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Mitglied der EOTA
Member of EOTA

European Technical Approval ETA-08/0038

English translation prepared by DIBt - Original version in German language

Handelsbezeichnung
Trade name

Zugstabsystem BESISTA 2-540
BESISTA 2-540 Tension Rod System

Zulassungsinhaber
Holder of approval

BESISTA-Betschart GmbH
Heckenweg 1
73087 Bad Boll

Zulassungsgegenstand
und Verwendungszweck
*Generic type and use
of construction product*

Vorgefertigtes Zugstabsystem
Prefabricated Tension Rod System

Geltungsdauer: vom
Validity: from
bis
to

18 April 2008
18 April 2013

Herstellwerk
Manufacturing plant

BESISTA-Betschart GmbH
Heckenweg 1
73087 Bad Boll

Diese Zulassung umfasst
This Approval contains

15 Seiten einschließlich 7 Anhänge
15 pages including 7 annexes



Europäische Organisation für Technische Zulassungen
European Organisation for Technical Approvals

I LEGAL BASES AND GENERAL CONDITIONS

- 1 This European technical approval is issued by Deutsches Institut für Bautechnik in accordance with:
 - Council Directive 89/106/EEC of 21 December 1988 on the approximation of laws, regulations and administrative provisions of Member States relating to construction products¹, modified by Council Directive 93/68/EEC² and Regulation (EC) N° 1882/2003 of the European Parliament and of the Council³;
 - Gesetz über das In-Verkehr-Bringen von und den freien Warenverkehr mit Bauprodukten zur Umsetzung der Richtlinie 89/106/EWG des Rates vom 21. Dezember 1988 zur Angleichung der Rechts- und Verwaltungsvorschriften der Mitgliedstaaten über Bauprodukte und anderer Rechtsakte der Europäischen Gemeinschaften (Bauproduktengesetz - BauPG) vom 28. April 1998⁴, zuletzt geändert durch Gesetz vom 06.01.2004⁵;
 - Common Procedural Rules for Requesting, Preparing and the Granting of European technical approvals set out in the Annex to Commission Decision 94/23/EC⁶.
- 2 Deutsches Institut für Bautechnik is authorized to check whether the provisions of this European technical approval are met. Checking may take place in the manufacturing plant. Nevertheless, the responsibility for the conformity of the products to the European technical approval and for their fitness for the intended use remains with the holder of the European technical approval.
- 3 This European technical approval is not to be transferred to manufacturers or agents of manufacturers other than those indicated on page 1, or manufacturing plants other than those indicated on page 1 of this European technical approval.
- 4 This European technical approval may be withdrawn by Deutsches Institut für Bautechnik, in particular pursuant to information by the Commission according to Article 5(1) of Council Directive 89/106/EEC.
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- 6 The European technical approval is issued by the approval body in its official language. This version corresponds fully to the version circulated within EOTA. Translations into other languages have to be designated as such.

1 Official Journal of the European Communities L 40, 11.02.1989, p. 12
2 Official Journal of the European Communities L 220, 30.08.1993, p. 1
3 Official Journal of the European Union L 284, 31.10.2003, p. 25
4 Bundesgesetzblatt I, p. 812
5 Bundesgesetzblatt I, p.2, 15
6 Official Journal of the European Communities L 17, 20.01.1994, p. 34

II SPECIFIC CONDITIONS OF THE EUROPEAN TECHNICAL APPROVAL

1 Definition of the product and intended use

1.1 Definition of the construction product

The construction product is a prefabricated tension rod system of different sizes (system sizes) used as a kit. The tension rod system consists of steel bars (tension rods) with external threads which are connected to each other and to the corresponding structure by special connecting devices. The tension rods are connected to the corresponding structure by cast fork end connectors with two eye loops and internal thread. The fork end connectors are connected by double shear pin connections to corresponding gusset plates or anchor discs. The tension rods are connected to each other by threaded sleeves (turnbuckles, couplers).

The tension rod system comprises tension rods, fork end connectors and threaded sleeves (turnbuckles, couplers) with metric ISO threads M 6 to M 76.

Drawings of the tension rod system and the components as well as the essential dimensions of the components are given in the Annexes to this ETA.

1.2 Intended use

The tension rod system is intended for the use in structures with predominantly static loads. Furthermore the installed tension rod system shall be accessible (in order) to facilitate replacement of individual components at any time.

The intended use comprises for instance the suspension of roof structures or vertical glazing as well as bracing and truss structures.

The fork end connectors may also be connected to compression bars. The compression bars themselves are not part of the ETA.

The provisions made in this European technical approval are based on an assumed working life of the tension rod system of 25 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.

2 Characteristics of the product and methods of verification

2.1 Characteristics of the product

2.1.1 Dimensions

The dimensions of the components of the tension rod system shall correspond to the drawings given in Annexes 3 to 7. The dimensions and tolerances of the components of the tension rod system not indicated in Annexes 3 to 7 shall correspond to the respective values and information laid down in the technical documentation⁷ to this European technical approval.

2.1.2 Material properties

The material properties of the components of the tension rod system shall correspond to the values and European standards given in Annex 2. The relation to the different components is given in Annexes 3 to 7.

⁷ The technical documentation to this European technical approval is deposited with Deutsches Institut für Bautechnik and, as far as relevant for the tasks of the approved bodies involved in the attestation of conformity procedure is handed over to the approved bodies.

The material characteristics of the components of the tension rod system not indicated in Annex 2 shall correspond to the respective values and information laid down in the technical documentation to this European technical approval.

2.1.3 Design values of resistance

2.1.3.1 Design tension resistance of the entire tension rod system

The design value N_{Rd} of the tension resistance of the entire tension rod system (tension rods, fork end connectors incl. pins, couplers, turnbuckles, gusset plates and anchor discs) is the minimum value of the design tension resistance $N_{Rd, \text{Tension Rod}}$ of the tension rod, the design tension resistance $N_{Rd, \text{Turnbuckle}}$ of the turnbuckle, the design tension resistance $N_{Rd, \text{Coupler}}$ of the coupler and the design bearing resistance $N_{Rd, \text{Gusset Plate/Anchor Disc}}$ of the gusset plate or anchor disc.

The design values shall be determined according to EN 1993-1-1:2005 and EN 1993-1-8:2005 as follows:

$$N_{Rd, \text{Tension Rod}} = \min \{ A \cdot f_{y,k} / \gamma_{M1}; 0.9 \cdot A_S \cdot f_{u,k} / \gamma_{M2} \}$$

A = minimum cross section of the unthreaded part of the tension rod

A_S = cross section of the threaded part of the tension rod

$f_{y,k}$ = characteristic value of the yield strength of the tension rod according to the minimum value of R_e and $R_{p0.2}$ respectively given in Annex 2

$f_{u,k}$ = characteristic value of the tensile strength of the tension rod according to the minimum value of R_m given in Annex 2

$$N_{Rd, \text{Turnbuckle}} = A \cdot f_{y,k} / \gamma_{M1}$$

A = minimum cross section of the unthreaded part of the turnbuckle

$f_{y,k}$ = characteristic value of the yield strength of the turnbuckle according to the minimum value of R_e and $R_{p0.2}$ respectively given in Annex 2

$$N_{Rd, \text{Coupler}} = A_S \cdot f_{u,k} / \gamma_{M2}$$

A_S = cross section of the threaded part of the coupler

$f_{u,k}$ = characteristic value of the tensile strength of the coupler according to the minimum value of R_m given in Annex 2

$$N_{Rd, \text{Gusset Plate/Anchor Disc}} = 1.5 \cdot w_2 \cdot \varnothing d_1 \cdot f_{y,k} / \gamma_{M1}$$

w_2 = thickness of gusset plate or anchor disc according to Annexes 3 and 5

$\varnothing d_1$ = pin diameter according to Annex 3

$f_{y,k}$ = characteristic value of the yield strength of the gusset plate or anchor disc according to the minimum value of R_e and $R_{p0.2}$ respectively given in Annex 2

γ_{M1} = 1.10

γ_{M2} = 1.25

The values given for the partial safety factors γ_{M1} and γ_{M2} are recommended values. They should be used in cases where no values are given in national regulations of the Member State where the tension rod system is used or in the respective National Annex to Eurocode 3.

2.1.3.2 Design compression resistance of the fork end connectors

The design compression resistance of the fork end connectors used for the connection to compression bars is at least equal to the tension resistance $N_{Rd, \text{Tension Rod}}$ of the tension rods according to 2.1.3.1.

2.1.4 Safety in case of fire

The tension rod system is considered to satisfy the requirements of performance class A1 of the characteristic reaction to fire.

2.2 Methods of verification

2.2.1 General

The assessment of fitness of the tension rod system for the intended use in relation to the requirements for mechanical resistance and stability, safety in case of fire and safety in use in the sense of the essential requirements No. 1, No. 2 and No. 4 has been made in accordance with the "Common Understanding and Assessment Procedure (CUAP) for Tension Rod System" (Final version, February 2003; ETA request No 06.02/02).

2.2.2 Essential requirement No. 2: Safety in case of fire

The tension rod system is considered to satisfy the requirements of performance class A 1 of the characteristic reaction to fire, in accordance with the provisions of EC Decision 96/603/EC (as amended) without the need for testing on the basis of its listing in that decision.

2.2.3 Essential requirement No. 1: Mechanical resistance and stability

Essential requirement No. 4: Safety in use

In order to verify that the tension resistance of the fork end connectors is higher than the tension resistance of the corresponding tension rods made of steel grade S460N and thus not relevant to the resistance of the entire tension rod system, the characteristic values of the tension resistance of the fork end connectors were assessed by the evaluation of the results of tension tests. Tension tests were carried out on 18 system sizes of the fork end connectors.

Comparison of characteristic values of resistance of the corresponding tension rods calculated according to EN 1993-1-1:2005 and EN 1993-1-8:2005 with the statistically evaluated test results (characteristic values) has shown that the tension resistance of the fork end connectors (including pins) is not relevant to the tension resistance of the entire tension rod system. Thus it is sufficient to calculate only the tension resistance of the tension rods, turnbuckles and couplers as well as the bearing resistance of the gusset plates and anchor discs in order to determine the tension resistance of the entire tension rod system.

Due to the fact that the compression and tension resistance of the fork end connectors are identical the compression resistance of the fork end connectors is at least equal to the tension resistance of the tension rods.

3 Evaluation and attestation of conformity and CE marking

3.1 System of attestation of conformity

According to the Decision 98/214/EC of the European Commission⁸ system 2+ of the attestation of conformity applies.

This system of attestation of conformity is defined as follows:

System 2+: Declaration of conformity of the product by the manufacturer on the basis of:

- (a) Tasks for the manufacturer:
 - (1) initial type-testing of the product;
 - (2) factory production control;

⁸ Official Journal of the European Communities L 80 of 18.03.1998

- (3) testing of samples taken at the factory in accordance with a prescribed test plan.
- (b) Tasks for the approved body:
 - (4) certification of factory production control on the basis of:
 - initial inspection of factory and of factory production control;
 - continuous surveillance, assessment and approval of factory production control.

Note: Approved bodies are also referred to as "notified bodies".

3.2 Responsibilities

3.2.1 Tasks for the manufacturer

3.2.1.1 Factory production control

The manufacturer shall exercise permanent internal control of production. All the elements, requirements and provisions adopted by the manufacturer shall be documented in a systematic manner in the form of written policies and procedures, including records of results performed. This production control system shall insure that the product is in conformity with this European technical approval.

The manufacturer may only use initial materials stated in the technical documentation of this European technical approval.

The factory production control shall be in accordance with the "control plan of xx.04.2008 relating to the European technical approval ETA – 08/0038 issued on xx.04.2008" which is part of the technical documentation of this European technical approval. The control plan is laid down in the context of the factory production control system operated by the manufacturer and deposited with Deutsches Institut für Bautechnik.⁹

The results of factory production control shall be recorded and evaluated in accordance with the provisions of the control plan.

3.2.1.2 Other tasks for the manufacturer

The manufacturer shall, on the basis of a contract, involve a body which is approved for the tasks referred to in section 3.1 in the field of tension rod systems in order to undertake the actions laid down in section 3.2.2. For this purpose, the control plan referred to in sections 3.2.1.1 and 3.2.2 shall be handed over by the manufacturer to the approved body involved.

The manufacturer shall make a declaration of conformity, stating that the construction product is in conformity with the provisions of the European technical approval ETA – 08/0038 issued on xx.04.2008.

3.2.2 Tasks for the approved bodies

The approved body shall perform the

- initial inspection of factory and of factory production control,
 - continuous surveillance, assessment and approval of factory production control,
- in accordance with the provisions laid down in the control plan.

The approved body shall retain the essential points of its actions referred to above and state the results obtained and conclusions drawn in a written report.

The approved certification body involved by the manufacturer shall issue an EC certificate of conformity of the factory production control stating the conformity with the provisions of this European technical approval.

⁹

The "control plan" is a confidential part of the European technical approval and only handed over to the approved body involved in the procedure of attestation of conformity. See section 3.2.2.

In cases where the provisions of the European technical approval and its control plan are no longer fulfilled the certification body shall withdraw the certificate of conformity and inform Deutsches Institut für Bautechnik without delay.

3.3 CE marking

The CE marking shall be affixed on each packaging of the tension rod system. The letters "CE" shall be followed by the identification number of the approved certification body, where relevant, and be accompanied by the following additional information:

- the name and address of the producer (legal entity responsible for the manufacture),
- the last two digits of the year in which the CE marking was affixed,
- the number of the EC certificate for the factory production control,
- the number of the European technical approval,
- the name of the product,
- the system size and type (e.g., M 36).

4 Assumptions under which the fitness of the product for the intended use was favourably assessed

4.1 Manufacturing

The European technical approval is issued for the product on the basis of agreed data/information, deposited with Deutsches Institut für Bautechnik, which identifies the product that has been assessed and judged. Changes to the product or production process, which could result in this deposited data/information being incorrect, should be notified to Deutsches Institut für Bautechnik before the changes are introduced. Deutsches Institut für Bautechnik will decide whether or not such changes affect the approval and consequently the validity of the CE marking on the basis of the approval and if so whether further assessment or alterations to the approval shall be necessary.

4.2 Installation

The installation is carried out such that the tension rod system is accessible for repair or maintenance at any time.

The installation is only carried out according to the manufacturer's instructions. The manufacturer hands over the assembly instructions to the assembler. From the assembly instructions it is followed that, prior to installation, all components of the tension rod system shall be checked for their perfect condition and that damaged components shall not be used.

The fork end connectors are not subjected to sudden or impact loads (for instance pins of fork end connectors may not be adjusted by hammer blows).

The minimum thread engagements are marked in an appropriate way. The keeping of the minimum thread engagements "MeT" and "GL" given in Annexes 3 and 6 is checked by the assembler. How to do this is described in the assembly instructions.

The conformity of the installed tension rod system with the provisions of the ETA is attested by the executing assembler.

4.3 Design

The loading is predominantly static.

Dimensions, material properties and thread engagements "MeT" and "GL" as stated in the ETA are observed.

The tension rod system is not subjected to systematic bending.

The verification concept stated in EN 1990:2002 as well as the values of resistance stated in 2.1 are used for design.

The rules given in ENV 1090-1:1996 and EN ISO 12944:1998 are taken into account.

Design is carried out by the designer of the structure experienced in the field of steel structures.

5 Indications to the manufacturer

The manufacturer shall ensure that the information on the specific conditions according to 1, 2, 4.2 and 4.3 (including Annexes referred to) is given to those who are concerned. This information may be given by reproduction of the respective parts of the European technical approval.

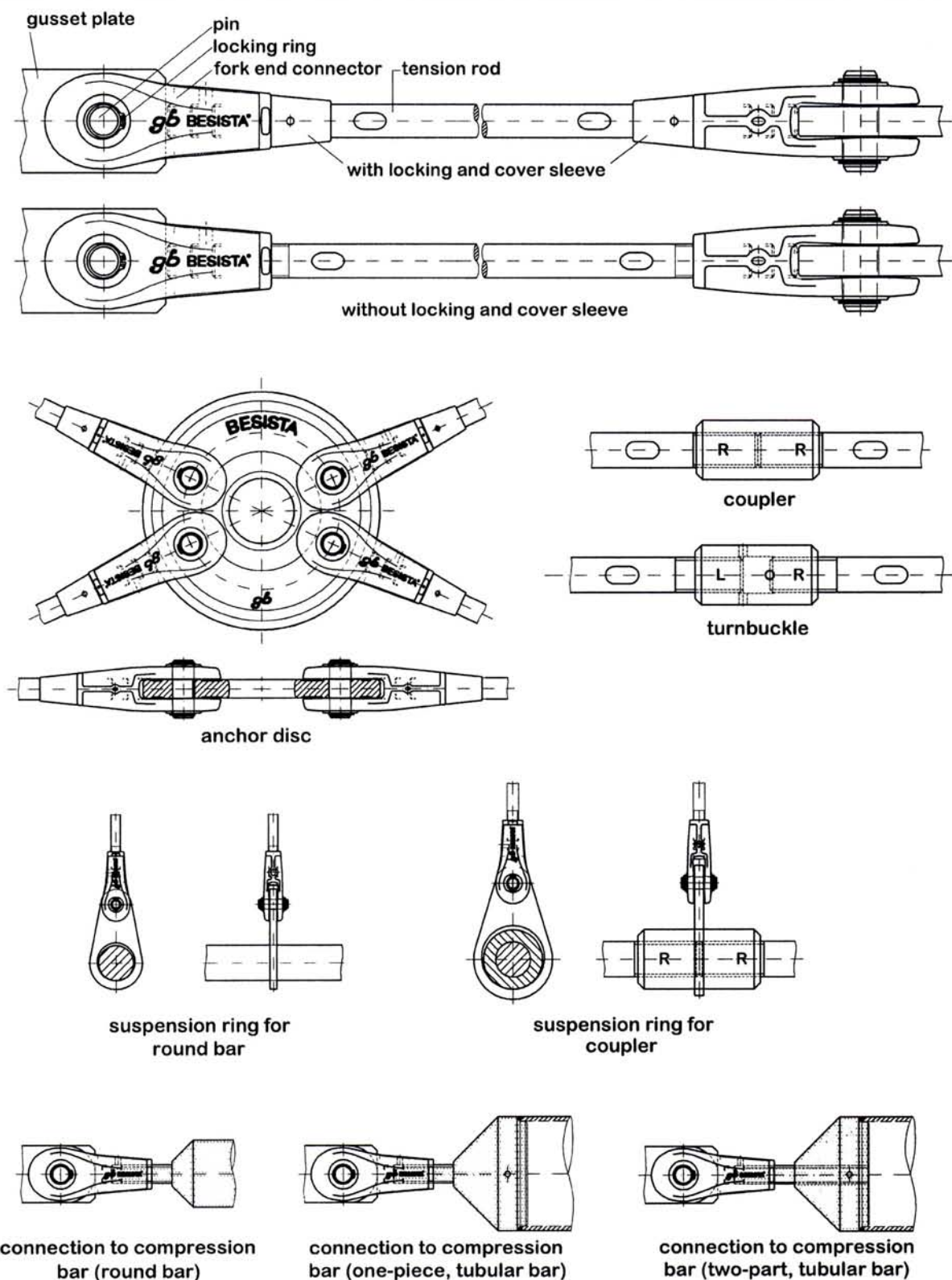
In addition all essential installation data (e.g., minimum thread engagement "MeT" and "GL" according to Annexes 3 and 6) shall be shown clearly on the package and/or on an enclosed instruction sheet, preferably using illustration(s).

The prefabricated tension rod system shall be packaged and delivered as a complete unit only (tension rods, fork end connectors incl. pins, turnbuckles, couplers and anchor discs).

The fork end connectors used for the connection to compression bars may also be delivered separately.

In Vertretung
Vice-President of Deutsches Institut für Bautechnik
Berlin, 18 April 2008

beglaubigt
Dr. Hothan



BESISTA 2-540 Tension Rod System

System, components

Annex 1

to European technical approval

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Component	Material / Steel grade	Yield strength $R_e / R_{p0.2}$ [N/mm ²]	Tensile strength R_m [N/mm ²]
Fork end connector	EN-GJS-400-18-LT	250	400
Tension rod	S460N (M 6 to M 48)	520	720
	S460N (M 52 to M 76)	540	720
	S355	according to EN 10025-2:2004	
	S235	according to EN 10025-2:2004	
Pin	S460N (M 6 to M 48)	520	720
	S460N (M 52 to M 76)	540	720
	8.8	according to EN ISO 898-1:1999	
	10.9	according to EN ISO 898-1:1999	
Gusset plate, Anchor disc	S355	according to EN 10025-2:2004	
	EN-GJS-400-18-LT	250	400
	EN-GJS-400-15	according to EN 1563: 1997 + /A1: 2002 + /A2: 2005	
	S235	according to EN 10025-2:2004	
Coupler, Turnbuckle	S460N (M 6 to M 48)	520	720
	S460N (M 52 to M 76)	540	720
	S460N	according to EN 10025-3:2004	
	20MnV6	according to EN 10294-1:2005	
	EN-GJS-400-18-LT	250	400
	S355J2H	according to EN 10210-1:2006	
	S355	according to EN 10025-2:2004	

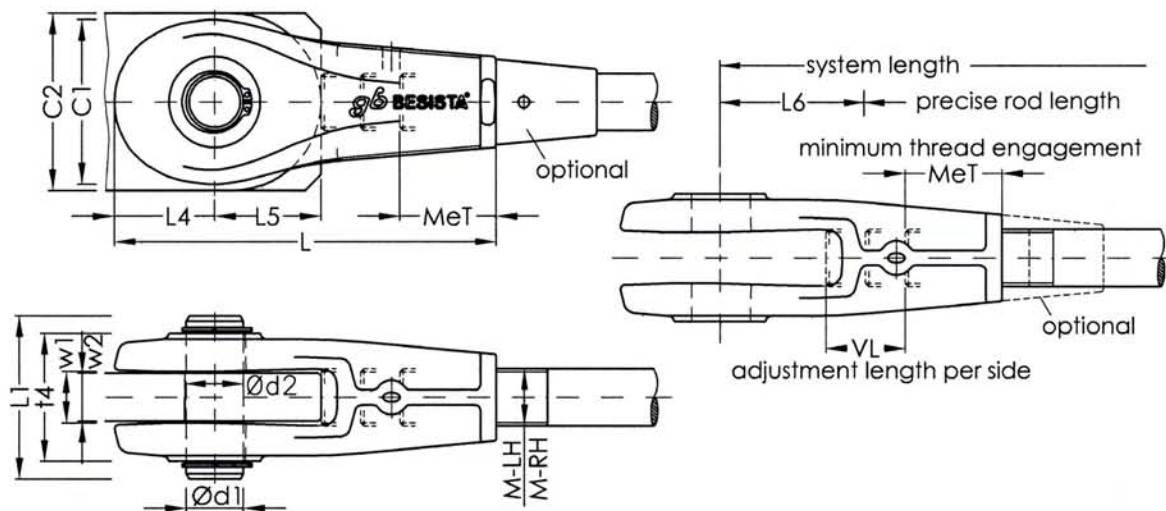
BESISTA 2–540 Tension Rod System

Material properties of components

Annex 2

to European technical approval

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M	fork end connector								pin		steel grade	gusset plate			
	C1	L4	w1	MeT	t4	L	VL	L6	Ø d1	L1		Ø d2	w2	L5	C2
6	18	11	6	10	13.5	45	12	18	6	20	S460N ($R_e = 520 \text{ N/mm}^2$, $R_m = 720 \text{ N/mm}^2$), 8.8 or 10.9	6.5	5	12	22
8	24	14.2	7	15.3	19	59.5	14	23	8	29.6		8.5	6	16	28
10	29	17.5	9.2	18	23	71.5	16	28	10	32.3		11	8	20	35
12	35.4	21	11.2	22	27.2	83.5	18	32	12	38.4		13	10	23	41
14	41.2	24.5	13.4	24.5	31.8	96	20	37	14	41.9		15	12	27	47
16	45.6	27.5	16.4	28	38.5	108.5	22	42	16	48.4		17	15	31	52
18	51.6	31.5	16.6	31.5	40.2	122	26	46	18	53.9		19	15	34	57
20	56	35	19.6	35	46.5	135	28	51	20	59.9		21	18	37	62
22	63	38.5	19.6	37.5	50	148	30	57	22	62.9		23	18	42	70
24	69	42	21.8	41	54.5	164	36	63	24	67.8		25	20	45	75
27	78	47	23.8	46	61.4	184	40	71	27	75.1	S460N ($R_e = 520 \text{ N/mm}^2$, $R_m = 720 \text{ N/mm}^2$)	28	22	51	85
30	86	52.5	27	51	67.6	203.5	44	78	30	82.1		31	25	56	93
33	95	57.5	32.2	56.5	78	220	46	83	33	92.6		34	30	60	99
36	104	63	32.2	61	80.8	241	50	92	36	98.8		37	30	67	112
39	112	68	37.4	66.5	90	259.5	54	98	39	106.8		40	35	71	117
42	121	73.5	37.4	70	95	279.5	58	107	42	115		43	35	78	130
45	129	79	42.8	76	105	301	64	114	45	126		46	40	82	136
48	138	84	42.5	81.5	110	325.5	70	125	48	129		50	40	91	153
52	149	91	47.8	87	120	351	74	137	52	145		54	45	100	167
56	161	99	52.8	93	132	378	80	146	56	158		58	50	106	175
60	173	105	58	99	142	401	84	155	60	168	S460N ($R_e = 540 \text{ N/mm}^2$, $R_m = 720 \text{ N/mm}^2$)	62	55	113	187
64	184	112	58	106	147	431	92	167	64	175		66	55	122	203
68	196	119.5	63	113	160	457.5	96	177	68	188		70	60	129	214
72	206	126	68	119	168	480	100	185	72	196		74	65	135	224
76	221	134.5	73	126	183	509.5	108	195	76	212		78	70	141	244

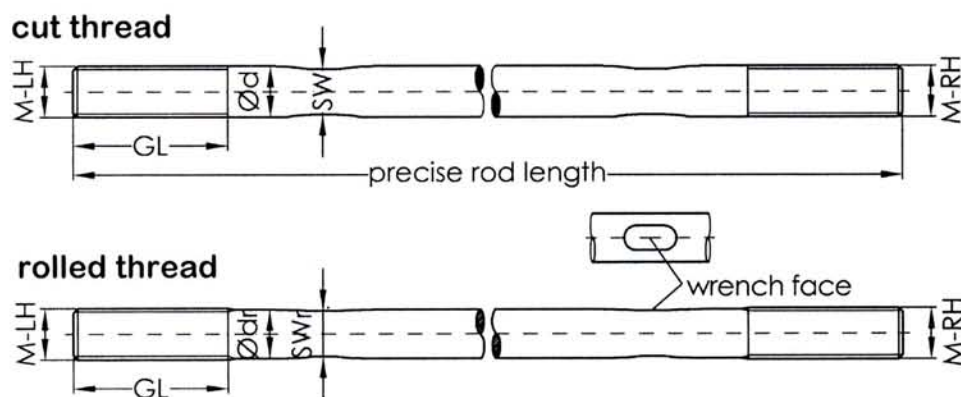
BESISTA 2-540 Tension Rod System

Fork end connector, pin, gusset plate

Annex 3

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***Note:** When using couplers and turnbuckles tension rods have a shorter thread length (GL-VH and GL-SH see Annex 6).

M	GL *	cut threads		rolled threads	
		$\varnothing d$	SW	$\varnothing dr$	SWr
6	28	6	5	5.3	4.5
8	34	8	7	7.1	6
10	39	10	9	8.9	8
12	45	12	11	10.8	10
14	51	14	13	12.6	11
16	57	16	15	14.5	13
18	65	18	16	16.2	15
20	71	20	18	18.2	16
22	75	22	20	20.2	18
24	87	24	22	22	20
27	96	27	25	25	23
30	107	30	28	27.5	25
33	114	33	30	30.5	28
36	124	36	33	33.2	30
39	133	39	36	36.2	33
42	142	42	39	39	36
45	154	45	42	42	39
48	166	48	45	44.7	42
52	175	52	49	48.7	45
56	189	56	52	52.3	49
60	199	60	56	56.3	52
64	216	64	60	60	56
68	227	68	64	64	60
72	237	72	68	68	64
76	252	76	72	72	68

BESISTA 2-540 Tension Rod System

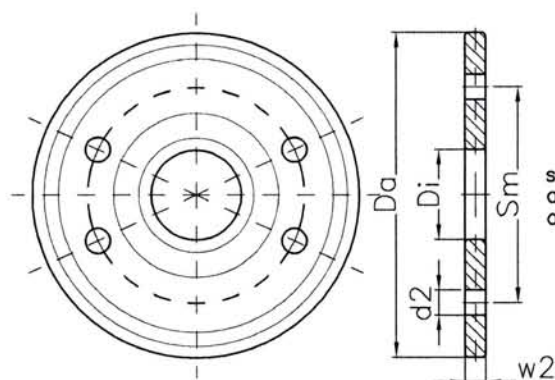
Tension rod

Annex 4

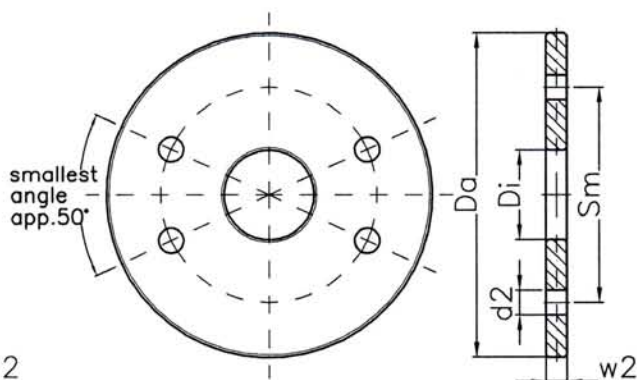
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anchor disc made of cast iron



anchor disc made of steel



Note: The anchor discs made of cast iron and the anchor discs made of steel have the same dimensions.

M	Da	Di	Sm	w2	d2
6	73	23	49	5	6.5
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

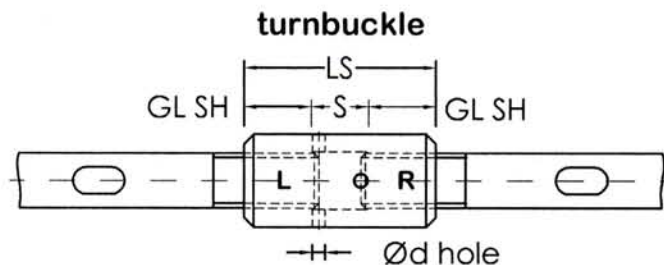
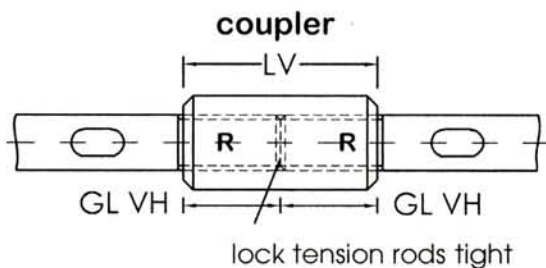
BESISTA 2-540 Tension Rod System

Anchor disc

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M	coupler (VH)		turnbuckle (SH)			
	GL VH	LV	GL SH	LS	S	Ø d hole
6	10.5	21	7.5	21	6	3
8	14	28	10	28	8	4
10	17.5	35	12.5	35	10	4
12	21	42	15	42	12	5
14	24.5	49	17.5	49	14	5
16	28	56	20	56	16	6
18	31.5	63	22.5	63	18	6
20	35	70	25	70	20	6
22	38.5	77	27.5	77	22	6
24	42	84	30	84	24	8
27	47.5	95	34	95	27	8
30	52.5	105	37.5	105	30	8
33	58	116	41.5	116	33	8
36	63	126	45	126	36	10
39	68.5	137	49	137	39	10
42	73.5	147	52.5	147	42	10
45	79	158	56.5	158	45	10
48	84	168	60	168	48	10
52	91	182	65	182	52	12
56	98	196	70	196	56	12
60	105	210	75	210	60	12
64	112	224	80	224	64	12
68	119	238	85	238	68	15
72	126	252	90	252	72	15
76	133	266	95	266	76	15

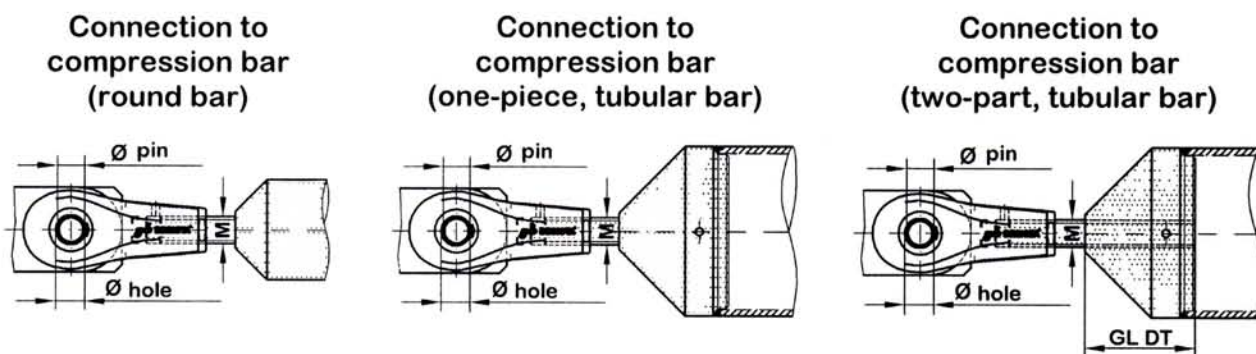
BESISTA 2-540 Tension Rod System

Annex 6

Turnbuckle, coupler

to European technical approval

ETA-08/0038



Note: The diameters of the pins for connections to compression bars are larger than the diameters of the pins for connections to tension rods.

M	Connection to compression bars		
	Ø pin	Ø hole	GL DT
6	8	8,5	1.20 x M
8	10	10,5	
10	12	13	
12	14	15	
14	16	17	
16	18	19	
18	20	21	
20	22	23	
22	24	25	
24	27	28	
27	30	31	
30	33	34	
33	36	37	
36	39	40	
39	42	43	
42	45	46	
45	48	49	
48	52	54	
52	56	58	
56	60	62	
60	64	66	
64	68	70	
68	72	74	
72	76	78	
76	80	82	

BESISTA 2-540 Tension Rod System

Annex 7

Connections to compression bars

to European technical approval

ETA-08/0038