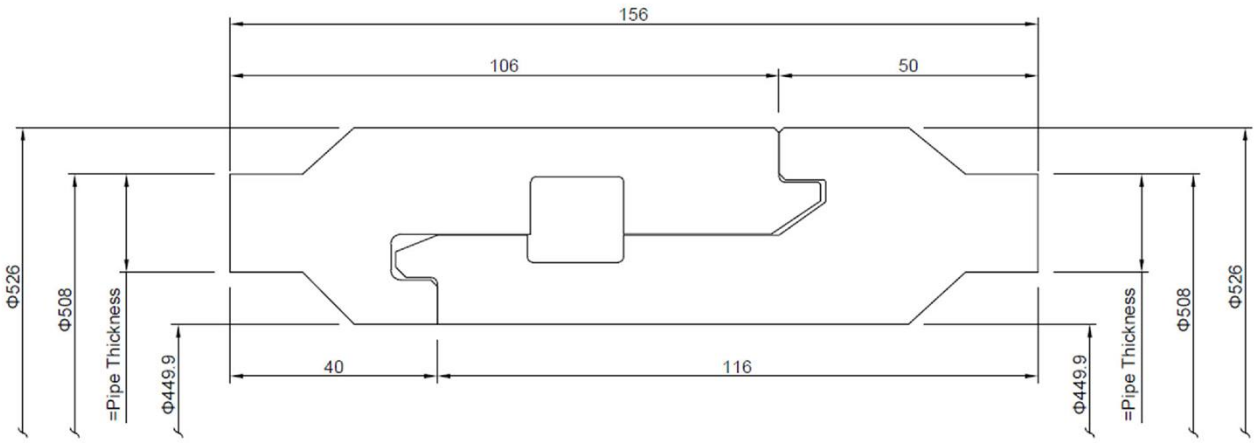

Table 9: Characteristic values of load bearing capacity

Characteristic values for joint Type 4					
Characteristic	Number of rotation keys				
	2	4	6	8	10
V_{Rk} [kN]	3554				
M_{Rk} [kNm]	1198				
$M_{T,Rk}$ [kNm]	83	166	248	331	414
For interaction					
$V_{R,i,k}$ [kN]	1903				
$M_{R,i,k}$ [kNm]	562				

For combined acting shear forces and bending moments, linear interaction values can be determined using $M_{R,i,k}$ and $V_{R,i,k}$ based on figure 5 in annex A4..

Laqnican Joint	**Annex B4**
Essential characteristics - Joint Type 4	

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Essential characteristics – Joint Type 5

Figure 11: Dimensions

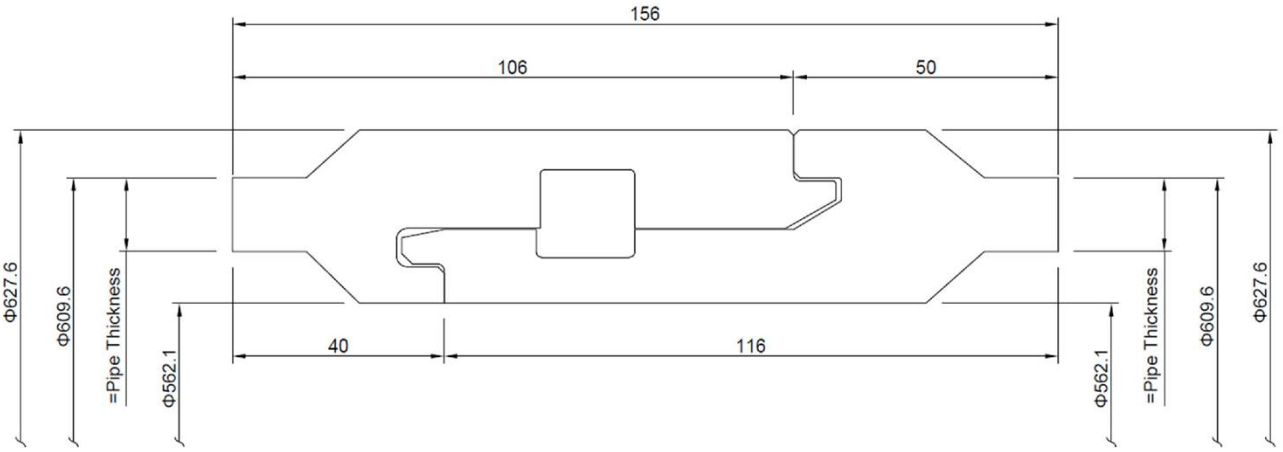

Table 10: Characteristic values of load bearing capacity

Characteristic values for joint Type 5						
Characteristic	Number of rotation keys					
	2	4	6	8	10	12
V_{Rk} [kN]	2964					
M_{Rk} [kNm]	1565					
$M_{T,Rk}$ [kNm]	99	199	298	397	497	596
For interaction						
$V_{R,i,k}$ [kN]	1889					
$M_{R,i,k}$ [kNm]	575					

For combined acting shear forces and bending moments, linear interaction values can be determined using $M_{R,i,k}$ and $V_{R,i,k}$ based on figure 5 in annex A4.

Laqnican Joint	**Annex B5**
Essential characteristics - Joint Type 5	

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Essential characteristics – Joint Type 6

Figure 12: Dimensions

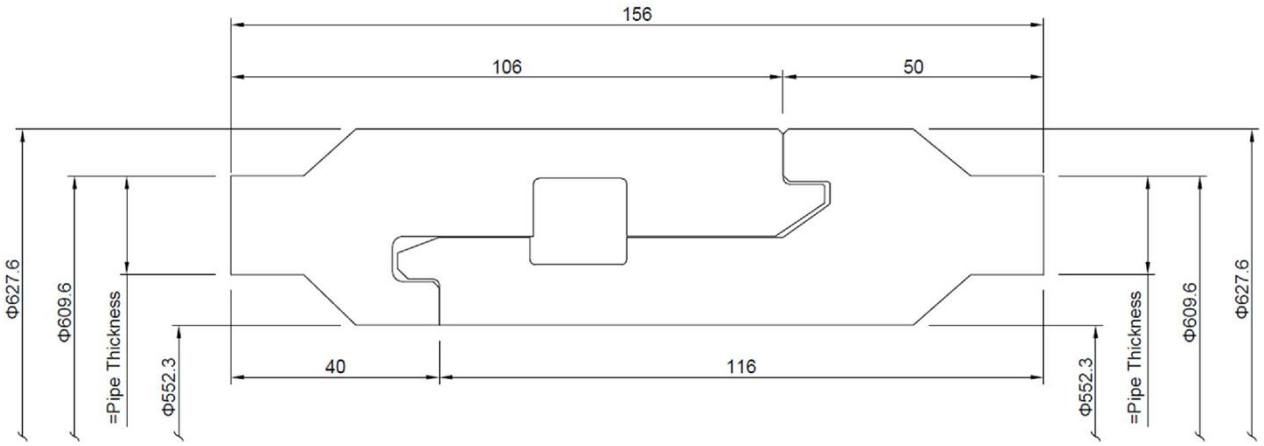

Table 11: Characteristic values of load bearing capacity

Characteristic values for joint Type 6						
Characteristic	Number of rotation keys					
	2	4	6	8	10	12
V_{Rk} [kN]	3786					
M_{Rk} [kNm]	1745					
$M_{T,Rk}$ [kNm]	99	199	298	397	497	596
For interaction						
$V_{R,i,k}$ [kN]	2173					
$M_{R,i,k}$ [kNm]	751					

For combined acting shear forces and bending moments, linear interaction values can be determined using $M_{R,i,k}$ and $V_{R,i,k}$ based on figure 5 in annex A4.

Laqnican Joint	**Annex B6**
Essential characteristics - Joint Type 6	

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Essential characteristics – Joint Type 7

Figure 13: Dimensions

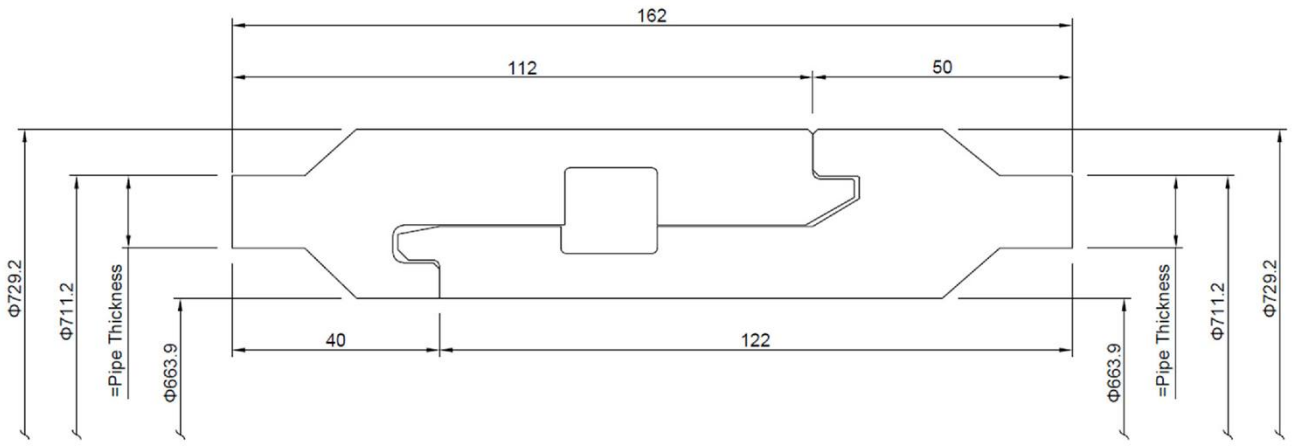

Table 12: Characteristic values of load bearing capacity

Characteristic values for joint Type 7						
Characteristic	Number of rotation keys					
	2	4	6	8	10	12
V_{Rk} [kN]	3192					
M_{Rk} [kNm]	2120					
$M_{T,Rk}$ [kNm]	116	232	348	464	580	696
For interaction						
$V_{R,i,k}$ [kN]	2160					
$M_{R,i,k}$ [kNm]	696					

For combined acting shear forces and bending moments, linear interaction values can be determined using $M_{R,i,k}$ and $V_{R,i,k}$ based on figure 5 in annex A4.

Laqnican Joint	**Annex B7**
Essential characteristics - Joint Type 7	

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Essential characteristics – Joint Type 8

Figure 14: Dimensions

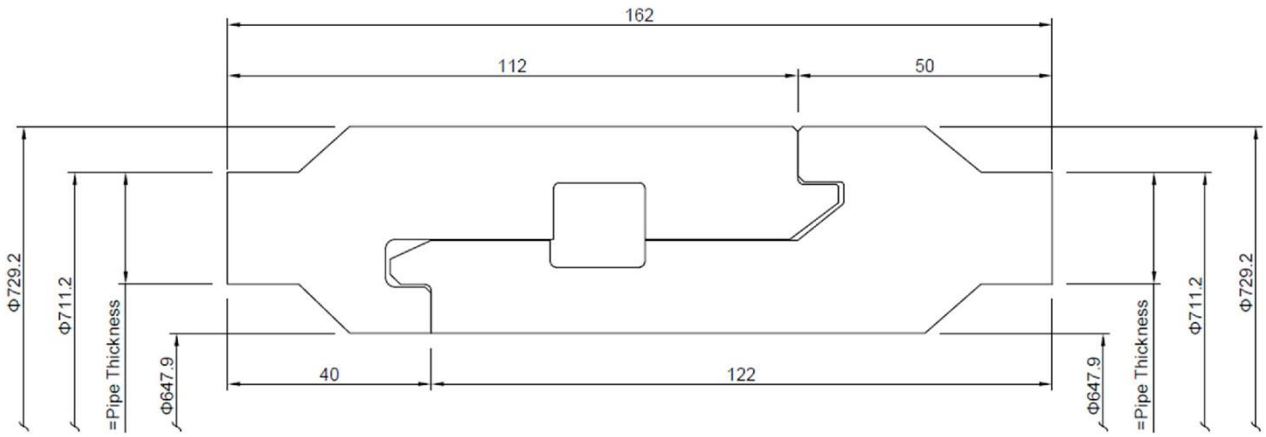

Table 13: Characteristic values of load bearing capacity

Characteristic values for joint Type 8						
Characteristic	Number of rotation keys					
	2	4	6	8	10	12
V_{Rk} [kN]	4576					
M_{Rk} [kNm]	2420					
$M_{T,Rk}$ [kNm]	116	232	348	464	580	696
For interaction						
$V_{R,i,k}$ [kN]	2646					
$M_{R,i,k}$ [kNm]	1032					

For combined acting shear forces and bending moments, linear interaction values can be determined using $M_{R,i,k}$ and $V_{R,i,k}$ based on figure 5 in annex A4.

Laqnican Joint	**Annex B8**
Essential characteristics - Joint Type 8	

Essential characteristics – Joint Type 9

Figure 15: Dimensions

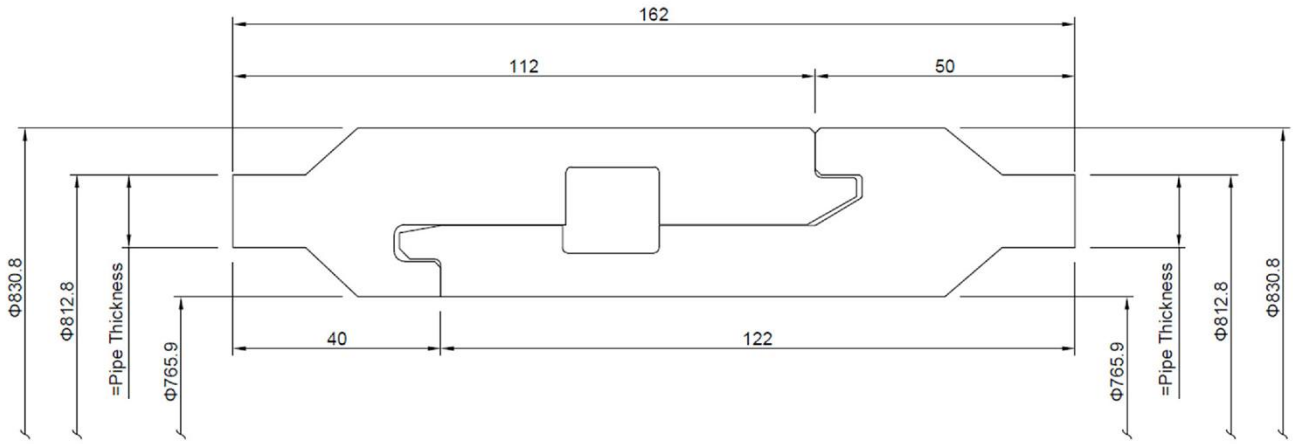

Table 14: Characteristic values of load bearing capacity

Characteristic values for joint Type 9							
Characteristic	Number of rotation keys						
	2	4	6	8	10	12	16
V_{Rk} [kN]	3324						
M_{Rk} [kNm]	2724						
$M_{T,Rk}$ [kNm]	132	265	397	530	662	795	1060
For interaction							
$V_{R,i,k}$ [kN]	2382						
$M_{R,i,k}$ [kNm]	785						

For combined acting shear forces and bending moments, linear interaction values can be determined using $M_{R,i,k}$ and $V_{R,i,k}$ based on figure 5 in annex A4.

Laqnican Joint	**Annex B9**
Essential characteristics - Joint Type 9	

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Essential characteristics – Joint Type 10

Figure 16: Dimensions

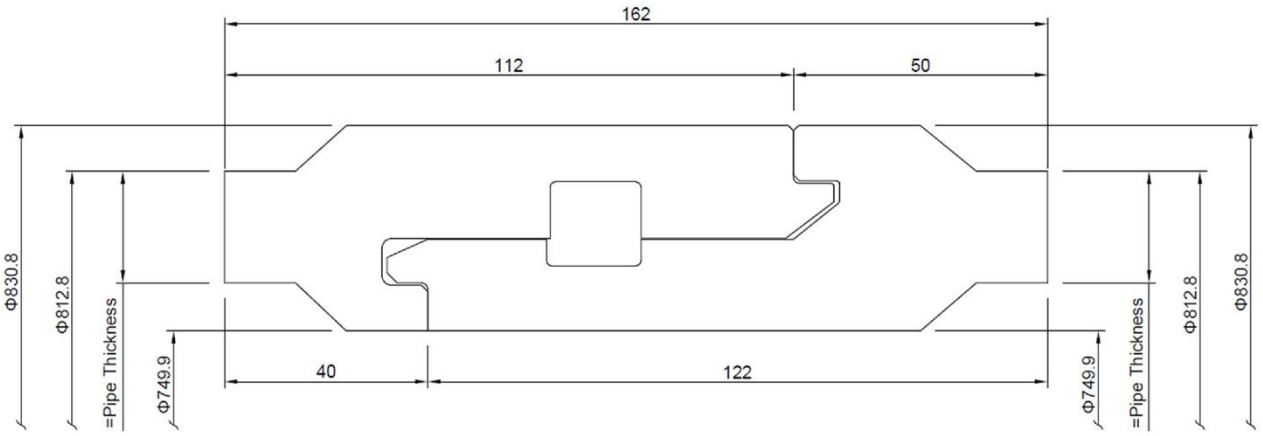

Table 15: Characteristic values of load bearing capacity

Characteristic values for joint Type 10							
Characteristic	Number of rotation keys						
	2	4	6	8	10	12	16
V_{Rk} [kN]	4688						
M_{Rk} [kNm]	3158						
$M_{T,Rk}$ [kNm]	132	265	397	530	662	795	1060
For interaction							
$V_{R,i,k}$ [kN]	2851						
$M_{R,i,k}$ [kNm]	1252						

For combined acting shear forces and bending moments, linear interaction values can be determined using $M_{R,i,k}$ and $V_{R,i,k}$ based on figure 5 in annex A4.

Laqnican Joint	**Annex B10**
Essential characteristics - Joint Type 10	

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Essential characteristics – Joint Type 11

Figure 17: Dimensions

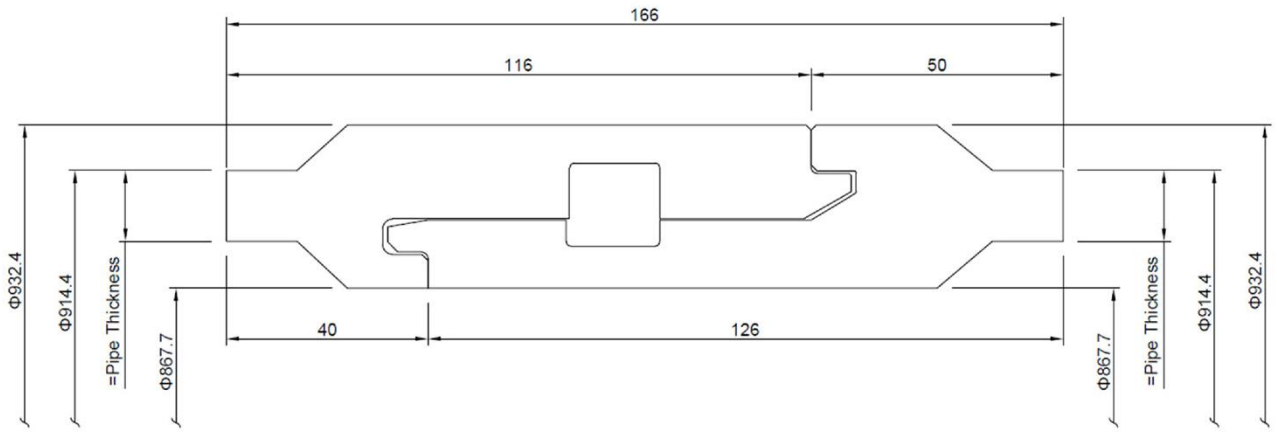

Table 16: Characteristic values of load bearing capacity

Characteristic values for joint Type 11								
Characteristic	Number of rotation keys							
	2	4	6	8	10	12	16	18
V_{Rk} [kN]	3505							
M_{Rk} [kNm]	3450							
$M_{T,Rk}$ [kNm]	149	298	447	596	745	894	1192	1341
For interaction								
$V_{R,i,k}$ [kN]	2621							
$M_{R,i,k}$ [kNm]	886							

For combined acting shear forces and bending moments, linear interaction values can be determined using $M_{R,i,k}$ and $V_{R,i,k}$ based on figure 5 in annex A4.

Laqnican Joint	**Annex B11**
Essential characteristics - Joint Type 11	

Essential characteristics – Joint Type 12

Figure 18: Dimensions

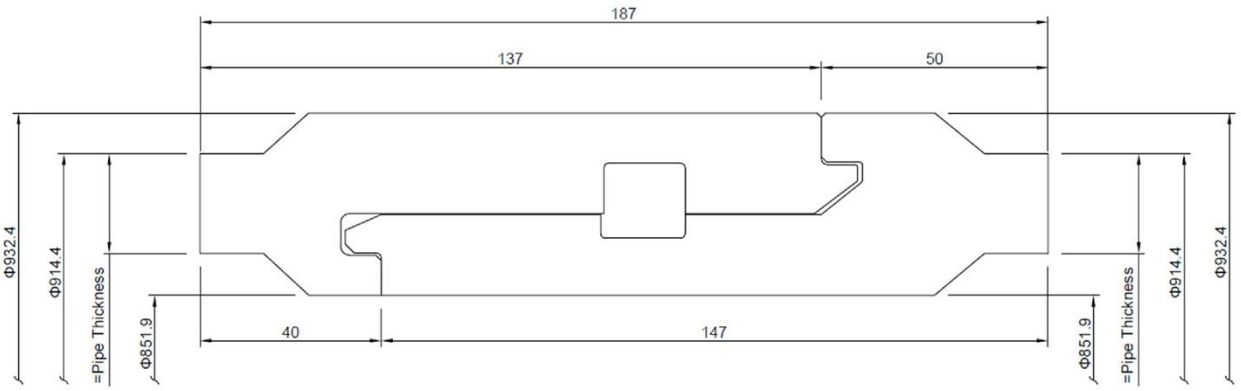

Table 17: Characteristic values of load bearing capacity

Characteristic values for joint Type 12								
Characteristic	Number of rotation keys							
	2	4	6	8	10	12	16	18
V_{Rk} [kN]	5387							
M_{Rk} [kNm]	3730							
$M_{T,Rk}$ [kNm]	149	298	447	596	745	894	1192	1341
For interaction								
$V_{R,i,k}$ [kN]	3323							
$M_{R,i,k}$ [kNm]	1447							

For combined acting shear forces and bending moments, linear interaction values can be determined using $M_{R,i,k}$ and $V_{R,i,k}$ based on figure 5 in annex A4.

Laqnican Joint	**Annex B12**
Essential characteristics - Joint Type 12	

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Essential characteristics – Joint Type 13

Figure 19: Dimensions

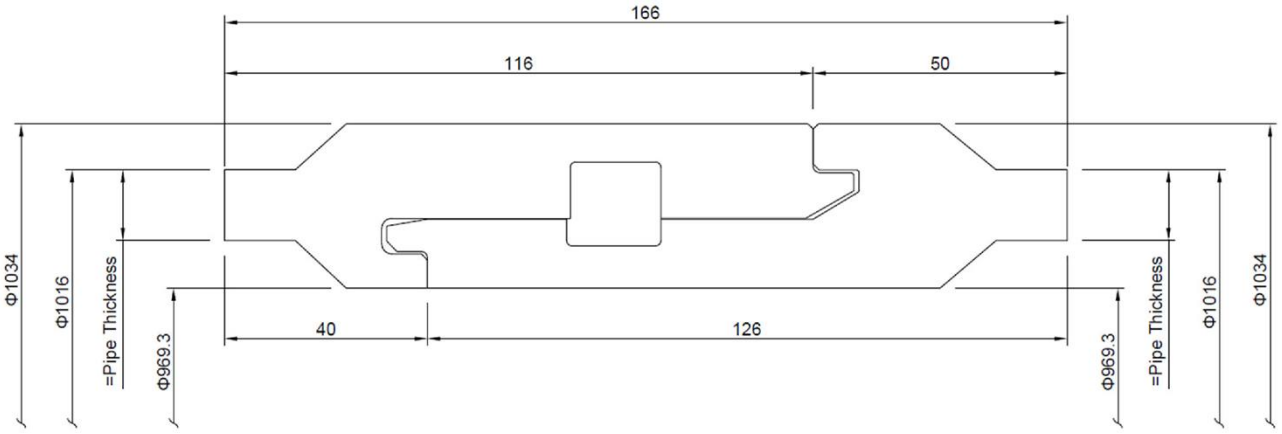

Table 18: Characteristic values of load bearing capacity

Characteristic values for joint Type 13									
Characteristic	Number of rotation keys								
	2	4	6	8	10	12	16	18	20
V_{Rk} [kN]	3588								
M_{Rk} [kNm]	4130								
$M_{T,Rk}$ [kNm]	166	331	497	662	828	994	1325	1490	1656
For interaction									
$V_{R,i,k}$ [kN]	2807								
$M_{R,i,k}$ [kNm]	919								

For combined acting shear forces and bending moments, linear interaction values can be determined using $M_{R,i,k}$ and $V_{R,i,k}$ based on figure 5 in annex A4.

Laqnican Joint	**Annex B13**
Essential characteristics - Joint Type 13	

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Essential characteristics – Joint Type 14

Figure 20: Dimensions

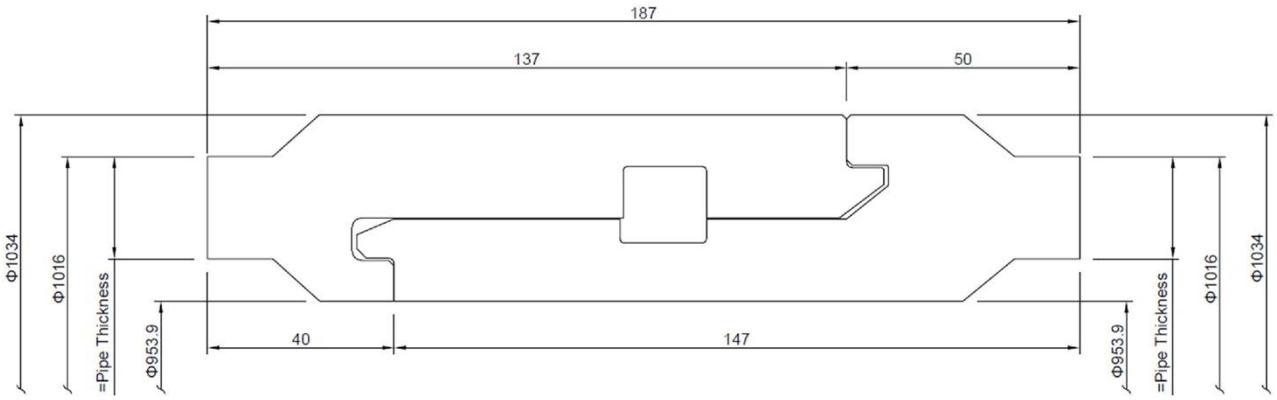

Table 19: Characteristic values of load bearing capacity

Characteristic values for joint Type 14									
Characteristic	Number of rotation keys								
	2	4	6	8	10	12	16	18	20
V_{Rk} [kN]	5640								
M_{Rk} [kNm]	4687								
$M_{T,Rk}$ [kNm]	166	331	497	662	828	994	1325	1490	1656
For interaction									
$V_{R,i,k}$ [kN]	3604								
$M_{R,i,k}$ [kNm]	1714								

For combined acting shear forces and bending moments, linear interaction values can be determined using $M_{R,i,k}$ and $V_{R,i,k}$ based on figure 5 in annex A4.

Laqnican Joint	**Annex B14**
Essential characteristics - Joint Type 14	

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Essential characteristics – Joint Type 15

Figure 21: Dimensions

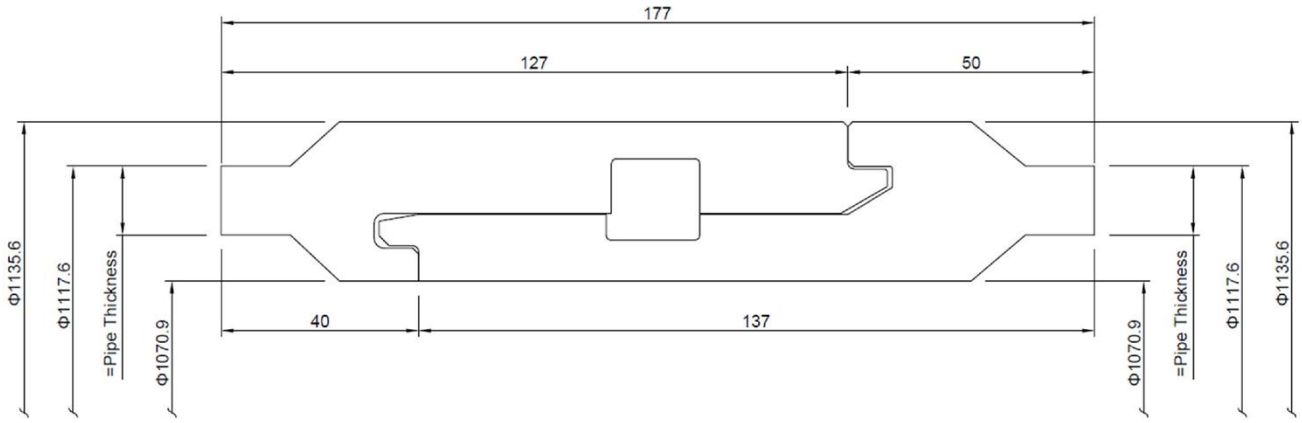

Table 20: Characteristic values of load bearing capacity

Characteristic values for joint Type 15									
Characteristic	Number of rotation keys								
	2	4	6	8	10	12	16	18	20
V_{Rk} [kN]	4071								
M_{Rk} [kNm]	4834								
$M_{T,Rk}$ [kNm]	182	364	547	729	911	1093	1457	1640	1822
For interaction									
$V_{R,i,k}$ [kN]	2891								
$M_{R,i,k}$ [kNm]	1425								

For combined acting shear forces and bending moments, linear interaction values can be determined using $M_{R,i,k}$ and $V_{R,i,k}$ based on figure 5 in annex A4.

Laqnican Joint	**Annex B15**
Essential characteristics - Joint Type 15	

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Essential characteristics – Joint Type 16

Figure 22: Dimensions

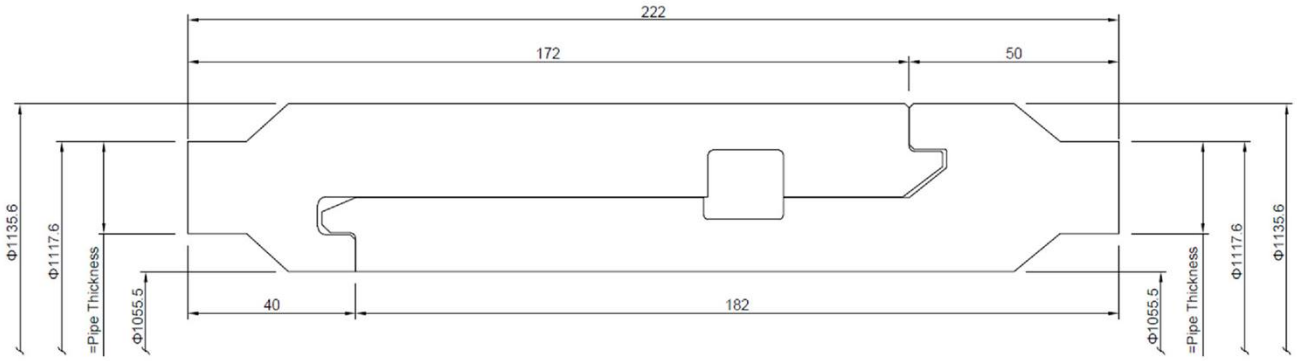

Table 21: Characteristic values of load bearing capacity

Characteristic values for joint Type 16									
Characteristic	Number of rotation keys								
	2	4	6	8	10	12	16	18	20
V_{Rk} [kN]	6583								
M_{Rk} [kNm]	5520								
$M_{T,Rk}$ [kNm]	182	364	547	729	911	1093	1457	1640	1822
For interaction									
$V_{R,i,k}$ [kN]	4009								
$M_{R,i,k}$ [kNm]	2184								

For combined acting shear forces and bending moments, linear interaction values can be determined using $M_{R,i,k}$ and $V_{R,i,k}$ based on figure 5 in annex A4.

Laqnican Joint	**Annex B16**
Essential characteristics - Joint Type 16	

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Essential characteristics – Joint Type 17

Figure 23: Dimensions

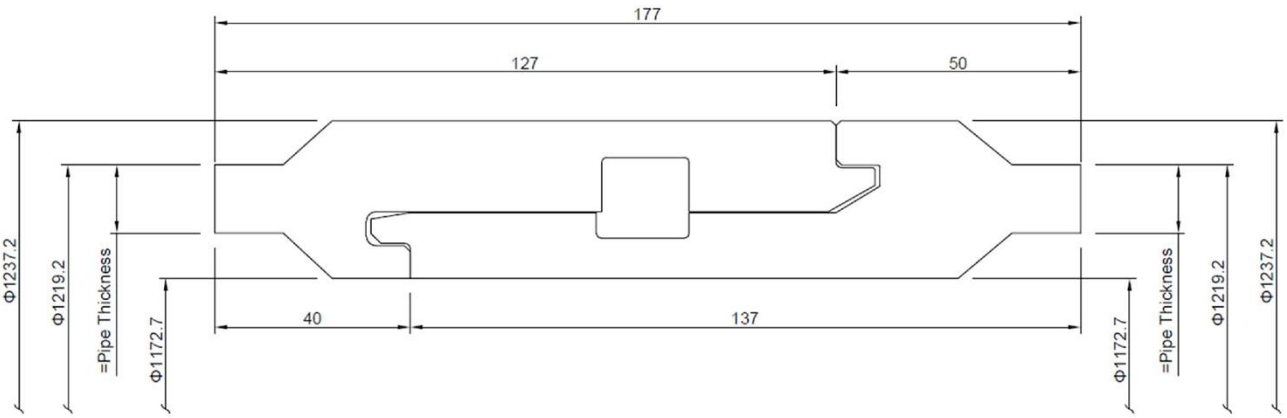

Table 22: Characteristic values of load bearing capacity

Characteristic values for joint Type 17										
Characteristic	Number of rotation keys									
	2	4	6	8	10	12	16	18	20	24
V_{Rk} [kN]	4199									
M_{Rk} [kNm]	5726									
$M_{T,Rk}$ [kNm]	199	397	596	795	994	1192	1590	1789	1987	2385
For interaction										
$V_{R,i,k}$ [kN]	3153									
$M_{R,i,k}$ [kNm]	1454									

For combined acting shear forces and bending moments, linear interaction values can be determined using $M_{R,i,k}$ and $V_{R,i,k}$ based on figure 5 in annex A4.

Laqnican Joint	**Annex B17**
Essential characteristics - Joint Type 17	

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Essential characteristics – Joint Type 18

Figure 24: Dimensions

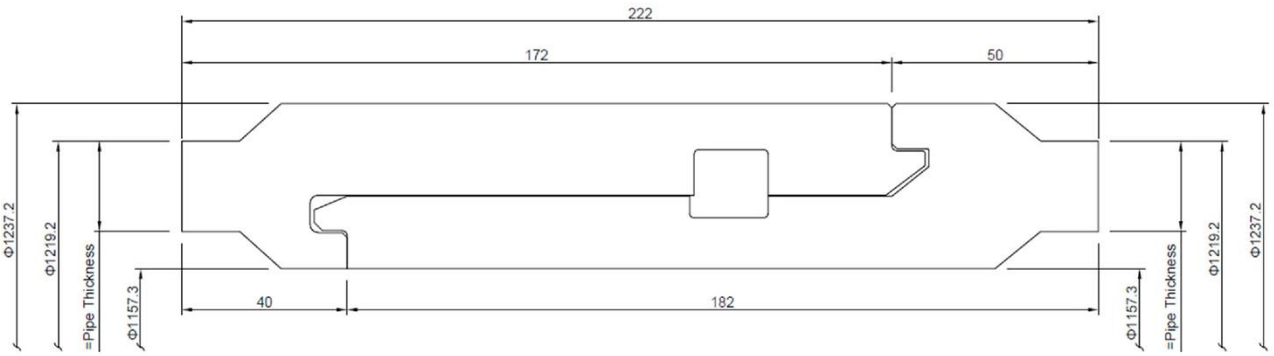

Table 23: Characteristic values of load bearing capacity

Characteristic values for joint Type 18										
Characteristic	Number of rotation keys									
	2	4	6	8	10	12	16	18	20	24
V_{Rk} [kN]	6793									
M_{Rk} [kNm]	6482									
$M_{T,Rk}$ [kNm]	199	397	596	795	994	1192	1590	1789	1987	2385
For interaction										
$V_{R,i,k}$ [kN]	4498									
$M_{R,i,k}$ [kNm]	2221									

For combined acting shear forces and bending moments, linear interaction values can be determined using $M_{R,i,k}$ and $V_{R,i,k}$ based on figure 5 in annex A4.

Laqnican Joint	**Annex B18**
Essential characteristics - Joint Type 18	