TECHNICAL MANUAL

BESISTA® Rod System

Aesthetic bracing system for structures

Version PEIKKO GROUP 04/2023

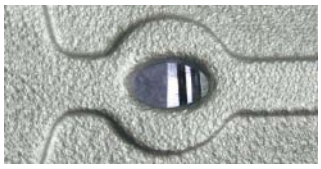
peikko®

BESISTA® Rod System

Aesthetic bracing system for structures

- Aesthetic design from every angle and down to the last detail.
- Covered and verified by European Technical Assessment (ETA).
- CE marked system.
- Simple installation without any additional thread protection need thanks to special HDG rod thread.

- Visual checking points via inspection holes in Rod Anchors.



- Individual rod lengths up to 15 m.
- Capable to tolerate misalignment up to 2° due to special shape of the slot.

- Costs and material optimization thanks to 24 thread sizes from M8 to M76, with limit tensile forces up to 2016 kN.
- Capable of transfer compression forces with compression rods made of steel or timber.
- Possibility to pretension rods with extra-light BESISTA® pretensioning systems BVS-230 kN and BVS-500 kN.

BESISTA® tension rod and compression rod systems set the standard for elegantly braced buildings and other load-bearing structures. With detailed aesthetics, and patented safety features as well as installation elements, BESISTA® is your first choice for load-carrying connections that boldly stand out.

BESITSA® Rod System for architecture and civil engineering consists of rod anchors and tension/compression rods as a main part and a wide range of accessories like cover or extension sleeves, and cross anchors for different projects.

Tension rods with a guaranteed yield strength of 540 N/mm^2. Hot-dip galvanized rod including special hot-dip galvanized rod threads provide corrosion protection during the whole lifetime, simple handling, and installation without special assembly work like sealing or encapsulation. Rod anchor is made of EN-GJS400-18C-LT material which is known as “ductile iron” to provide sufficient capacity and flexibility in connection between gusset plate and rod.

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About BESISTA® Rod System

1. Product properties

BESISTA® Rod System is used for bracing of structures where transfer of tension or compression loads is needed. It is particularly suitable for situations where the bracing system is a part of the architectural design. BESISTA® Rod System is composed of two main product groups:

a) Tension Rod System – is suitable for situations where the system must transfer only tensile forces from the structure. The tension rod system is composed from of tension rods, rod anchors (fork heads) with pins, and locking rings.

b) Compression Rod System – is solution suitable for the situation where transfer of compression loads is needed. The compression rod system is composed from of compression rods and rod anchors (fork heads) with pins and locking rings.

Either the tension rod system or the compression rod system are attached to the structure by gusset plates. BESISTA® Rod System is supported by a range of accessories which can be used in combination with the rod system.

BESISTA® Rod System is a prefabricated rod system solution of different sizes used as a package. The rod system consists of tension rods with threads which are connected to each other and to the structure. The tension rods are connected to the corresponding structure by fork heads secured by pins. Pins are secured by the locking rings. The tension rods can be connected to each other by extension sleeves. The tension rod system comprises tension rods, rod anchors, sleeves and crossing items.

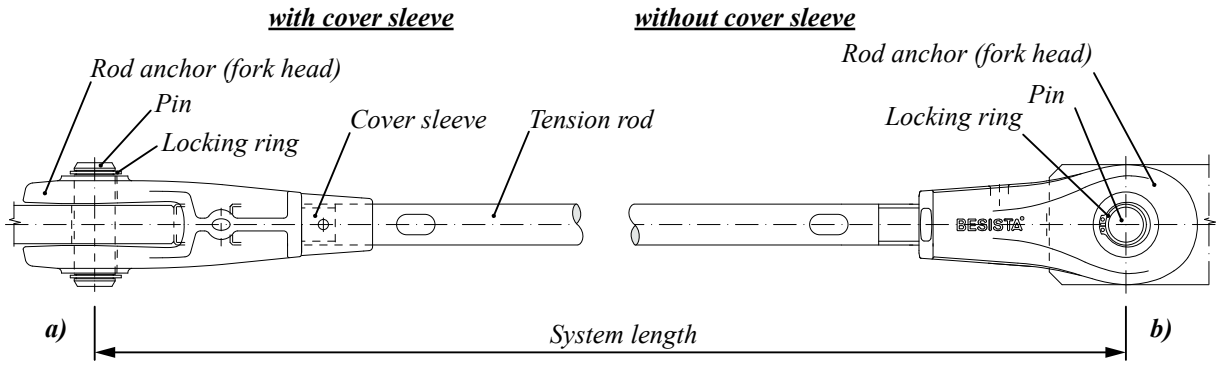
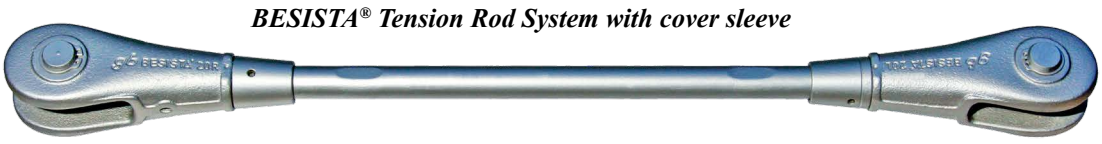
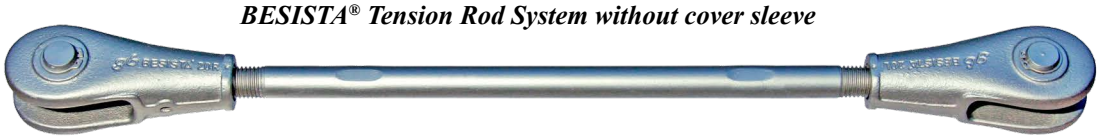


Figure 1. BESISTA® Rod System - main components. a) top view; b) side view

BESISTA® Tension Rod System



BESISTA® Tension Rod System with cover sleeve



BESISTA® Tension Rod System without cover sleeve

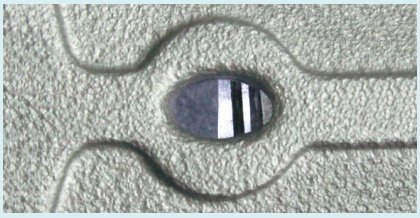
BESISTA® Compression Rod System

1.1 BESISTA® Tension Rod System

1.1.1 BESISTA® Tension rod anchors (fork heads)

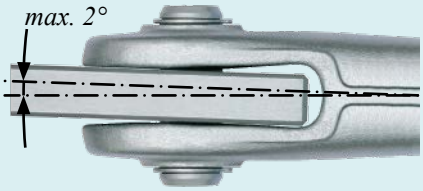
The BESISTA® rod anchors are used to connect tension rods to gusset plates. The rod anchors are made of top-grade, highly ductile EN-GJS-400-18C-LT spheroidal graphite cast iron, with guaranteed notched bar impact test at -20 °C. This cast iron is particularly suitable for these components.

The 100% control of the thread screw-in depth by means of inspection holes is a unique feature of the BESISTA® rod anchors. This obviates the need for the cover sleeves required by other rod systems to ensure an adequate screw-in depth.



The wrench flats on the tension rods, used in conjunction with those on the rod anchors serving as a counterholder, allow simple tensioning of the rod systems. Particularly by tensioning from both sides at the same time, high tensile force can be achieved by hand without distorting either the rod systems or the gusset plates.

The patented specially designed internal straps on the BESISTA® rod anchors allow axial offsets of up to 2°. This largely prevents transverse stresses and protects coatings – a major benefit during installation.



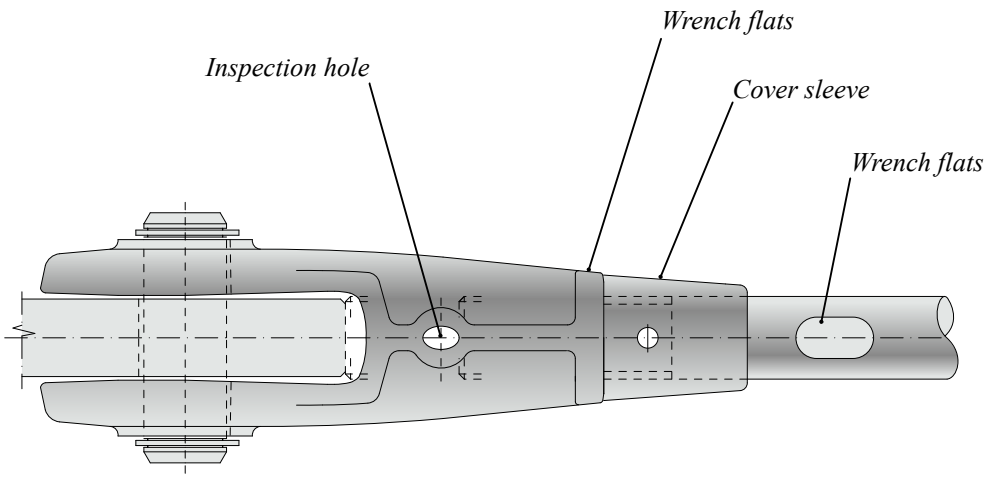
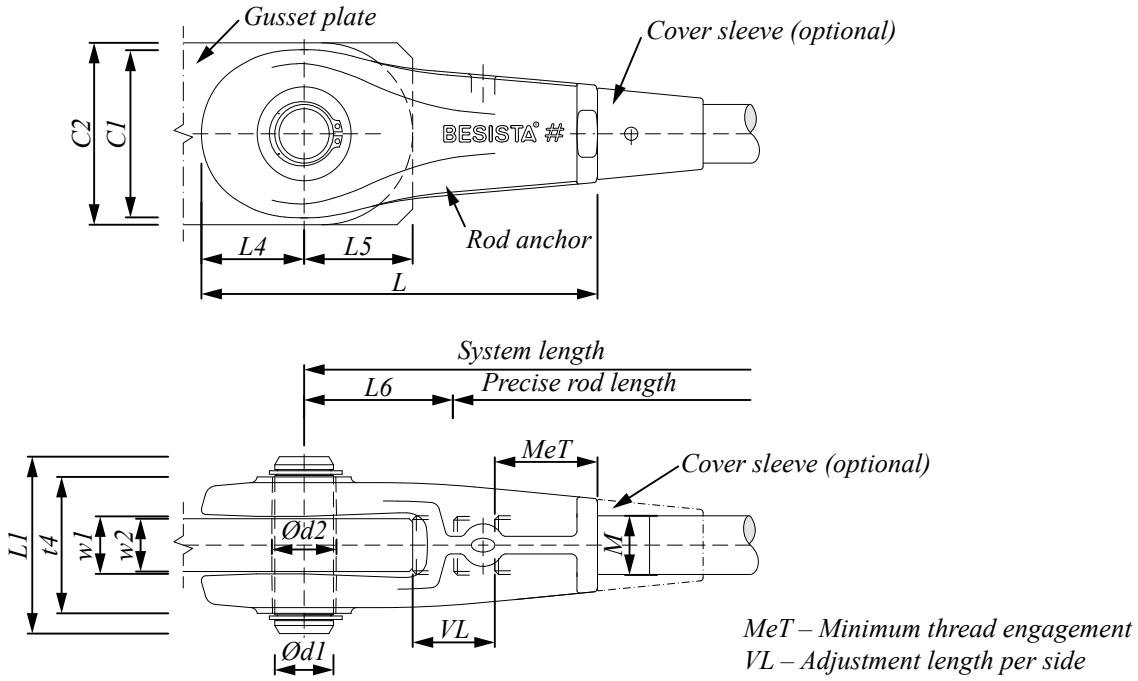


Figure 2. BESISTA® Rod anchor - details.

Table 1. BESISTA® Rod Anchor dimensions.



M	Tension rod anchors										Pins		
	C1	L4	w1	Ø d2	MeT	t4	L	VL	L6	Material	Ø d1	L1	Material
	[mm]										[mm]		
8	24	14.2	7	8.5	15.3	19	59.5	14	23	EN-GJS-400-18C-LT ; (f_{yk} = 250 N/mm²) ; (f_{uk} = 400 N/mm²)	8	29.6	S460N ; (f_{yk} = 520 N/mm²) ; (f_{uk} = 720 N/mm²)
10	29	17.5	9.2	11	18	23	71.5	16	28		10	32.3	
12	35.4	21	11.2	13	22	27.2	83.5	18	32		12	38.4	
14	41.2	24.5	13.4	15	24.5	31.8	96	20	37		14	41.9	
16	45.6	27.5	16.4	17	28	38.5	108.5	22	42		16	48.4	
18	51.6	31.5	16.6	19	31.5	40.2	122	26	46		18	53.9	
20	56	35	19.6	21	35	46.5	135	28	51		20	59.9	
22	63	38.5	19.6	23	37.5	50	148	30	57		22	62.9	
24	69	42	21.8	25	41	54.5	164	36	63		24	67.8	
27	78	47	23.8	28	46	61.4	184	40	71		27	75.1	
30	86	52.5	27	31	51	67.6	203.5	44	78		30	82.1	
33	95	57.5	32.2	34	56.5	78	220	46	83		33	92.6	
36	104	63	32.2	37	61	80.8	241	50	92		36	98.8	
39	112	68	37.4	40	66.5	90	259.5	54	98		39	106.8	
42	121	73.5	37.4	43	70	95	279.5	58	107		42	115	
45	129	79	42.8	46	76	105	301	64	114		45	126	
48	138	84	42.5	50	81.5	110	325.5	70	125		48	129	
52	149	91	47.8	54	87	120	351	74	137		52	145	S460N ; (f_{yk} = 540 N/mm²) ; (f_{uk} = 720 N/mm²)
56	161	99	52.8	58	93	132	378	80	146		56	158	
60	173	105	58	62	99	142	401	84	155		60	168	
64	184	112	58	66	106	147	431	92	167		64	175	
68	196	119.5	63	70	113	160	457.5	96	177		68	188	
72	206	126	68	74	119	168	480	100	185		72	196	
76	221	134.5	73	78	126	183	509.5	108	195		76	212	

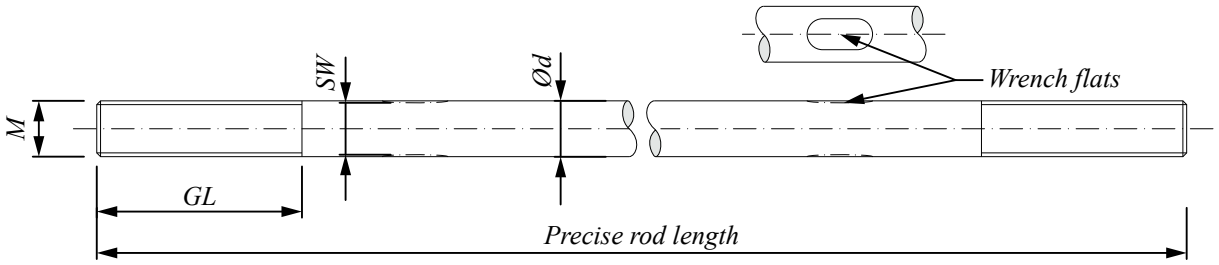
NOTE: For BESISTA® Tension Rod Systems, the required thread engagement length is ensured by the inspection hole, the cover sleeves are not structurally necessary.

1.1.2 BESISTA® Tension rods

Tension rods with left- and right-hand threads are made of special S460N, with a guaranteed yield strength of 540 N/mm^2. Individual rod lengths of up to 15 m are available from M14 rods. Extension and tensioning sleeves are used for longer rods. BESISTA® products require no sealing or encapsulation of the threads thanks to the special HDG thread surface.

Tension rods of special S460N with guaranteed yield strength 540 N/mm^2 must be supplied exclusively by Peikko. In order to avoid confusion with steel of lower strength, Peikko always supplies special S460N as standard (with yield strength of 540 N/mm^2) – even if S355 or S235 are specified.

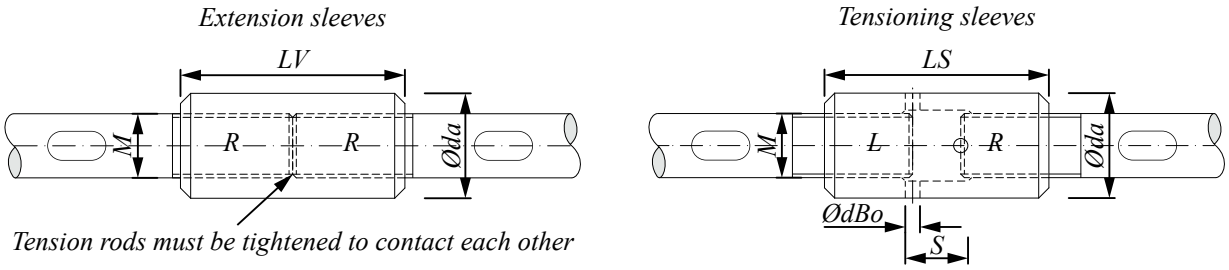
Table 2. BESISTA® Tension rods dimensions.



M	Tension rods			
	GL	*Ød*	*SW*	Max. length
	[mm]			
8	34	8	7	6500
10	39	10	9	8000
12	45	12	11	9000
14	51	14	13	15000
16	57	16	15	15000
18	65	18	16	15000
20	71	20	18	15000
22	75	22	20	15000
24	87	24	22	15000
27	96	27	25	15000
30	107	30	28	15000
33	114	33	30	15000
36	124	36	33	15000
39	133	39	36	15000
42	142	42	39	15000
45	154	45	42	15000
48	166	48	45	15000
52	175	52	49	15000
56	189	56	52	15000
60	199	60	56	15000
64	216	64	60	15000
68	227	68	64	15000
72	237	72	68	15000
76	252	76	72	15000

NOTE: When using extension and tensioning sleeves, the thread lengths of the tension rods are shorter.

1.1.3 BESISTA® Extension sleeves and Tensioning sleeves



The extension sleeves with continuous, right-hand internal threads are used to extend and secure the tension rods. For additional safety, the threads of BESISTA® sleeves are longer than necessary.

NOTE: The tension rods must be tightened to contact each other in the center of the sleeve to ensure that the complete rod is turned when tensioning. The thread screw-in depth is reached when the rod threads project from the sleeve on both sides by no more than 4 thread pitches.

The tensioning sleeves with left and right-hand threads are used to pretension the tension rods. They can also be used as “turnbuckles” e.g., in order to increase the adjustment distance.

NOTE: The required thread screw-in depth is reached when, after the tensioning process, the threads are visible in both inspection holes.

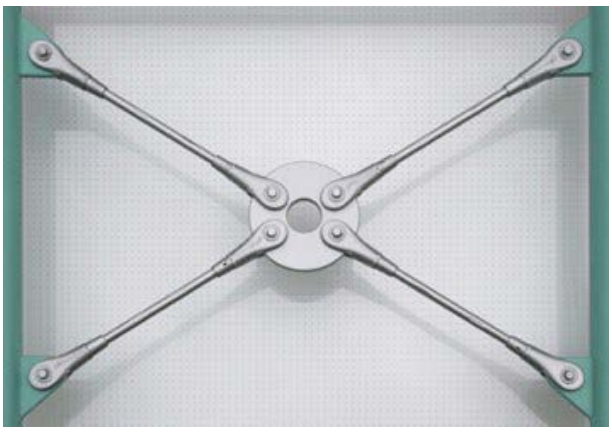
Table 3. BESISTA® Extension sleeves and Tensioning sleeves dimensions.

M	Extension sleeves (VH)			Tensioning sleeves (SH)				
	LV	*Øda* S460N	*Øda* S355	*LS*	*Øda* S460N	*Øda* S355	*S* (tensioning)	*Ø dBo* (hole)
	[mm]							
8	28	14	-	28	14	-	8	4
10	35	16	-	35	16	-	10	4
12	42	20	-	42	20	-	12	5
14	49	22	-	49	22	-	14	5
16	56	27	-	56	27	-	16	6
18	63	30	-	63	30	-	18	6
20	70	33	-	70	33	-	20	6
22	77	36	-	77	36	-	22	6
24	84	39	-	84	39	-	24	8
27	95	42	-	95	42	-	27	8
30	105	48	-	105	48	-	30	8
33	116	52	-	116	52	-	33	8
36	126	56	-	126	56	-	36	10
39	137	64	-	137	64	-	39	10
42	147	68	-	147	68	-	42	10
45	158	72	-	158	72	-	45	10
48	168	76	-	168	76	-	48	10
52	182	-	88.9	182	-	88.9	52	12
56	196	-	95.0	196	-	95.0	56	12
60	210	-	101.6	210	-	101.6	60	12
64	224	-	108.0	224	-	108.0	64	12
68	238	-	114.8	238	-	114.3	68	15
72	252	-	121.0	252	-	121.0	72	15
76	266	-	127.0	266	-	127.0	76	15

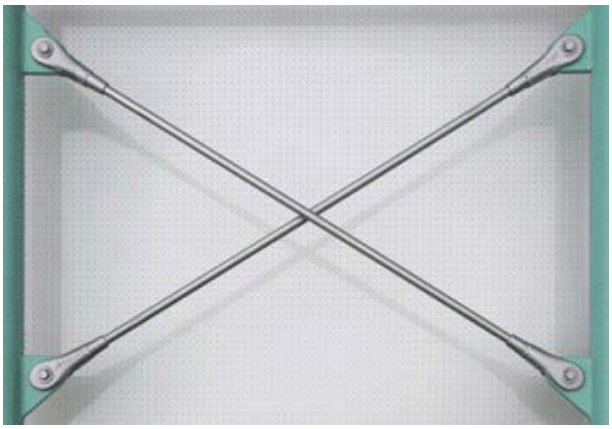
1.1.4 BESISTA® Crossing options

Cross anchors (x-braces) are used to form structurally the most optimal flawless crossing points. The elegantly shaped members allow the contact-free crossing of tension rods within the same plane, thereby ensuring that the lines of force meet exactly in the middle. Another benefit is exceptionally straightforward installation.

Circular discs offer a further visually attractive design variant. Yet, proper structural performance depends on precise installation of the discs, with the lines of force running exactly along the axes, and this is difficult to achieve in practice. Circular discs are also a more expensive option than cross anchors.



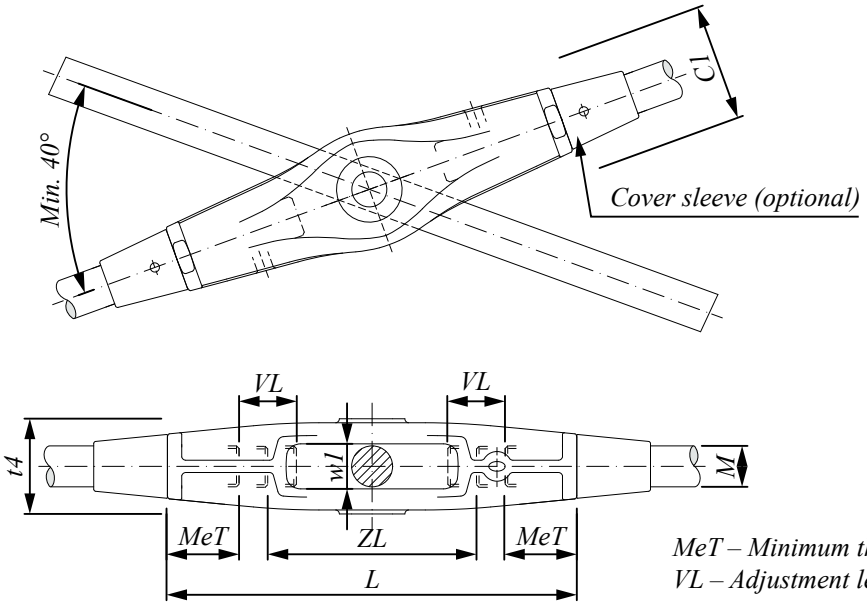
Rods that cross over each other is a solution while offering the same structural efficiency as cross anchors. This variant, however, only works where the gusset plates at the rod ends are offset by the rod thickness. With most assemblies, this is either overly complicated or unfeasible.



1.1.4.1 Cross anchors (x-braces)

The BESISTA® Cross anchors (x-braces) are used to form structurally flawless crossing points. Like the rod anchors, the cross anchors are made of highly ductile C spheroidal graphite cast iron with guaranteed notched bar impact test at -20°C.

Table 4. BESISTA® Cross anchors (x-braces) dimensions.



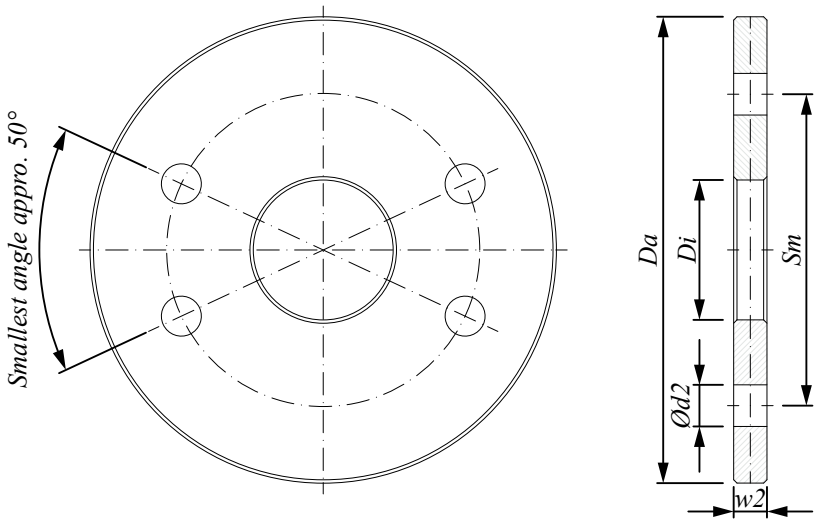
MeT – Minimum thread engagement
VL – Adjustment length per side

M	Cross anchors						
	C1	*w1*	*MeT*	*t4*	*L*	*ZL*	*VL*
	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]
8	23	8.8	15.3	19.5	90	46	14
10	27	11	18	22.6	110	56	16
12	33	13	22	26.9	123	64	18
14	39	15	24.5	31.9	141	74	20
16	42	17.5	28	38.7	160	84	22
18	48	19.5	31.5	41.3	180	94	26
20	53	21.5	35	47.2	202	102	28
22	60	23.5	37.5	49.8	218	114	30
24	66	25.5	41	54.7	243	126	36
27	75	28.5	46	60.3	271	142	40
30	83	32	51	667	298	156	44
33	92	35	56.5	77.1	328	166	46
36	101	38	61	81.3	360	184	50
39	109	41	66.5	90	385	196	54
42	117	44	70	96.2	418	214	58
45	125	47.5	76	105	444	228	64
48	133	50.5	81.5	110	483	252	70
52	144	54.5	87	120	520	274	74
56	155	59	93	132	558	292	80
60	167	63	99	142	592	310	84
64	177	67	106	147	638	336	92
68	189	71	113	160	676	354	96
72	198	75	119	168	708	370	100
76	213	79	126	183	750	390	108

1.1.4.2 Circular discs

The BESISTA® Circular discs offer a further visually attractive design alternative. The circular discs are made of S355 steel. As standard, the supplied circular discs are delivered cut out of steel sheet and have a smooth surface. On request and subject to a surcharge, the discs can also be supplied with incorporated grooves. Special larger discs can be fabricated for cases where the smallest angle is less than 50°.

Table 5. BESISTA® Circular discs dimensions.

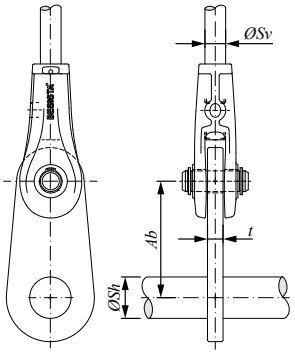


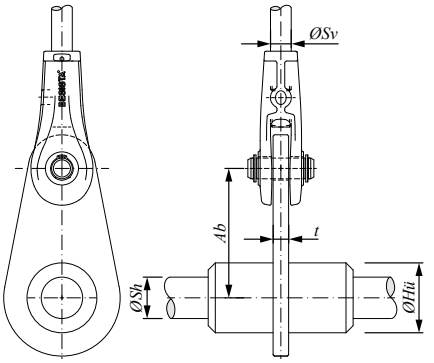
M	Circular discs				
	Da	*Di*	*Sm*	*w2*	*Ød2*
	[mm]	[mm]	[mm]	[mm]	[mm]
8	96	30	64	6	8.5
10	118	36	78	8	11
12	140	42	94	10	13
14	162	48	108	12	15
16	184	54	122	15	17
18	204	60	136	15	19
20	224	66	150	18	21
22	248	72	164	18	23
24	268	78	178	20	25
27	302	88	200	22	28
30	334	98	222	25	31
33	364	108	244	30	34
36	400	118	266	30	37
39	430	128	288	35	40
42	466	138	310	35	43
45	496	148	332	40	46
48	534	158	354	40	50
52	582	170	382	45	54
56	626	184	414	50	58
60	668	196	442	55	62
64	718	210	474	55	66
68	764	226	506	60	70
72	800	234	530	65	74
76	848	248	566	70	78

1.1.5 BESISTA® Suspension rings

The suspension rings serve to suspend the tension rods of all BESISTA® Tension Rod Systems. Unlike other solutions, such as sleeves with straps, they permit turning and tensioning of installed tension rods together with the precise alignment of suspended rods.

Table 6. BESISTA® Suspension rings dimensions.





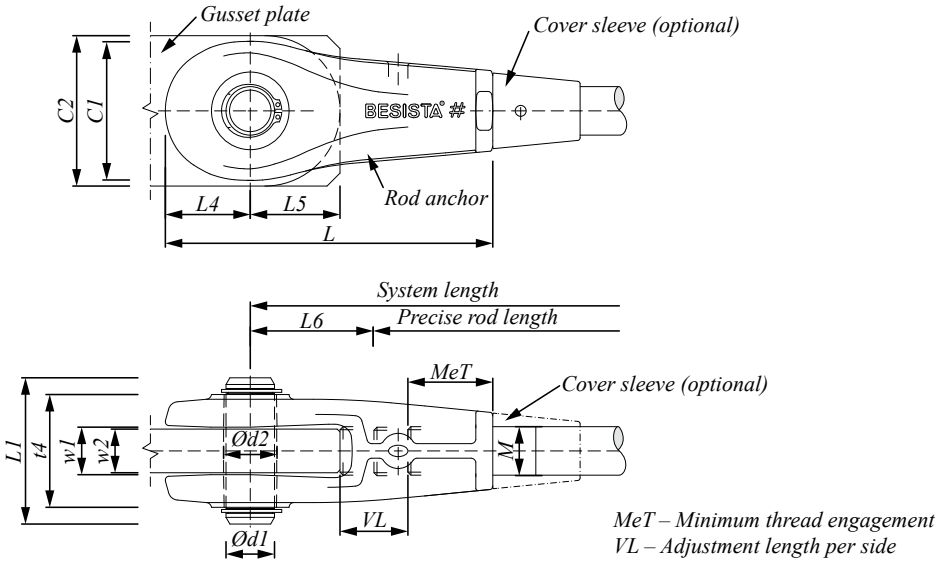
M	Suspension rings for solid rods					Suspension rings for extension or tensioning sleeves					
	Ring no.	Ø Sh	Ø Sv	Ab	t	Ring no.	Ø Sh	ØHü	ØSv	Ab	t
		[mm]					[mm]				
8	A1	8	8	40	6	A2	8	14	8	45	6
10		10					10	16			
12		12					12	20			
14	A2	14		45		A3	14	22		50	
16		16				A4	16	27			
18		18					18	30			
20		20				A5	20	33	10	60	8
22	A3	22		50			22	36			
24		24				A6	24	39			
27	A4	27					27	42			
30		30				A7	30	48		65	
33	A5	33	10	60	8	A8	33	52	12	75	10
36		36					36	56			
39	A6	39				A9	39	64	14	85	12
42		42				A10	42	68		90	
45	A7	45		65			45	72			
48		48				A11	48	76	16	95	15
52	A8	52	12	75	10	A13	52	88.9		105	
56		56				A14	56	95		115	
60	A9	60	14	85	12	A15	60	101.6		120	
64		64				A16	64	108			
68	A10	68		90		A17	68	114.3		130	
72		72				A18	72	121		135	
76	A11	76	16	95	15	A19	76	127		140	

1.2 BESISTA® Compression Rod System

1.2.1 BESISTA® Compression rod anchors (fork heads)

The BESISTA® rod anchors are used to connect compression rods to gusset plates. The rod anchors are made of top-grade, highly ductile EN-GJS-400-18C-LT spheroidal graphite cast iron, with guaranteed notched bar impact test at -20 °C. This cast iron is particularly suitable for these components.

Table 7. BESISTA® Compression rod anchors dimensions.



M	Compression rod anchors										Pins		
	C1	L4	w1	Ø d2	MeT	t4	L	VL	L6	Material	Ø d1	L1	Material
	[mm]										[mm]		
8	24	14.2	7	10.5	15.3	19	59.5	14	23	EN-GJS-400-18C-LT ; (f_{yk} = 250 N/mm²) ; (f_{uk} = 400 N/mm²)	10	29.6	S460N ; (f_{yk} = 520 N/mm²) ; (f_{uk} = 720 N/mm²)
10	29	17.5	9.2	13	18	23	71.5	16	28		12	32.3	
12	35.4	21	11.2	15	22	27.2	83.5	18	32		14	38.4	
14	41.2	24.5	13.4	17	24.5	31.8	96	20	37		16	41.9	
16	45.6	27.5	16.4	19	28	38.5	108.5	22	42		18	48.4	
18	51.6	31.5	16.6	21	31.5	40.2	122	26	46		20	53.9	
20	56	35	19.6	23	35	46.5	135	28	51		22	59.9	
22	63	38.5	19.6	25	37.5	50	148	30	57		24	62.9	
24	69	42	21.8	28	41	54.5	164	36	63		27	67.8	
27	78	47	23.8	31	46	61.4	184	40	71		30	75.1	
30	86	52.5	27	34	51	67.6	203.5	44	78		33	82.1	
33	95	57.5	32.2	37	56.5	78	220	46	83		36	92.6	
36	104	63	32.2	40	61	80.8	241	50	92		39	98.8	
39	112	68	37.4	43	66.5	90	259.5	54	98		42	106.8	
42	121	73.5	37.4	46	70	95	279.5	58	107		45	115	
45	129	79	42.8	50	76	105	301	64	114		48	126	
48	138	84	42.5	54	81.5	110	325.5	70	125		52	129	
52	149	91	47.8	58	87	120	351	74	137		56	145	S460N ; (f_{yk} = 540 N/mm²) ; (f_{uk} = 720 N/mm²)
56	161	99	52.8	62	93	132	378	80	146		60	158	
60	173	105	58	66	99	142	401	84	155		64	168	
64	184	112	58	70	106	147	431	92	167		68	175	
68	196	119.5	63	74	113	160	457.5	96	177		72	188	
72	206	126	68	78	119	168	480	100	185		76	196	
76	221	134.5	73	82	126	183	509.5	108	195		80	212	

1.2.2 BESISTA® Compression rods

All types are individually manufactured by Peikko in accordance with the client's structural design.

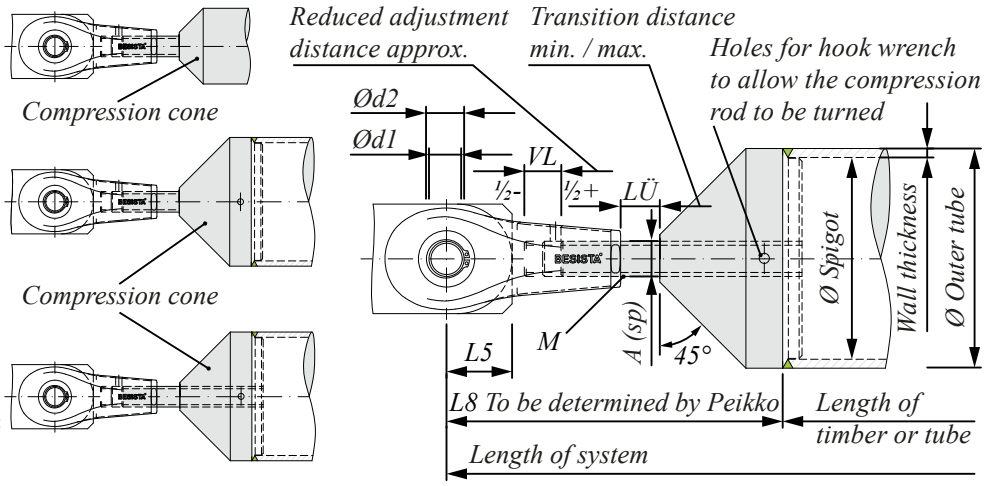
NOTE: For compression loads, the pin diameters are larger than those of standard pins for tensile loads. In order to limit the critical transition distance ***LÜ***, the adjustment distance ***LV*** is also shorter than for tension rods.

Table 8. BESISTA® Compression rod dimensions.

Type 1: Machined solid rods up to Ø 76 mm made of special S460N

Type 2: one-part, as machined component made of S355 for timber or for welding to steel tubes made of S355

Type 3: two-part, as machined component made of S355 for timber or for welding to steel tubes made of S355, though with higher-strength threaded pins made of special S460N



M	Compression rod connections											
	Ød1	*Ød2*	*L5*	*t*	*A* (Sp)	*VL* approx.	*LÜ* min.	*LÜ* max.	*L8*	*Ø* tube	Wall thickness	*V-seam*
	[mm]											
8	10	10.5	16	6	36.6	8	5	13	Depends on selected outer diameter of tube. Since there are over 6,000 variants, *L8* is determined by Peikko. Please specify only system lengths.	In accordance with structural verification on load-bearing capacity, defined by customer		
10	12	13	20	8	58	10	6	16				
12	14	15	23	10	84.3	12	7	19				
14	16	17	27	12	115	14	8	22				
16	18	19	31	15	157	16	9	25				
18	20	21	34	15	193	18	11	29				
20	22	23	37	18	245	20	12	32				
22	24	25	42	18	303	22	13	35				
24	27	28	45	20	353	24	14	38				
27	30	31	51	22	459	27	14	41				
30	33	34	56	25	561	30	15	45				
33	36	37	60	30	694	33	17	50				
36	39	40	67	30	817	36	18	54				
39	42	43	71	35	976	39	19	58				
42	45	46	78	35	1121	42	20	62				
45	48	49	82	40	1306	45	21	66				
48	52	54	91	40	1473	48	21	69				
52	56	58	100	45	1758	52	21	73				
56	60	62	106	50	2030	56	24	80				
60	64	66	113	55	2362	60	24	84				
64	68	70	122	55	2676	64	26	90				
68	72	74	129	60	3055	68	26	94				
72	76	78	135	65	3463	72	26	98				
76	80	82	141	70	3889	76	26	102				

2. Material properties

System component	Material	Material no.	Technical delivery condition	Note
Rod anchors	EN-GJS400-18C-LT	5.3103	EN 1563	
Pins	S460N	1.8901	EN 10025-3	
Tension rods	S460N	1.8901	EN 10025-3	
Compression rods	S460N	1.8901	EN 10025-3	Type 1
	S355J2	1.0577	EN 10025-2	Type 2, 3
Sleeves	S460N	1.8901	EN 10025-3	for M8 - M48
	S355J2	1.0577	EN 10025-2	for M52 - M76
Circular discs, Cross anchors, Gusset plates	S355J2	1.0577	EN 10025-2	Material combination 1
	EN-GJS400-18C-LT	5.3103	EN 1563	Material combination 2
	S235J2	1.0117	EN 10025-2	Material combination 3
Suspension rings	S235J2	1.0117	EN 10025-2	

2.1 Surface treatment

BESISTA® Rod System can be manufactured with surface treatment as hot-dip galvanized (HDG), painted by protective primer or timber finish (compression rods only).

Hot-dip galvanized (HDG) finish.

Protective painting finish.

Timber surface finish. (Compression rods only).

The BESISTA® Rod System is produced with hot-dip galvanized thread at tension rod. Threads are the most sensitive part of all tension rod system. Peikko provide top-class machined hot-dip galvanized protected threads and the whole rod based on sound scientific principles. **If "hot-dip galvanized" is specified, the client is entitled to expect complete hot-dip galvanizing, including hot-dip galvanized rod threads.** In recognition of the integral, good practice galvanizing methods successfully applied to its rod systems.

Production process secures ensures that the thread at of the tension rod system is fully galvanized and secures standard tolerances for metric threads.

For additional safety with regard to the load-carrying capacity of the threads and sustainable performance, the internal threads of BESISTA® rod anchors are about 40% longer than necessary. Millions of threads – successfully in use since 1987 – are a further testament to our quality philosophy.

3. Resistances

The resistances of the BESISTA® Rod System are determined by a design concept that refers to the following standards and specifications:

- EN 1993-1-1
- EN 1993-1-8
- ETA-08/0038

3.1 Tension rods

To avoid confusion with steel of lower strength, Peikko always supplies special S460N as standard. Tension rods of special S460N must be supplied exclusively by Peikko. For BESISTA® Tension Rod Systems, the required thread screw-in depth is ensured by the inspection hole. The cover sleeves are not structurally necessary.

Table 9. Limit tensile forces in [kN] BESISTA®.

	Special S460N Tension rods $f_{y.k}$ = 540 N/mm² $f_{u.k}$ = 720 N/mm² E = 210 000 N/mm²		
Gusset plates Circular discs	S355	EN-GJS-400-18C-LT	S235
Rod anchors	EN-GJS400-18C-LT	EN-GJS400-18C-LT	EN-GJS-400-18C-LT
M	Standard type Material combination 1	Material combination 2	Material combination 3
	$N_{R,d}$ [kN]	$N_{R,d}$ [kN]	$N_{R,d}$ [kN]
8	19	16.4	15.4
10	30.1	27.3	25.6
12	43.7	40.9	38.5
14	59.6	57.3	53.8
16	81.4	81.4	76.9
18	100.1	92	86.5
20	127	122.7	110.5
22	157.1	135	121.5
24	183	163.6	147.3
27	237.9	202.5	182.3
30	290.8	255.7	230.1
33	359.8	337.5	303.8
36	423.5	368.2	331.4
39	506	465.3	418.8
42	581.1	501.1	451
45	677	613.6	552.3
48	763.6	654.5	589.1
52	911.3	797.7	686
56	1052.4	954.5	820.9
60	1224.5	1125	967.5
64	1387.2	1200	1032
68	1583.7	1390.9	1196.2
72	1795.2	1595.5	1372.1
76	2016.1	1813.6	1559.7

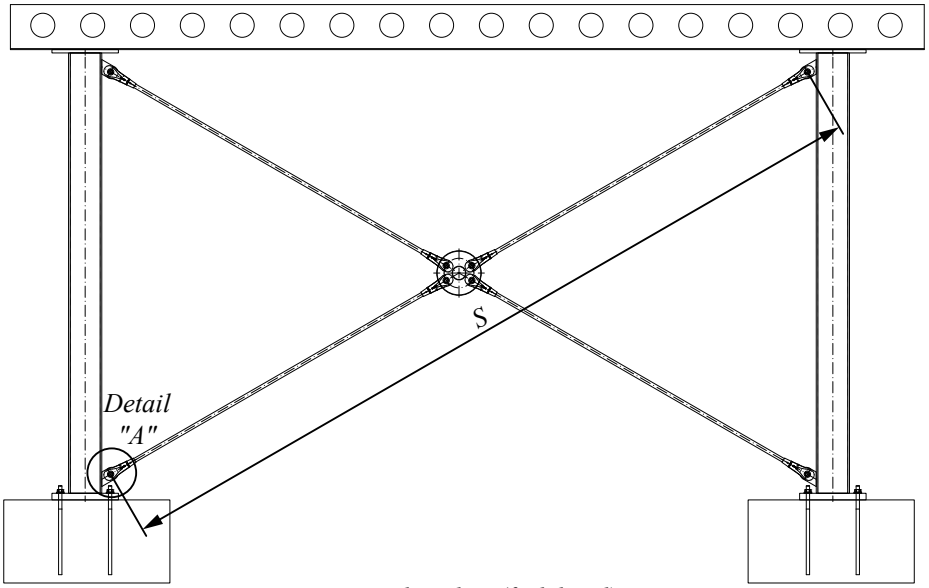
3.2 Compression rods

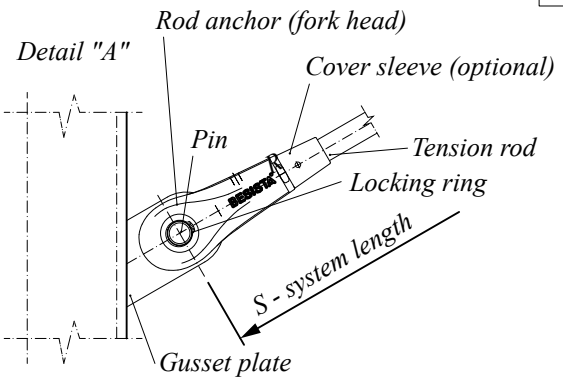
The limit compression forces shall comply with values presented in *Table 10*. The buckling verification shall be performed in each individual case by the responsible designer according to the relevant standard. In case of the compression rod connection types 2 and 3, made of S355 (compression cone), the limit compression forces depend on the buckling resistance of the timber or steel tube and compression resistance of the compression cone. All types are individually manufactured by Peikko in accordance with the client's structural design.

Table 10. Limit compression forces in [kN] BESISTA® in compression cone.

M	For gusset plates made of S355							
	Type 1 Solid rods up to Ø76	Types 2 and 3 Compression cone of S355 for timber or welding to steel tubes made of S355						
	S460N EN 10025-3	S355 EN 10025-2 (reduction levels $f_{y.k}$, Ø)						
		$f_{y.k}$= 355	$f_{y.k}$= 345	$f_{y.k}$= 335	$f_{y.k}$= 325	$f_{y.k}$= 315	$f_{y.k}$= 295	$f_{y.k}$= 285	$f_{y.k}$= 275
		[N/mm²]						
	Ø8 to Ø76	Ø ≤ 16	16 < Ø ≤ 40	40 < Ø ≤ 63	63 < Ø ≤ 80	80 < Ø ≤ 100	100 < Ø ≤ 150	150 < Ø ≤ 200	200 < Ø ≤ 250
	$N_{R,d}$ [kN]							
8	19.0	12.4				12.4	11.9	11.9	11.9
10	30.1	19.6				19.6	18.8	18.8	18.8
12	43.7	28.5				28.5	27.3	27.3	27.3
14	59.6	38.9				38.9	37.3	37.3	37.3
16	81.4	53.1				53.1	50.9	50.9	50.3
18	100.1	65.3				65.3	62.5	62.5	62.5
20	127.0	82.9				82.9	79.4	79.4	78.6
22	157.1	102.5				102.5	98.2	98.2	95.0
24	183.0	119.5				119.5	114.4	114.4	113.1
27	237.9	155.3				155.3	148.7	148.4	143.2
30	290.8	189.8				189.8	181.8	181.8	176.7
33	359.8	234.8				234.8	224.9	221.6	213.8
36	423.5	276.5				276.5	264.7	263.7	254.5
39	506.0	330.3				330.3	316.2	309.5	298.7
42	581.1	379.3				379.3	363.2	358.9	346.4
45	677.0	442.0				442.0	423.1	412.1	397.6
48	763.6	498.5				498.5	477.3	468.9	452.4
52	911.3	594.9				594.9	569.5	550.2	530.9
56	1052.4	687.0				687.0	657.7	638.1	615.8
60	1224.5	779.3				799.3	758.3	732.6	706.9
64	1387.2	905.6				905.6	862.7	833.5	804.3
68	1583.7	1033.8				1033.8	974.0	940.9	907.9
72	1795.2	1171.9				1165.9	1091.9	1054.9	1017.9
76	2016.1	1316.0				1299.1	1216.6	1175.4	1134.1

Selecting BESISTA®





Input data:

Material: S355
System length: S = 4842 mm
Force: N_{Ed} = 175 kN
Finish: Hot Dipped galvanized (HDG)

Output data:

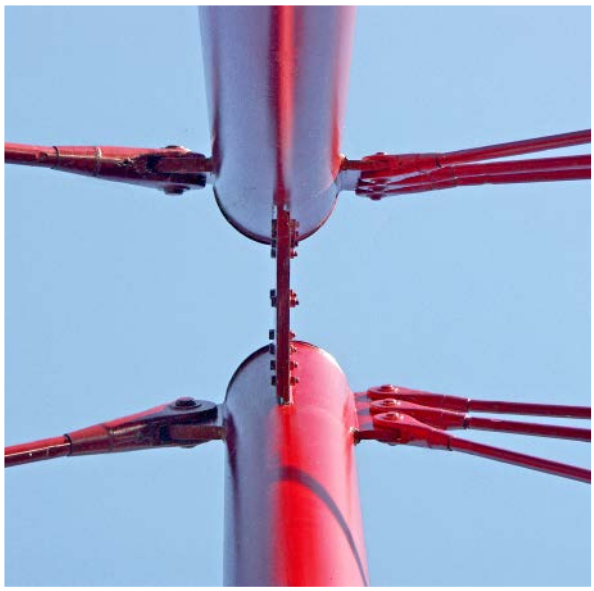
Material: S460N (with guaranteed f_{yk} = 540 N/mm^2)
BESISTA® 2-540 cross bracing with circular disc M24; N_{Rd} = 183 kN

Item list				
Rods [pcs]	Rod length [mm]	Rod anchors [pcs]	Cover sleeves [pcs]	Circular disc [pcs]
4	2206	8	8	1

Annex A – Worked Examples

Bridge with lookout tower near Redwitz, Germany

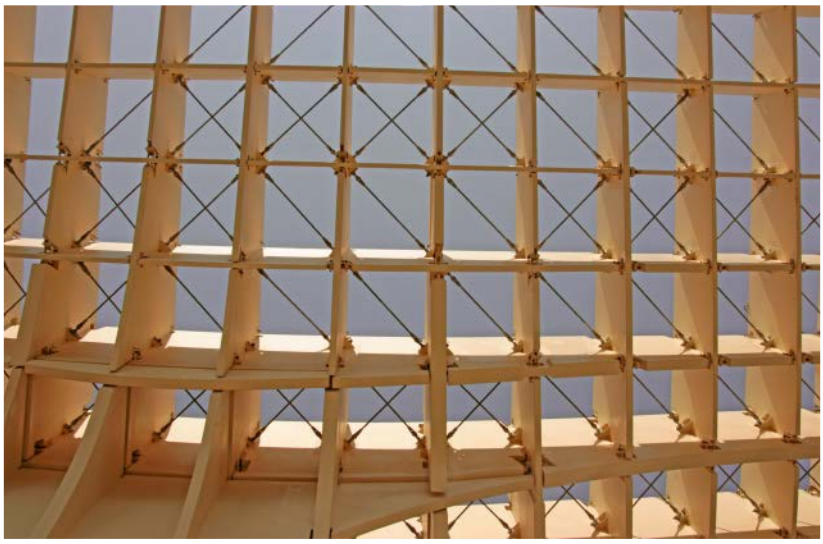
The lookout tower on top of the very interesting bridge offers a fantastical view stretching over the Rodach river to the historical town of Redwitz. The pedestrian bridge was built with the BESISTA® Rod System. The BESISTA® Rod System do not only stabilizes the bridge, but it also improves the preventive flood control, thus protecting the environment.



ANNEX A

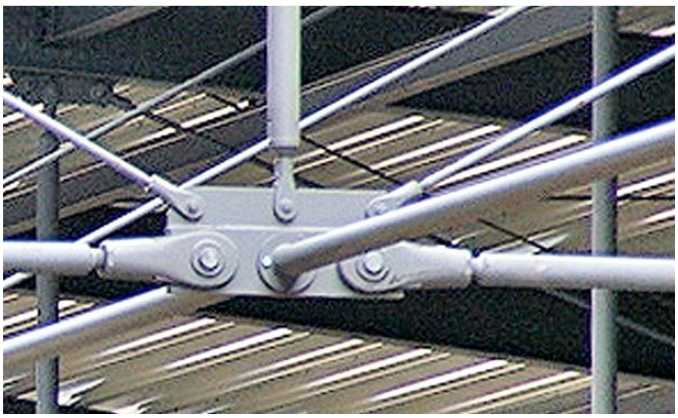
Metropol Parasol, Seville, Spain

The 3,600 BESISTA® Tension Rod Systems, with all their high-quality features, blend seamlessly with the structure's organic forms. The BESISTA® Tension Rod System with its consistently supreme standards of safety and reliability vouches for the stability of the filigree assembly. After scooping the Red Dot Design Award in 2012, the exceptional design concept was nominated for the 2013 Mies van der Rohe Award.

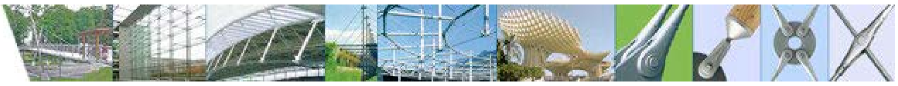


Fire Brigade, Mönchengladbach, Germany

One example of an intelligent combination of tension rods and compression struts are the bracings and underpinnings of the “Feuer- und Rettungswache II“ in Mönchengladbach, Germany. The building serves as a modern technical and logistics center of the Mönchengladbach Fire Brigade and accommodates up to 20 emergency forces.



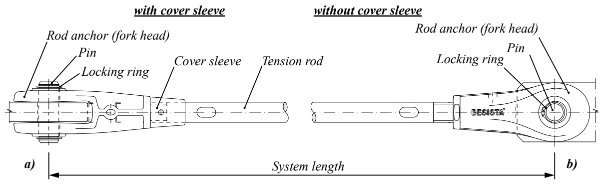
Annex B – Order form



BESISTA® rod systems

Peikko BESISTA® GmbH DE 73087 Bad Boll Reuteweg 3 Tel +49 7164 9123 9-0 Fax -17 besista@peikko.com

ISO 9001:2015 **ETA-08/0038** **0672-CPD-0091/BI14** **www.besista.com**



☐ **Enquiry** ☐ **Order**

Customer: ....

Street: ....

Location / post code: ....

Phone / Fax: ....

Email: ....

Date: ....

Project. / No.: ....

Officer: ....

BESISTA® Tension Rod System under European technical approval ETA-08/0038, each consisting of 2 rod anchors (fork heads) made of EN-GJS-400-18-LT with cross-pins and locking rings and 1 tension rod with left-hand / right-hand thread and wrench flats, made of special S460N with guaranteed yield strength of 540 N/mm².

Please enter all data and send a drawing

☐ The offer is for a current project ☐ The offer is for an offer on your part

☐ Interior ☐ Exterior Limit tensile forces $N_{R,d}$ in kN determined for: ☐ Deformation ☐ Tensile force

Steel grade according to statics: ☐ S235 ☐ S355 ☐ S460 ☐ S540 ☐ Delivery date ________________

☐ Hot-dip galvanized with hot-dip galv. rod threads ☐ Without cover sleeves ☐ With cover sleeves

$N_{R,d}$ [kN]	M (Ø)	System length [mm]	Quantity	$N_{R,d}$ [kN]	M (Ø)	System length [mm]	Quantity
....	....	....	....	....	....	....	....
....	....	....	....	....	....	....	....
....	....	....	....	....	....	....	....
....	....	....	....	....	....	....	....
....	....	....	....	....	....	....	....
....	....	....	....	....	....	....	....
....	....	....	....	....	....	....	....
....	....	....	....	....	....	....	....
....	....	....	....	....	....	....	....
....	....	....	....	....	....	....	....
....	....	....	....	....	....	....	....
....	....	....	....	....	....	....	....

BESISTA® Circular discs made of S355 or **BESISTA® Cross anchors** made of EN-GJS-400-18-LT

☐ Circular discs ☐ Cross anchors ☐ Hot-dip galvanized

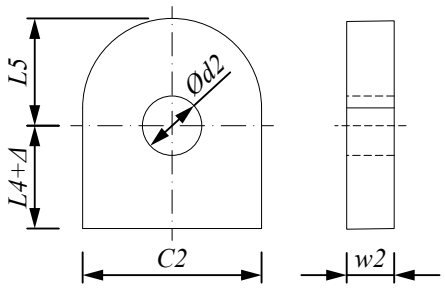
for M (Ø)	smallest angle	Quantity	for M (Ø)	smallest angle	Quantity
....	....	....	....	....	....
....	....	....	....	....	....
....	....	....	....	....	....
....	....	....	....	....	....

BESISTA® Compression Rod System - please send us a drawing with dimensions.

Annex C – Gusset plate recommended values

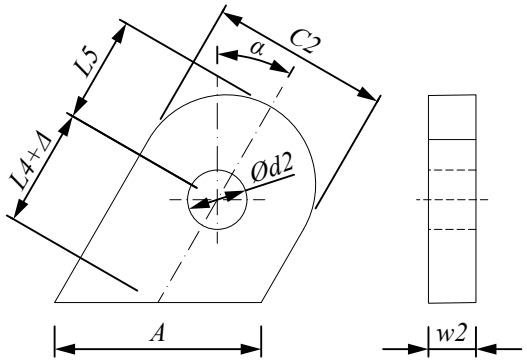
The values of gusset plate dimensions are calculated for S355J2 as standard material. The total length of the plate must be defined by the structural engineer defining the size of the welds and installation tolerances.

Type 1



M	Gusset plates					
	Ø d2	w2	L4	L5	C2	Δ
	[mm]					
8	8.5	6	15	16	28	To be designed by the structural engineer, size of the weld + installation tolerance
10	11	8	18	20	35	
12	13	10	21	23	41	
14	15	12	25	27	47	
16	17	15	28	31	52	
18	19	15	32	34	57	
20	21	18	35	37	62	
22	23	18	39	42	70	
24	25	20	42	45	75	
27	28	22	47	51	85	
30	31	25	53	56	93	
33	34	30	58	60	99	
36	37	30	63	67	112	
39	40	35	68	71	117	
42	43	35	74	78	130	
45	46	40	79	82	136	
48	50	40	84	91	153	
52	54	45	91	100	167	
56	58	50	99	106	175	
60	62	55	105	113	187	
64	66	55	112	122	203	
68	70	60	120	129	214	
72	74	65	126	135	224	
76	78	70	135	141	244	

Type 2



M	Gusset plates								
	Ø d2	w2	L4	L5	C2	α = 10°	α = 20°	α = 30°	Δ
	[mm]					A			
8	8.5	6	15	16	28	29	30	33	To be designed by the structural engineer, size of the weld + installation tolerance
10	11	8	18	20	35	36	38	41	
12	13	10	21	23	41	42	44	48	
14	15	12	25	27	47	48	51	55	
16	17	15	28	31	52	53	56	61	
18	19	15	32	34	57	58	61	66	
20	21	18	35	37	62	63	66	72	
22	23	18	39	42	70	72	75	81	
24	25	20	42	45	75	77	80	87	
27	28	22	47	51	85	87	91	99	
30	31	25	53	56	93	95	99	108	
33	34	30	58	60	99	101	106	115	
36	37	30	63	67	112	114	120	130	
39	40	35	68	71	117	119	125	136	
42	43	35	74	78	130	133	139	151	
45	46	40	79	82	136	139	145	158	
48	50	40	84	91	153	156	163	177	
52	54	45	91	100	167	170	178	193	
56	58	50	99	106	175	178	187	203	
60	62	55	105	113	187	190	200	216	
64	66	55	112	122	203	207	217	235	
68	70	60	120	129	214	218	228	248	
72	74	65	126	135	224	228	239	259	
76	78	70	135	141	244	248	260	282	

Installation of BESISTA®

INSTALLING THE PRODUCT – CONSTRUCTION SITE

Peikko offers the BESISTA® Rod System for delivery as separate items or preassembled, which means rod anchors and all ordered accessories are assembled on rod.

The BESISTA® Rod System may only be preassembled upon the customer's request, and on the customer's own responsibility. Peikko recommends not preassembling the BESISTA® Rod System due to possible damage during transportation.

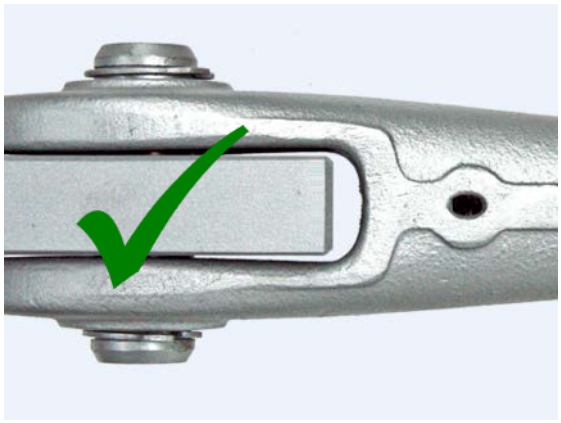
Although preassembled rod systems are often touted as a selling point, Peikko rejects this practice. **The fact that the rod anchors at the ends are far thicker than the tension rods makes preassembled systems extremely bulky and difficult to transport. It is impossible, without an inordinate amount of effort, to properly secure preassembled rod systems on trucks.** The problem becomes particularly acute where unloading and reloading is necessary during transit. The transportation of preassembled systems is also difficult to reconcile with existing European regulations.

Moreover, preassembled rod systems are particularly prone to damage and deformation during shipment and on site. Another potential hazard – especially with long rods – is that the rod anchors may work loose during transportation and cause serious accidents. **All these risks mean that nobody can accept liability for bent or damaged preassembled rod systems.** Moreover, all technical approvals – which are identical for all manufacturers – cease to be valid for bent or damaged systems.

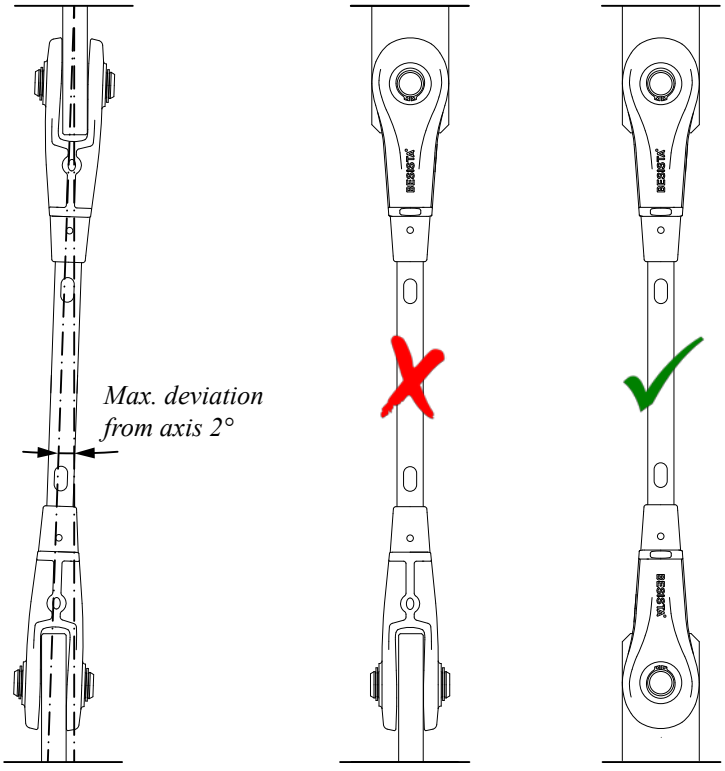
To minimize the risk of damage during shipment, Peikko ensures that the rods are properly prepared for transportation and for movement by stackers, forklifts, and cranes: placed on skids and arranged parallel in bundles to maximize stiffness, with threads well-protected. Peikko ships its rod anchors, pins and locking rings as well sorted and protected consignments in robust boxes or cage pallets. Proper packaging offers better protection whenever rod systems need to be stored for extended periods, especially on building sites. This also makes them easier to move with simple equipment than as bulky preassembled systems.

BESISTA® products do not require factory preassembly to check the fit of all system components. This is because, in line with precise standard engineering practice, our threads are manufactured and checked using thread gauges. To ensure high-quality assembly, Peikko recommends that the threads be rechecked for cleanliness immediately prior to installation. Only then should the threads be liberally greased or lubricated for the simplest screwing of rod anchor or other accessories. The BESISTA® Rod System must be assembled in accordance with the enclosed guidelines. The hot-dip galvanized rod threads allow instant and efficient installation without the need for any additional surface treatment such as sealing or spraying.

Do not pull apart or squeeze together the straps. The rod anchors must not be modified, deformed, heated, or subjected to sudden loads.



The plates must not collide with the straps.



Ensure the position of the rod anchor.

Revisions

Version: PEIKKO GROUP 04/2023. Revision: 001

- First publication.

Resources

DESIGN TOOLS

Use our powerful software every day to make your work faster, easier and more reliable. Peikko design tools include design software, 3D components for modeling programs, installation instructions, technical manuals and product approvals of Peikko's products.

peikko.com/design-tools

TECHNICAL SUPPORT

Our technical support teams around the world are available to assist you with all of your questions regarding design, installation etc.

peikko.com/technical-support

APPROVALS

Approvals, certificates and documents related to CE-marking (DoP, DoC) can be found on our websites under each products' product page.

peikko.com/products

EPDS AND MANAGEMENT SYSTEM CERTIFICATES

Environmental Product Declarations and management system certificates can be found at the quality section of our websites.

peikko.com/qehs

Quality Management certified
according to DIN EN ISO 9001

CE