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Bautechnisches Prüfamt

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European Technical Assessment ETA-06/0236 of 12 July 2018

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General Part

Technical Assessment Body issuing the European Technical Assessment:	Deutsches Institut für Bautechnik
Trade name of the construction product	m·connect Tension Rod System 460 / 560
Product family to which the construction product belongs	Prefabricated Tension Rod System
Manufacturer	MÜRMANN Gewindetechnik GmbH Wölzower Weg 27 19243 Wittenburg DEUTSCHLAND
Manufacturing plant	MÜRMANN Gewindetechnik GmbH Wölzower Weg 27 19243 Wittenburg DEUTSCHLAND
This European Technical Assessment contains	21 pages including 15 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 200032-00-0602
This version replaces	ETA-06/0236 issued on 21 October 2011

Deutsches Institut für Bautechnik
Kolonnenstraße 30 B | 10829 Berlin | GERMANY | Phone: +49 30 78730-0 | Fax: +49 30 78730-320 | Email: dibt@dibt.de | www.dibt.de

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Specific Part

1 Technical description of the 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 or stainless 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 steel cast or stainless steel / stainless steel cast fork end connectors with two eye loops and internal thread. The fork end connectors are connected by double shear pin connections to corresponding steel or stainless steel gusset plates. The tension rods are connected to each other by steel / steel cast or stainless steel / stainless steel cast threaded sleeves (couplers).

The tension rod system comprises tension rods, fork end connectors and threaded sleeves (couplers) with metric ISO threads M6 to M120.

A drawing of the tension rod system and the components as well as the essential dimensions of the components is given in the Annexes to this European technical approval.

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

The tension rod system is intended for the use in structures with static or quasi-static loads according to EN 1990:2002, where no verification of fatigue relating to EN 1993-1-9:2005 is necessary.

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

The tension rod system is not subjected to systematic bending.

The fork end connectors may also be connected to compression bars. The compression bars themselves with a strength class not higher than strength class S355 are not part of the ETA.

The performances given in Section 3 are only valid if the tension rod system is used in compliance with the specifications and conditions given in Annex A and Annexes B1 to B12.

The verifications and assessment methods on which this European Technical Assessment is based lead to the assumption of a working life of the tension rod system of at least 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.

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

3.1 Mechanical resistance and stability (BWR 1)

3.1.1 General

The dimensions, tolerances and materials of the components of the tension rod system not indicated in Annexes shall correspond to the respective values and information laid down in the technical documentation[1] to this European technical assessment.

3.1.2 Fork end connector, locking nut, coupler, turnbuckle, cross sleeve, pin, gusset plate, circlip

Essential characteristic	Performance
Geometry incl. tolerances	See Annexes B4, B5, B8 to B12
Dimensions incl. tolerances	
Thread incl. tolerances	
Material	See Annexes B2 and B3
Load bearing capacity	See Annex A
Resistance to corrosion	

3.1.3 Tension rod

Essential characteristic	Performance
Nominal rod diameter	See Annexes B6 and B7
Thread incl. tolerances	
Yield strength	See Annexes B2 and B3
Tensile strength	
Material	
Tension resistance	See Annex A
Compression force	
Resistance to corrosion	

3.2 Safety in case of fire (BWR 2)

Tension rod, fork end connector, locking nut, coupler, turnbuckle, cross sleeve, pin, gusset plate, circlip

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

The components of the tension rod system satisfy the requirements for performance class A1 of the characteristic reaction to fire, in accordance with the provisions of EC decision 96/603/EC (as amended).

3.3 Safety and accessibility in use (BWR 4)

Same as BWR 1.

[1] 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.

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

In accordance with European Assessment Document EAD No. 200032-00-0602, the applicable European legal act is: 98/214/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 12 July 2018 by Deutsches Institut für Bautechnik

BD Dipl.-Ing. Andreas Kummerow
Head of Department

beglaubigt:
Bertram

Annex A

A.1 Assumptions concerning design

The design of the tension rod system is carried out under the following conditions:

The loading is static or quasi-static according to EN 1990:2002 without need of verification of fatigue relating to EN 1993-1-9:2005.

The tension rod systems are not used, when constructions are susceptible to vibrations under wind loads or wind-induced cross vibrations of the entire construction appear.[2]

Dimensions, material properties and screw-in lengths "m2" given in Annexes B4 to B12 are observed.

The tension rod system is not subjected to systematic bending.

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

The rules given in EN 1090-2:2008, EN ISO 12944:1998 and EN 1993-1-4:2006 are taken into account.

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

Design tension resistance of the entire tension rod system:

The design value $F_{t,RD}$ of the tension resistance of the entire tension rod system (tension rod, fork end connector incl. couplers, turnbuckle, cross sleeves, gusset plates, circlips) is the minimum value of the design tension resistance $F_{t,RD,Tension\ Rod}$ of the tension rod, the design tension resistance $F_{t,RD,Turnbuckle}$ of the turnbuckle or cross sleeve and the design bearing resistance $F_{b,Rd,Gusset\ Plate}$ of the gusset plate.

The design values shall be determined according to EN 1993-1-1:2005, EN 1993-1-4:2006 and EN 1993-1-8:2005 as follows:

$$F_{t,RD,Tension\ Rod} = \min \{A \cdot f_{y,k}/\gamma_{M0};\ 0.9 \cdot A_S \cdot f_{u,k}/\gamma_{M2}\}$$

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

A_S = of the threaded part tensile stress area of the tension rod

$f_{y,k}$ = characteristic value of the yield strength of the tension rod material according to $R_{p0,2}$ given in Annexes B2 and B3

$f_{u,k}$ = characteristic value of the tensile strength of the tension rod material according to R_m given in Annexes B2 and B3

$$F_{t,RD,Turnbuckle} = A \cdot f_{y,k}/\gamma_{M0}$$

A = net cross section of the unthreaded part of the turnbuckle or cross sleeve

$f_{y,k}$ = characteristic value of the yield strength of the turnbuckle or cross sleeve material according to $R_{p0,2}$ given in Annexes B2 and B3

$$F_{b,Rd,Gusset\ Plate} = 1.5 \cdot T_1 \cdot D_1 \cdot f_{y,k}/\gamma_{M0}$$

T_1 = thickness of gusset plate according to Annex B4 and B5

D_1 = pin diameter according to Annex B4 and B5

[2] The national provisions of the Member State applicable for the location where the product is incorporated in the works shall be taken into account.

$f_{y,k}$ = characteristic value of the yield strength of the gusset plate material according to $R_{p0,2}$ given in Annexes B2 and B3

γ_{M0} = 1.1 for stainless steel

γ_{M0} = 1.0 for steel

γ_{M2} = 1.25

The values given for the partial safety factors γ_{M0} and γ_{M2} are recommended minimum 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.

Screw-in depths "m2" given in Annexes B4 to B12 have to be observed.

Design values of the compression force of tension rods

The design value of the compression force $F_{c,RD}$ of tension rods in combination with fork end connectors according to Annexes B4 and B5 is the minimum value of

- the design value of the compression force of struts in the cross-section of the thread and
- the design value of the compression force of struts calculated according to EN 1993-1-1:2005 or EN 1993-1-4:2006.

The strength class of the compression bars is limited to strength class S355.

Design value of the compression force of struts in the cross-section of the thread $F_{c,RD}$ should be determined as follows:

$$F_{c,RD} = \left[\frac{\gamma_{M2}}{A_S \cdot f_{u,c}} + \frac{\left(\frac{b - T_1}{2} + \frac{E}{50} \right) \cdot \gamma_{M0}}{W_{pl,S} \cdot f_{y,c}} \right]^{-1}$$

Where:

A_S tensile stress area of the thread

$W_{pl,S}$ plastic section modulus of the core cross section

$f_{y,c}$ characteristic value of the yield strength of the strut, where $f_{y,c} = R_{eH}$ characteristic value of the yield strength of the strut according to product standard

$f_{u,c}$ characteristic value of the tension resistance of the strut, where $f_{u,c} = R_m$ characteristic value of the tensile strength of the strut according to product standard

The dimensions of b, T_1 and E are stated in Annexes B4 and B5.

Recommended values for the partial safety factors γ_{M0} and γ_{M2} are:

γ_{M0} = 1.00 for steel

γ_{M0} = 1.10 for stainless steel

γ_{M2} = 1.25

The design value of the compression force of struts has to be determined according to EN 1993-1-1:2005 or EN 1993-1-4:2006 considering the additional bending strength in consequence of one-sided contact of the gusset plates.

In addition EN 1993-1-1:2005 or EN 1993-1-4:2006 applies for verification against buckling.

A.2 Assumptions concerning Installation

The installation of the tension rod system is carried out under the following conditions:

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 screw-in lengths are marked in an appropriate way. The keeping of the minimum screw-in lengths "m2" given in Annexes B4 to B12 is checked by the assembler. How to do this is described in the assembly instructions. The compliance of the screw-in lengths shall be attested with a written confirmation by a person responsible for the construction site.

All relevant components shall be checked continuously regarding corrosion damage after installation. The result of the checks should be recorded.

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

A.3 Indications to the manufacturer

The manufacturer shall ensure that the information on the specific conditions is given to those who are concerned. This information may be given by reproduction of the European Technical Assessment. In addition all essential installation data (e. g, minimum screw-in length "m2" according to Annexes B4 to B12) 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, cross sleeves and gusset plates).

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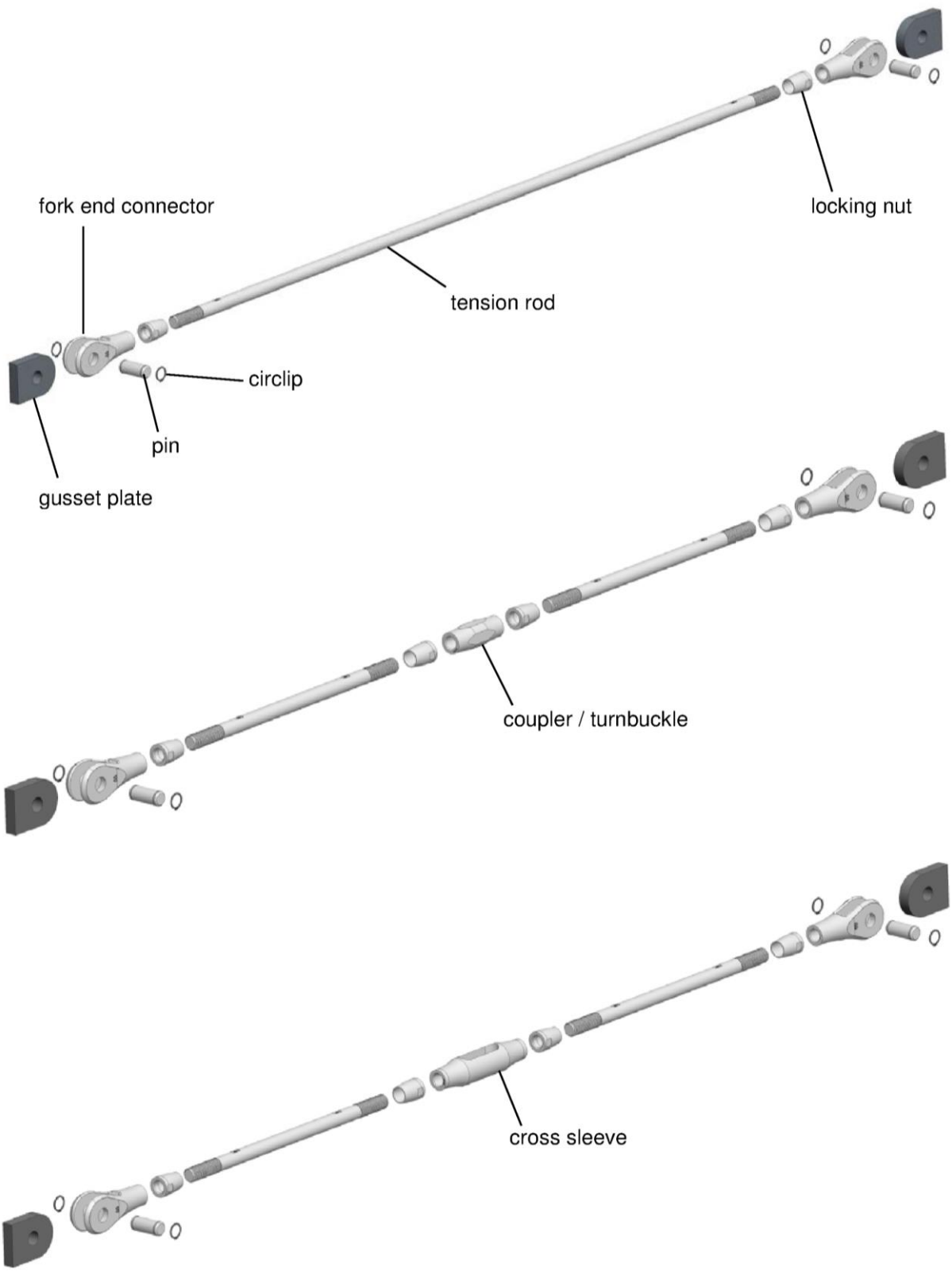

tension rod system 460 / 560	**Annex B1**
system components	

component	material		techn. delivery condition		mechanical properties (minimum values)			
	material or steel grade	material number			yield strength $R_{p0,2}$ [N/mm²]	tensile strength R_m [N/mm²]	elongation A_5 [%]	charpy impact value ISO-V ③ [K/°C]
fork end connector	G20Mn5+QT ①	1.6220	EN 10293:2012-02		360	500	22	27 / -20
locking nut	G20Mn5+N	1.6220	DIN EN 10293:2012-02	also other material allowed	-			
	S460N	1.8901	DIN EN 10025-3:2005-02					
	S355J2	1.0577	DIN EN 10025-2:2005-04					
	S355J0	1.0553	DIN EN 10025-2:2005-04					
	11SMn30	1.0715	DIN EN 10087:1999-01					
tension rod	S460N	1.8901	DIN EN 10025-3:2005-02		460	625	17	27 / -20
	21CrMoV5-7+QT	1.7709	DIN EN 10269:2014-02					
	S355J2	1.0577	DIN EN 10025-2:2005-04		360	490	17	27 / -20
	S355J0	1.0553	DIN EN 10025-2:2005-04					
	quenched and tempered steel		DIN EN 10083-1:2006-10		360	490	17	27 / -20
	S460N ②	1.8901	DIN EN 10025-3:2005-02		560	725	17	27 / -20
coupler turnbuckle cross sleeve	G20Mn5+QT ①	1.6220	DIN EN 10293:2012-02		360	500	22	27 / -20
	S460N	1.8901	DIN EN 10025-3:2005-02					
	S355J2	1.0577	DIN EN 10025-2:2005-04					
	21CrMoV5-7+QT	1.7709	DIN EN 10269:2014-02					
pin	8.8	-	DIN EN ISO 898-1:2013-05		640	800	12	acc. to techn. delivery condition
	10. 9	-	DIN EN ISO 898-1:2013-05					
	34CrNiMo6+QT	1.6582	DIN EN 10269:2014-02					
gusset plate	S355J2	1.0577	DIN EN 10025-2:2005-04	thickness	≤ 16 mm → 355 > 16 mm → 345 > 40 mm → 335 > 63 mm → 325 > 80 mm → 315 > 100 mm → 295	490	acc. to techn. delivery condition	
circlip	-	-	DIN 471:2011-04		-			

① the alternative use of other steel types acc. to DIN EN 10293:2012-02 are allowed if the mechanical properties are equal to G20Mn5+QT
② with manufacturer-specific requirements (higher steel grade)
③ $KV_{min} \geq 27$ J / -20°C

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Tension rod system 460 / 560

Material properties of stainless steel / stainless steel cast components

component	material		techn. delivery condition	mechanical properties (minimum values)			
	material or steel grade	material number		yield strength $R_{p0,2}$ [N/mm²]	tensile strength R_m [N/mm²]	elongation A_5 [%]	charpy impact value ISO-V ④ [K/°C]
fork end connector	GX2CrNiMoN22-5-3①	1.4470	EN 10283:2010	360	500	acc. to techn. delivery condition	
	GX2CrNiMoN25-6-3①	1.4468					
	X2CrNiMoN22-5-3	1.4462	EN 10088-3:2014-12				
locking nut	GX2CrNiMoN22-5-3①	1.4470	EN 10283:2010	-			
	GX2CrNiMoN25-6-3①	1.4468					
	X2CrNiMoN22-5-3	1.4462	EN 10088-3:2014-12				
tension rod	X2CrNiMoN22-5-3	1.4462	EN 10088-3:2014-12	460	625	acc. to techn. delivery condition	
	X2CrNiMo17-12-2	1.4404	EN 10088-3:2014-12				
	X3CrNiMo13-4	1.4313	EN 10088-3:2014-12				
	X6CrNiMoTi17-12-2	1.4571	EN 10088-3:2014-12	270 ③	500	acc. to techn. delivery condition	
	X5CrNi18-10	1.4301	EN 10088-3:2014-12	270 ③	500	acc. to techn. delivery condition	
coupler turnbuckle cross sleeve	GX2CrNiMoN22-5-3①	1.4470	EN 10283:2010	360	490	acc. to techn. delivery condition	
	GX2CrNiMoN25-6-3①	1.4468	EN 10283:2010				
	X2CrNiMoN22-5-3	1.4462	EN 10088-3:2014-12				
	X2CrNiMo17-12-2	1.4404	EN 10088-3:2014-12				
pin	X2CrNiMoN22-5-3	1.4462	EN 10088-3:2014-12	640	800	acc. to techn. delivery condition	
	X3CrNiMo13-4	1.4313	EN 10088-3:2014-12				
	X5CrNiCuNb16-4	1.4542	EN 10088-3:2014-12				
	X4CrNiMo16-5-1	1.4418	EN 10088-3:2014-12				
gusset plate	S355J2 ②	1.0577	EN 10025-2:2005-04	thickness: ≤ 16 mm → 355; > 16 mm → 345; > 40 mm → 335; > 63 mm → 325; > 80 mm → 315; > 100 mm → 295	490	acc. to techn. delivery condition	
	X2CrNiMo17-12-2	1.4404	EN 10088-3:2014-12			acc. to techn. delivery condition	
	X2CrNiMoN22-5-3	1.4462	EN 10088-3:2014-12				
circlip	-	1.4122	-	-			
		1.4034					

① in order to improve the corrosion behaviour a clean metallic surface is recommended
② S355J2 in carbon steel version
③ reduced load capacity
④ $KV_{min} \geq 27$ J / -20°C

Annex B3

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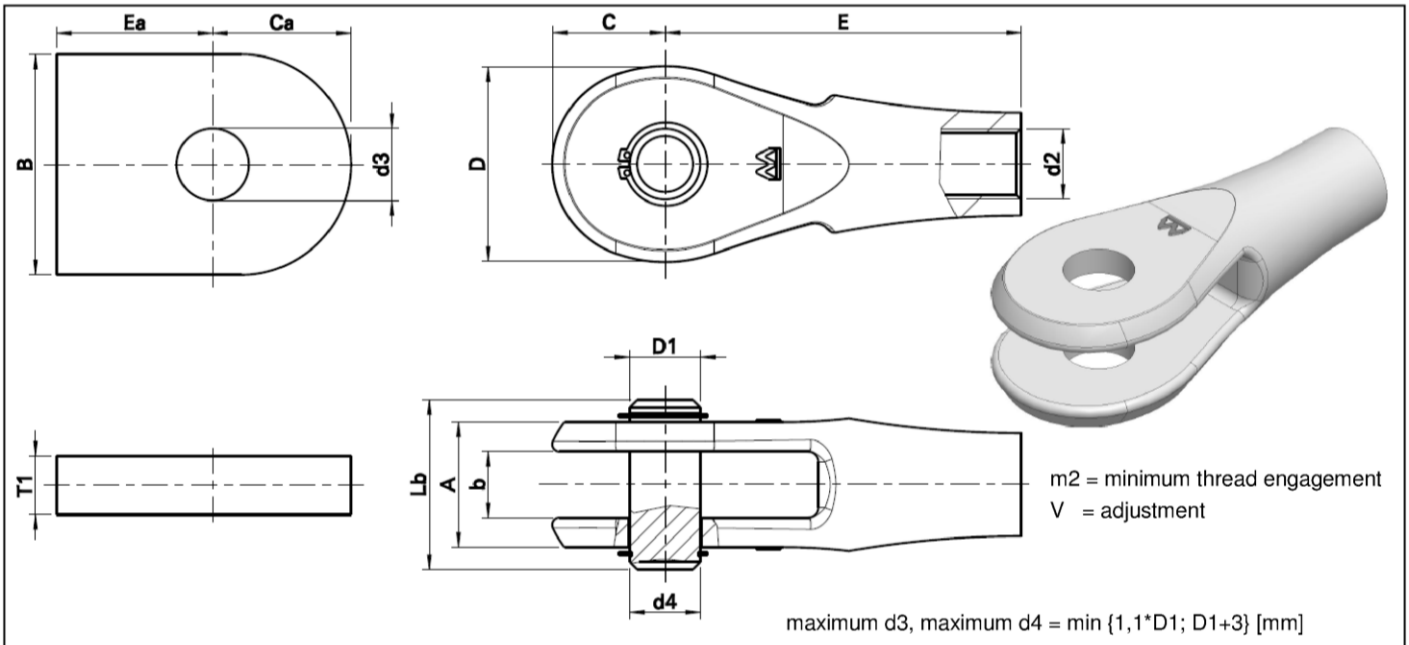

Größe	fork end connector									pin		gusset plate				
	d2 [mm]	A [mm]	b [mm]	E [mm]	C [mm]	d4 [mm]	D [mm]	V [mm]	m2 [mm]	D1 [mm]	Lb [mm]	B_{min} [mm]	T1 [mm]	Ca [mm]	Ea_{min} [mm]	d3 [mm]
M6	6,0	10,2	5,2	38,0	9,2	6,4	15,8	10,0	7,5	6,0	16,0	18,5	4,0	11,5	20,0	6,6
M8	8,0	13,5	6,5	47,0	12,0	8,4	20,4	12,0	9,5	8,0	20,5	25,0	5,0	15,5	22,0	8,6
M10	10,0	16,0	8,0	60,0	15,7	10,5	27,0	16,0	12,0	10,0	24,0	32,0	6,0	19,5	25,0	10,6
M12	12,0	20,0	10,0	70,0	18,6	12,6	32,0	20,0	14,0	12,0	29,0	37,0	8,0	22,5	30,0	12,7
M16	16,0	25,0	12,0	90,0	25,0	16,6	43,3	25,0	18,5	16,0	36,0	51,0	10,0	31,0	38,0	16,8
M20	20,0	31,0	14,0	106,0	30,5	20,6	52,5	25,0	23,0	20,0	44,0	64,0	12,0	39,0	45,0	20,8
M24	24,0	37,5	17,5	120,0	37,0	24,6	63,0	30,0	27,0	24,0	53,0	75,0	15,0	46,0	52,0	25,0
M30	30,0	48,5	22,5	136,0	45,0	30,6	78,6	30,0	34,0	30,0	67,5	91,0	20,0	56,0	62,0	31,0
M36	36,0	55,0	25,0	163,0	55,0	36,6	92,0	40,0	38,5	36,0	77,5	112,0	22,0	68,0	76,0	36,0
M42	42,0	64,0	28,0	198,0	65,4	42,6	110,0	50,0	47,0	42,0	89,5	135,0	25,0	82,0	90,0	43,0
M48	48,0	75,0	33,0	215,0	73,3	47,6	124,5	50,0	53,5	47,0	102,0	149,0	30,0	91,0	100,0	48,0
M56x4	56,0	86,0	38,0	251,0	87,0	55,7	148,5	60,0	60,0	55,0	117,0	176,0	35,0	107,0	120,0	56,0
M64x4	64,0	99,5	43,5	285,0	99,0	63,7	168,5	70,0	67,5	63,0	133,0	201,0	40,0	122,0	135,0	64,5
M72x4	72,0	119,5	53,5	318,0	108,7	72,7	187,0	80,0	75,0	72,0	156,0	225,0	50,0	137,0	145,0	73,5
M80x4	80,0	132,5	58,5	341,0	121,5	80,7	207,0	80,0	82,0	80,0	173,0	251,0	55,0	153,0	162,0	81,5
M90x4	90,0	147,5	63,5	383,0	135,7	90,7	232,5	90,0	91,0	90,0	192,0	286,0	60,0	174,0	180,0	91,5
M100x4	100,0	163,5	73,5	418,0	152,5	98,7	261,5	100,0	100,0	98,0	210,0	312,0	70,0	189,0	205,0	99,5

tension rod system 460 / 560

fork end connector, pin and gusset plate 460

Annex B4

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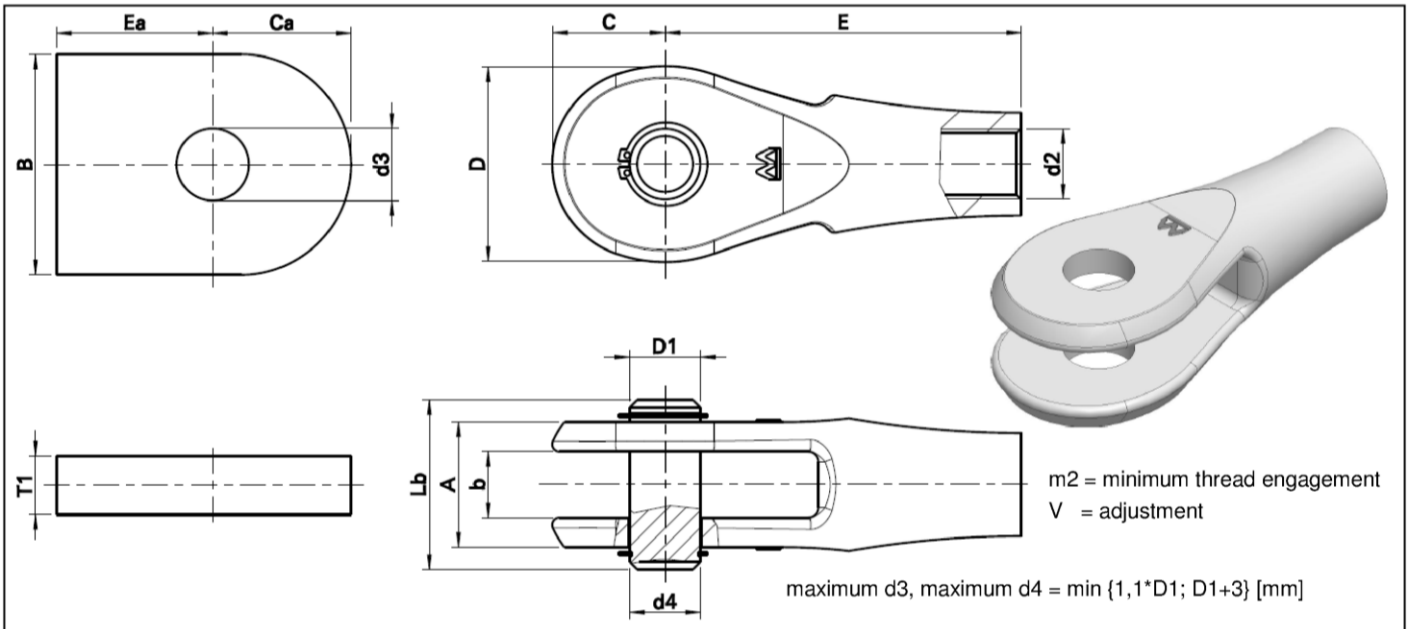


	fork end connector									pin		gusset plate				
system size	d2 [mm]	A [mm]	b [mm]	E [mm]	C [mm]	d4 [mm]	D [mm]	V [mm]	m2 [mm]	D1 [mm]	Lb [mm]	B_{min} [mm]	T1 [mm]	Ca [mm]	Ea_{min} [mm]	d3 [mm]
M6	6,0	11,2	6,2	40,5	9,5	6,4	16,0	10,0	7,5	6,0	17,0	20,0	5,0	14,0	20,0	6,5
M8	8,0	14,5	7,5	49,5	12,4	8,4	21,0	12,0	10,0	8,0	21,5	26,0	6,0	18,0	22,0	8,5
M10	10,0	18,0	10,0	62,5	16,3	10,5	28,0	16,0	12,0	10,0	26,0	33,0	8,0	22,0	26,0	10,5
M12	12,0	22,0	12,0	72,5	19,2	12,6	33,0	20,0	14,5	12,0	31,0	40,0	10,0	25,0	31,0	12,5
M16	16,0	30,0	17,0	92,0	25,9	16,6	45,0	25,0	19,5	16,0	41,0	52,0	15,0	33,0	39,0	16,5
M20	20,0	37,0	20,0	106,0	31,8	20,6	55,0	25,0	24,0	20,0	50,0	64,0	18,0	39,0	46,0	20,5
M24	24,0	42,5	22,5	121,0	38,3	24,6	67,0	30,0	29,0	24,0	58,0	75,0	20,0	47,0	53,0	24,5
M27	27,0	47,5	24,5	130,0	42,9	27,6	75,0	30,0	32,5	27,0	64,5	85,0	22,0	53,0	59,0	27,5
M30	30,0	53,5	27,5	142,0	47,3	30,6	83,0	30,0	36,0	30,0	72,5	92,0	25,0	60,0	64,0	30,5
M36	36,0	63,0	33,0	171,0	56,8	36,6	97,0	40,0	43,5	36,0	85,5	112,0	30,0	71,0	78,0	36,5
M42	42,0	74,0	38,0	201,5	67,0	42,6	114,0	50,0	50,5	42,0	99,5	130,0	35,0	82,0	92,0	42,5
M48	48,0	85,0	43,0	223,5	75,7	48,6	130,0	50,0	58,0	48,0	112,0	150,0	40,0	95,0	103,0	48,5
M52	52,0	93,0	48,0	245,5	82,5	52,6	142,0	55,0	62,5	52,0	122,0	165,0	45,0	104,0	112,0	52,5
M56x4	56,0	101,0	53,0	261,5	89,6	56,7	154,0	60,0	67,5	56,0	138,0	175,0	50,0	110,0	123,0	56,5
M60x4	60,0	110,5	58,5	278,5	96,0	60,7	166,0	65,0	72,0	60,0	148,5	188,0	55,0	117,0	130,0	61,0
M64x4	64,0	114,5	58,5	298,5	102,1	64,7	176,0	70,0	77,0	64,0	154,0	201,0	55,0	126,0	138,0	65,0
M72x4	72,0	134,5	68,5	331,5	114,6	72,7	196,0	80,0	86,5	72,0	177,0	225,0	65,0	139,0	151,0	73,0
M76x4	76,0	143,5	73,5	348,5	119,5	76,7	208,0	80,0	91,5	76,0	188,0	238,0	70,0	150,0	158,0	77,0
M80x4	80,0	147,5	73,5	358,0	126,3	81,5	218,0	80,0	96,0	80,0	194,0	260,0	70,0	156,0	167,0	81,0
M85x4	85,0	157,5	78,5	382,0	134,0	87,0	232,0	85,0	102,0	85,0	206,0	276,0	75,0	168,0	176,0	86,0
M90x4	90,0	167,5	83,5	401,0	142,4	92,0	247,0	90,0	108,0	90,0	218,0	290,0	80,0	175,0	187,0	91,0
M95x4	95,0	175,5	88,5	423,5	151,7	97,0	263,0	95,0	114,0	95,0	227,0	308,0	85,0	186,0	198,0	96,0
M100x4	100,0	184,5	93,5	442,0	160,3	102,0	278,0	100,0	120,0	100,0	237,0	320,0	90,0	193,0	213,0	101,0
M105x4	105,0	191,0	94,0	465,0	165,8	107,0	285,0	100,0	126,0	105,0	249,0	340,0	90,0	206,0	220,0	106,0
M110x4	110,0	202,0	99,0	490,0	172,6	112,0	295,0	110,0	132,0	110,0	260,0	354,0	95,0	214,0	230,0	111,0
M115x4	115,0	210,0	104,0	508,0	182,1	117,0	312,0	110,0	138,0	115,0	269,0	374,0	100,0	226,0	241,0	116,0
M120x4	120,0	224,0	114,0	530,0	190,1	122,5	326,0	120,0	144,0	120,0	281,0	386,0	110,0	233,0	250,0	121,0

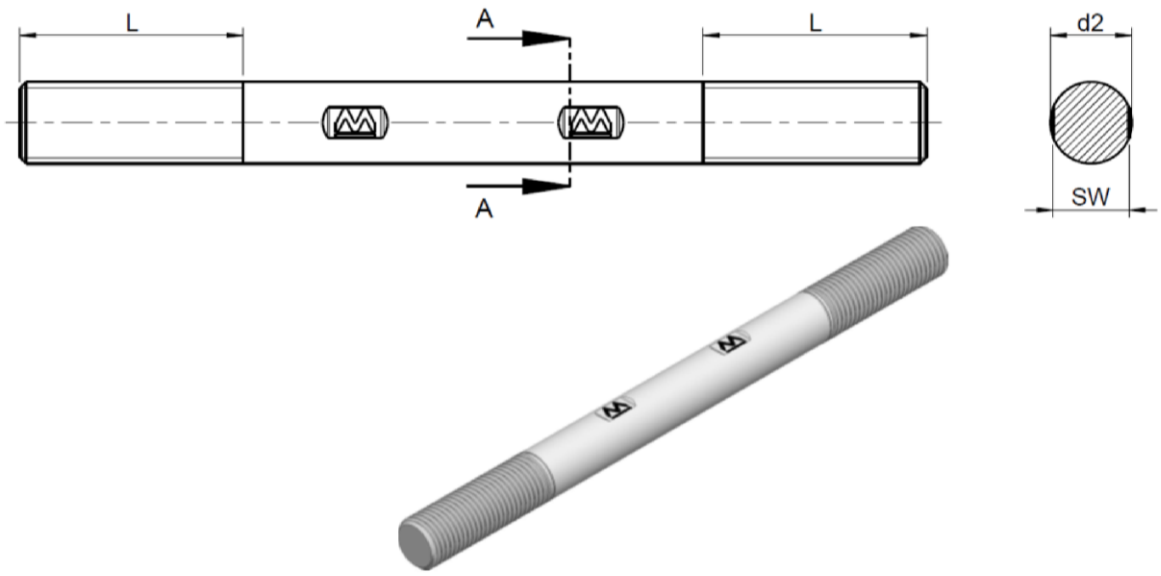
tension rod system 460 / 560

fork end connector, pin and gusset plate 560

Annex B5

Deutsches Institut für Bautechnik DIBt

cross-sectional area A-A

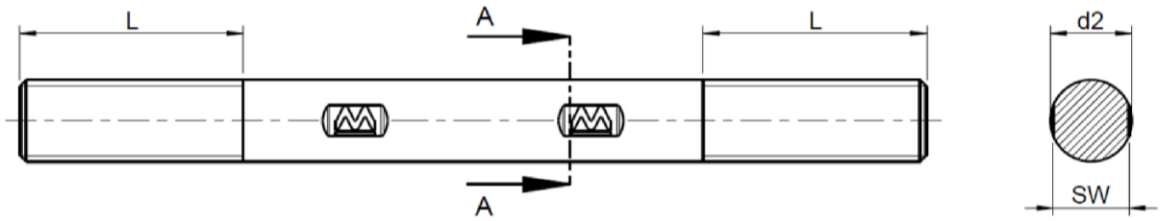


tension rod			
system size	d2 [mm]	L [mm]	SW [mm]
M6	6,0	21,0	5,0
M8	8,0	26,0	7,0
M10	10,0	33,0	9,0
M12	12,0	40,0	11,0
M16	16,0	52,0	15,0
M20	20,0	58,0	19,0
M24	24,0	69,0	22,0
M30	30,0	79,0	28,0
M36	36,0	96,0	32,0
M42	42,0	118,0	38,0
M48	48,0	127,0	46,0
M56x4	56,0	148,0	50,0
M64x4	64,0	169,0	60,0
M72x4	72,0	191,0	65,0
M80x4	80,0	202,0	75,0
M90x4	90,0	226,0	85,0
M100x4	100,0	250,0	95,0

tension rod system 460 / 560	**Annex B6**
tension rod 460	

Deutsches Institut für Bautechnik DIBt

cross-sectional area A-A



tension rod			
system size	d2 [mm]	L [mm]	SW [mm]
M6	6,0	21,0	5,0
M8	8,0	26,5	7,0
M10	10,0	33,0	9,0
M12	12,0	40,5	11,0
M16	16,0	53,0	15,0
M20	20,0	59,0	19,0
M24	24,0	71,0	22,0
M27	27,0	76,0	25,0
M30	30,0	81,0	28,0
M36	36,0	101,0	32,0
M42	42,0	122,0	38,0
M48	48,0	132,0	46,0
M52	52,0	143,0	50,0
M56x4	56,0	156,0	50,0
M60x4	60,0	167,0	55,0
M64x4	64,0	179,0	60,0
M72x4	72,0	203,0	65,0
M76x4	76,0	210,0	70,0
M80x4	80,0	216,0	75,0
M85x4	85,0	230,0	80,0
M90x4	90,0	243,0	85,0
M95x4	95,0	257,0	90,0
M100x4	100,0	270,0	95,0
M105x4	105,0	276,0	100,0
M110x4	110,0	297,0	105,0
M115x4	115,0	303,0	110,0
M120x4	120,0	324,0	115,0

tension rod system 460 / 560

tension rod 560

Annex B7

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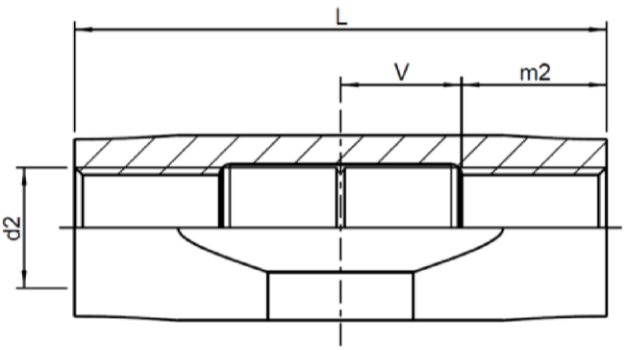

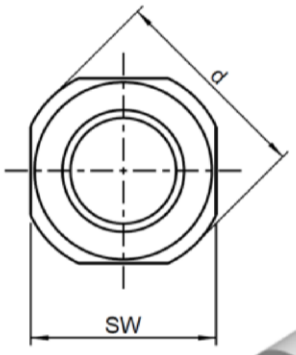

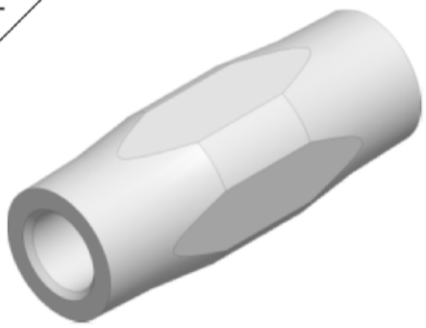

m2 = minimum thread engagement
V = adjustment

coupler / turnbuckle						
system size	**d2** [mm]	**d** [mm]	**L** [mm]	**SW** [mm]	**V** [mm]	**m2** [mm]
M6	6	11,5	35	10	10	7,5
M8	8	14,5	43	13	12	9,5
M10	10	18,0	56	16	16	12,0
M12	12	20,0	68	18	20	14,0
M16	16	27,0	87	24	25	18,5
M20	20	33,0	96	30	25	23,0
M24	24	40,0	114	36	30	27,0
M30	30	51,0	128	46	30	34,0
M36	36	61,0	157	55	40	38,5
M42	42	72,0	194	65	50	47,0
M48	48	83,0	207	75	50	53,5
M56x4	56	94,0	240	85	60	60,0
M64x4	64	111,0	275	100	70	57,5
M72x4	72	122,0	310	110	80	75,0
M80x4	80	138,5	324	125	80	82,0
M90x4	90	155,0	362	140	90	91,0
M100x4	100	172,0	400	155	100	100,0

tension rod system 460 / 560	**Annex B8**
coupler / turnbuckle 460	

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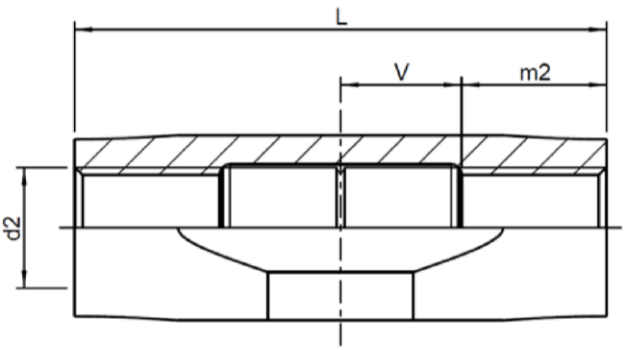
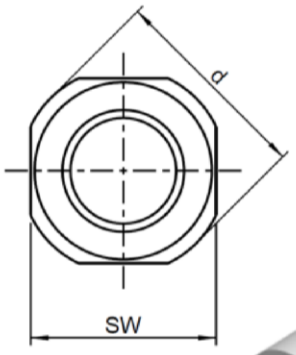
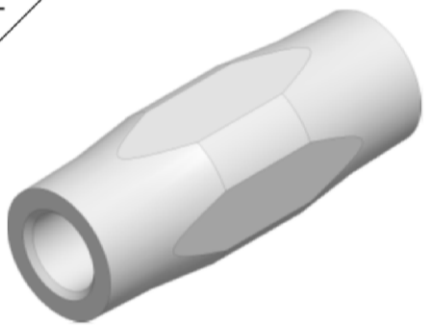






m2 = minimum thread engagement
V = adjustment

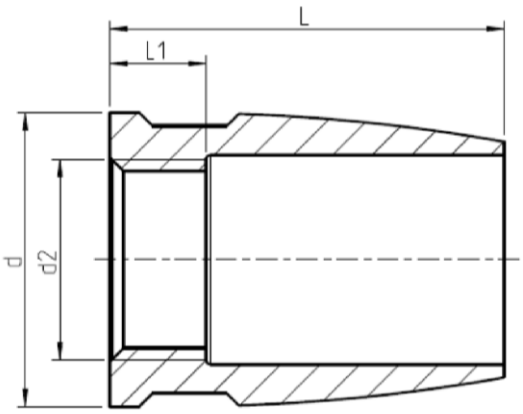
coupler / turnbuckle

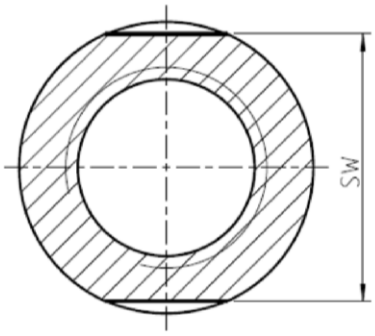
system size	d2 [mm]	d [mm]	L [mm]	SW [mm]	V [mm]	m2 [mm]
M6	6,0	11,5	35,0	10,0	10,0	7,5
M8	8,0	14,5	44,0	13,0	12,0	10,0
M10	10,0	18,0	56,0	16,0	16,0	12,0
M12	12,0	20,0	69,0	18,0	20,0	14,5
M16	16,0	27,0	89,0	24,0	25,0	19,5
M20	20,0	33,0	98,0	30,0	25,0	24,0
M24	24,0	40,0	118,0	36,0	30,0	29,0
M27	27,0	45,5	125,0	41,0	30,0	32,5
M30	30,0	51,0	132,0	46,0	30,0	36,0
M36	36,0	61,0	167,0	55,0	40,0	43,5
M42	42,0	72,0	201,0	65,0	50,0	50,5
M48	48,0	83,0	216,0	75,0	50,0	58,0
M52	52,0	88,5	235,0	80,0	55,0	62,5
M56x4	56,0	98,0	255,0	90,0	60,0	67,5
M60x4	60,0	105,0	274,0	95,0	65,0	72,0
M64x4	64,0	111,0	294,0	100,0	70,0	77,0
M72x4	72,0	124,0	333,0	115,0	80,0	86,5
M76x4	76,0	130,0	343,0	120,0	80,0	91,5
M80x4	80,0	139,0	352,0	125,0	80,0	96,0
M85x4	85,0	147,0	374,0	135,0	85,0	102,0
M90x4	90,0	155,0	396,0	140,0	90,0	108,0
M95x4	95,0	164,0	418,0	150,0	95,0	114,0
M100x4	100,0	172,0	440,0	155,0	100,0	120,0
M105x4	105,0	178,5	452,0	160,0	100,0	126,0
M110x4	110,0	185,0	484,0	170,0	110,0	132,0
M115x4	115,0	195,0	496,0	180,0	110,0	138,0
M120x4	120,0	202,0	528,0	190,0	120,0	144,0

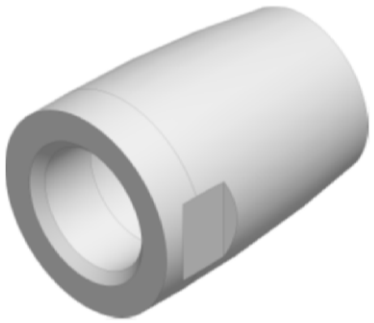
tension rod system 460 / 560

coupler / turnbuckle 560

Annex B9







locking nut					
system size	**d2** [mm]	**d** [mm]	**L** [mm]	**L1** [mm]	**SW** [mm]
M6	6,0	9,0	16,5	3,5	8,0
M8	8,0	11,5	20,0	4,3	10,0
M10	10,0	14,5	25,5	5,0	13,0
M12	12,0	17,5	31,0	5,8	16,0
M16	16,0	23,5	39,5	8,5	22,0
M20	20,0	29,0	42,5	10,0	27,0
M24	24,0	35,0	51,0	12,0	32,0
M30	30,0	44,0	55,5	15,0	41,0
M36	36,0	52,5	57,5	17,5	46,0
M42	42,0	61,5	71,0	21,0	55,0
M48	48,0	70,5	73,5	23,5	65,0
M56x4	56,0	82,8	88,0	28,0	80,0
M64x4	64,0	94,5	101,5	31,5	90,0
M72x4	72,0	106,0	116,0	36,0	100,0
M80x4	80,0	118,0	120,0	40,0	115,0
M90x4	90,0	133,0	135,0	45,0	125,0
M100x4	100,0	147,5	150,0	50,0	140,0

tension rod system 460 / 560	**Annex B10**
locking nut 460	

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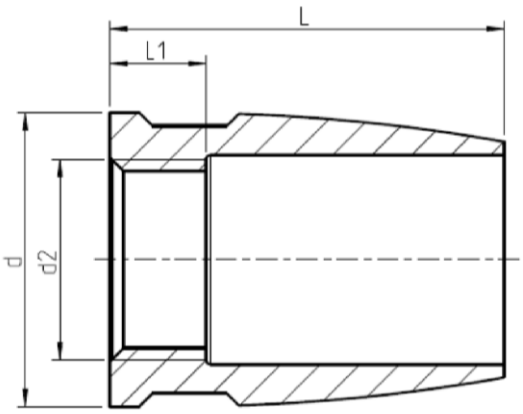
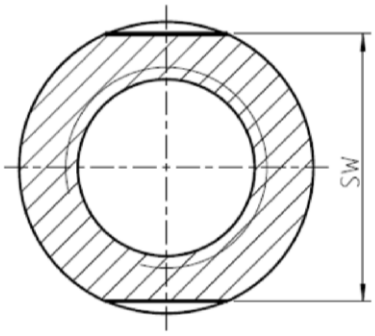
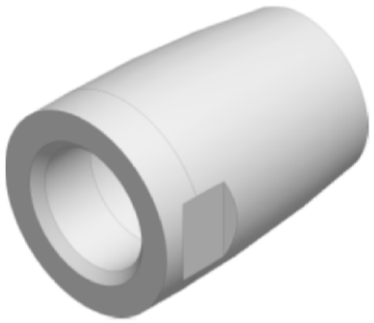






locking nut

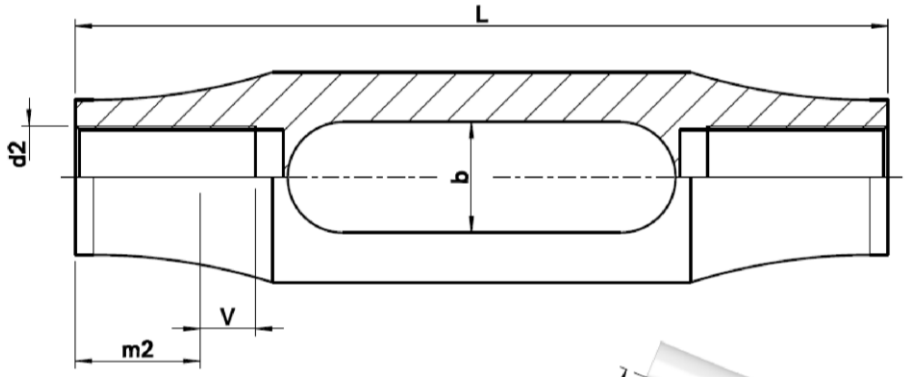
system size	d2 [mm]	d [mm]	L [mm]	L1 [mm]	SW [mm]
M6	6,0	9,0	16,5	3,5	8,0
M8	8,0	11,5	20,0	4,3	10,0
M10	10,0	14,5	25,5	5,0	13,0
M12	12,0	17,5	31,0	5,8	16,0
M16	16,0	23,5	39,5	8,5	22,0
M20	20,0	29,0	42,5	10,0	27,0
M24	24,0	35,0	51,0	12,0	32,0
M27	27,0	39,5	53,0	13,0	36,0
M30	30,0	44,0	55,5	15,0	41,0
M36	36,0	52,5	57,5	17,5	46,0
M42	42,0	61,5	71,0	21,0	55,0
M48	48,0	70,5	73,5	23,5	65,0
M52	52,0	77,0	80,5	25,5	70,0
M56x4	56,0	84,0	88,0	28,0	80,0
M60x4	60,0	90,0	94,5	29,5	85,0
M64x4	64,0	96,5	101,5	31,5	90,0
M72x4	72,0	108,5	116,0	36,0	100,0
M76x4	76,0	115,0	118,0	38,0	110,0
M80x4	80,0	120,5	120,0	40,0	115,0
M85x4	85,0	128,5	127,5	42,5	120,0
M90x4	90,0	136,0	135,0	45,0	125,0
M95x4	95,0	144,0	142,5	47,5	135,0
M100x4	100,0	151,0	150,0	50,0	140,0
M105x4	105,0	158,0	150,0	50,0	150,0
M110x4	110,0	165,5	165,0	55,0	155,0
M115x4	115,0	172,5	170,0	55,0	160,0
M120x4	120,0	179,5	180,0	60,0	170,0

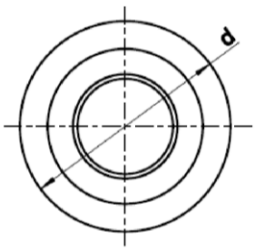
tension rod system 460 / 560

locking nut 560

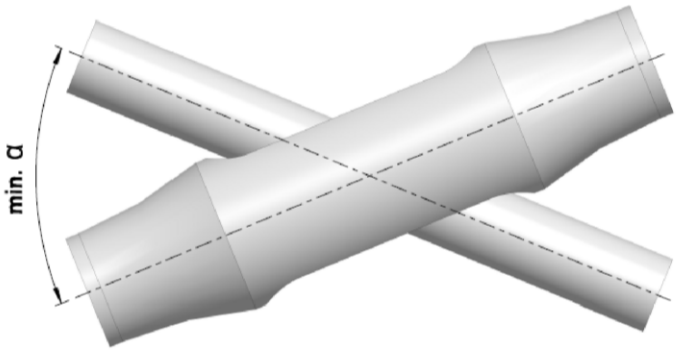
Annex B11

Deutsches Institut für Bautechnik DIBt





m2 = minimum thread engagement
V = adjustment



cross sleeve

system size	d2 [mm]	Ød [mm]	L [mm]	b [mm]	V [mm]	m2 [mm]	min.α [°]
M6	6,0	12,5	64,0	7,5	5,0	7,5	45,0
M8	8,0	16,5	80,0	9,5	6,0	10,0	45,0
M10	10,0	20,0	101,0	11,5	8,0	12,0	45,0
M12	12,0	27,0	123,0	13,5	10,0	14,5	45,0
M16	16,0	33,0	156,0	18,0	12,5	19,5	45,0
M20	20,0	40,5	176,0	22,5	12,5	24,0	45,0
M24	24,0	48,0	196,0	26,5	15,0	29,0	45,0
M27	27,0	54,0	228,0	29,5	15,0	32,5	45,0
M30	30,0	60,0	251,0	33,0	15,0	36,0	45,0
M36	36,0	72,0	310,0	39,0	20,0	43,5	45,0
M42	42,0	84,0	354,0	45,5	25,0	50,5	45,0
M48	48,0	96,0	399,0	51,5	25,0	58,0	45,0
M52	52,0	105,0	436,0	56,0	27,5	62,5	45,0
M56x4	56,0	114,0	372,0	60,0	30,0	67,5	60,0
M60x4	60,0	122,0	399,0	64,0	32,5	72,0	60,0
M64x4	64,0	130,0	423,0	68,0	35,0	77,0	60,0
M72x4	72,0	147,0	475,0	76,5	40,0	86,5	60,0
M76x4	76,0	155,0	495,0	81,0	40,0	91,5	60,0
M80x4	80,0	164,0	518,0	85,0	40,0	96,0	60,0
M85x4	85,0	173,5	546,0	90,0	42,5	102,0	60,0
M90x4	90,0	184,0	579,0	95,0	45,0	108,0	60,0
M95x4	95,0	194,0	608,0	100,0	47,5	114,0	60,0
M100x4	100,0	204,0	647,0	105,0	50,0	120,0	60,0
M105x4	105,0	212,0	651,0	110,0	50,0	126,0	60,0
M110x4	110,0	222,0	685,0	115,0	55,0	132,0	60,0
M115x4	115,0	232,0	710,0	120,0	55,0	138,0	60,0
M120x4	120,0	242,0	750,0	125,0	60,0	144,0	60,0

Tension Rod System 460 / 560

cross sleeve 560

Annex B12

Deutsches Institut für Bautechnik DIBt

system size	design tension resistance of the tension rod system $F_{t,Rd}$ [kN] 560
M6	10,5
M8	19,1
M10	30,3
M12	44,0
M16	81,8
M20	127,8
M24	184,0
M27	239,8
M30	292,7
M36	426,3
M42	585,2
M48	769,0
M52	917,6
M56x4	1119,1
M60x4	1297,0
M64x4	1488,0
M72x4	1909,4
M76x4	2139,8
M80x4	2383,3
M85x4	2706,2
M90x4	3049,5
M95x4	3413,3
M100x4	3797,7
M105x4	4034,4 ①
M110x4	4396,4 ②
M115x4	4820,0 ②
M120x4	5263,0 ②

the given design values are determined with the minimum partial safety coefficients γ_{M0} = 1,1 and γ_{M2} = 1,25 , note Annex A

design tension resistance of the tension rod system may differ with the use of materials with lower mechanical properties, e.g. 1.4301 as tension rod material

① the connecting plates are authoritative, the specified value was determined with 96% utilization of the tension bar

② the connecting plates are authoritative, the specified value was determined with 95% utilization of the tension bar

Tension Rod System 460 / 560	**Annex B13**
design tension resistance of the tension rod system 560	