Deutsches Institut für Bautechnik

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Bautechnisches Prüfamt

An institution established by the Federal and Laender Governments

Designated according to Article 29 of Regulation (EU) No 305/2011 and member of EOTA (European Organisation for Technical Assessment)

European Technical Assessment ETA-04/0038 of 29 July 2016

English translation prepared by DIBt - Original version in German language

General Part

Technical Assessment Body issuing the European Technical Assessment:	Deutsches Institut für Bautechnik
Trade name of the construction product	ASDO Tension Rod System
Product family to which the construction product belongs	Prefabricated tension rod system
Manufacturer	Anker Schroeder ASDO GmbH Hannöversche Straße 48 44143 Dortmund DEUTSCHLAND
Manufacturing plant	Anker Schroeder ASDO GmbH Hannöversche Straße 48 44143 Dortmund DEUTSCHLAND
This European Technical Assessment contains	15 pages including 10 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	European Assessment Document (EAD) 200032-00-0602

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Specific Part

1 Technical description of the product

The construction product is a prefabricated tension rod system of different 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 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 or centre discs. The tension rods are connected to each other by steel or stainless steel threaded sleeves (couplers, (cross) turnbuckles).

The tension rod system comprises tension rods, fork end connectors, centre discs and threaded sleeves (couplers, (cross) turnbuckles) with metric ISO threads M 12 to M 160.

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.

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. 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 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 B7.

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 its 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, gusset plate, centre disc, threaded sleeve (couplers and (cross) turnbuckles), nuts

Essential characteristic	Performance
Geometry incl. tolerances	See Annexes B4 to B7
Dimensions incl. tolerances	
Thread incl. tolerances	
Material	See Annexes B2 and B3
Load bearing capacity	See Annex A, A.1
Resistance to corrosion	

3.1.3 Tension rod

Essential characteristic	Performance
Nominal rod diameter	See Annexes B4 to B7
Thread incl. tolerances	
Yield strength	See Annexes B2 and B3
Tensile strength	
Material	
Tension resistance	See Annex A, A.1 and A.2
Compression force	
Resistance to corrosion	

3.2 Safety in case of fire (BWR 2)

Tension rod, fork end connector, gusset plate, centre disc, threaded sleeve (couplers and (cross) turnbuckles), nuts

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 29 July 2016 by Deutsches Institut für Bautechnik

Uwe Bender
Head of Department

beglaubigt:
Stöhr

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 "ME" given in Annexes B2 to B7 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 rods, fork end connectors incl. pins, couplers, (cross) turnbuckles, centre discs and gusset plates) is the minimum value of the design tension resistance $F_{t,RD,\ Tension\ Rod}$ of the tension rod, the design tension resistance $F_{t,RD,\ (Cross)\ Turnbuckle}$ of the (cross) turnbuckle and the design bearing resistance $F_{b,Rd,\ Gusset\ Plate/Centre\ disc}$ of the gusset plate or centre disc.

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

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

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

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

A = net cross section of the unthreaded part of the (cross) turnbuckle

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

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

T_1 = thickness of gusset plate and centre disk according to Annexes B4 and B5

D_1 = pin diameter according to Annexes 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 "ME" given in Annexes B4 to B7 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 either

- the design value of the compression force of struts in the cross-section of the thread or
- 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:

$$F_{c,RD} = \left[\frac{\gamma_{M2}}{A_S \cdot f_{u,c}} + \frac{\left(\frac{T - T_1}{2} + \frac{L - L_1}{50} \right) \cdot \gamma_{M0}}{W_{pl,S} \cdot f_{y,c}} \right]^{-1}$$

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 T, T_1, L und L_1 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 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 screw-in lengths are marked in an appropriate way. The keeping of the minimum screw-in lengths "ME" given in Annexes B4 to B7 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.

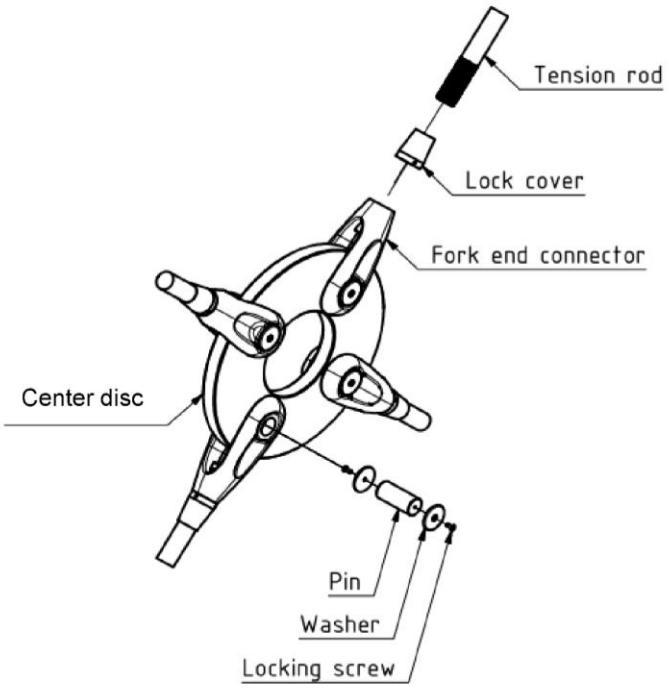
The conformity of the installed tension rod system with the provisions of the ETA is attested by the executing assembler.

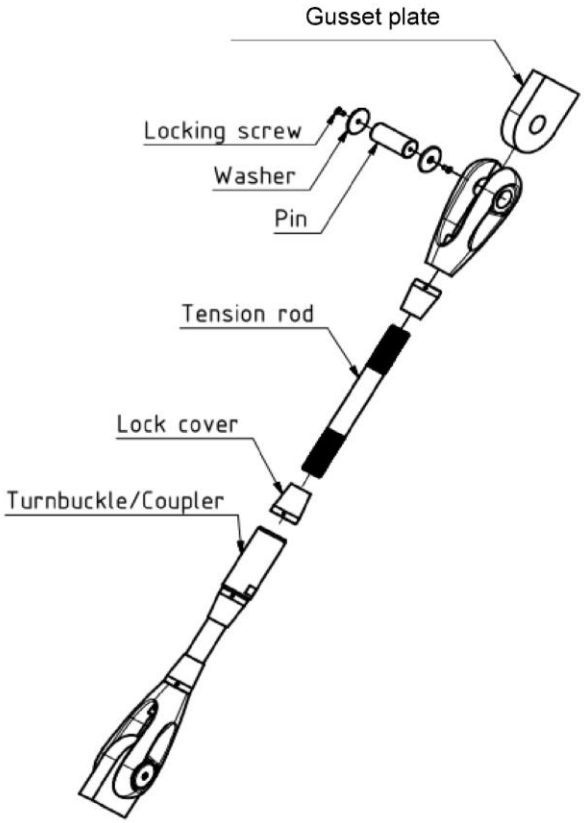
A.3 Indications to the manufacturer

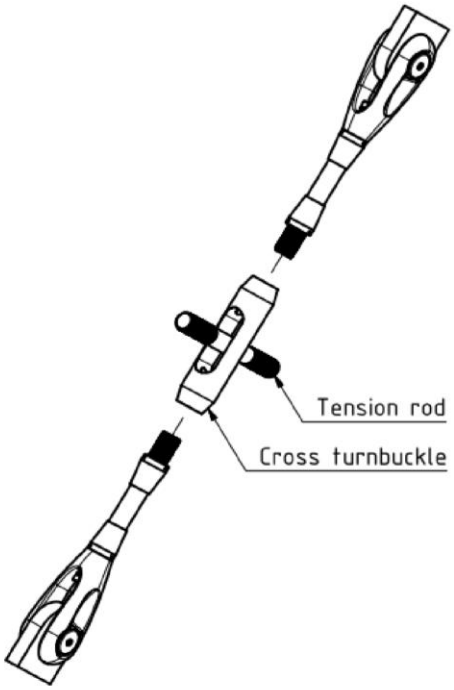
The manufacturer shall ensure that the information on the specific conditions is given to those who are concerned. This information may be given by reproduction of the European Technical Assessment. In addition all essential installation data (eg, minimum screw-in length "ME" according to Annexes B4 to B7) 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, couplers, (cross) turnbuckles, centre discs and gusset plates).

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







ASDO Tension Rod System	Annex B1
System, components	

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Component	Steel grade / material			Nominal thickness	Mechanical properties			
	Steel grade/ material	Material no./ Strength class	Technical delivery condition	t [mm]	Yield strength $R_{p0,2,\ min.}$ [N/mm²]	Tensile strength $R_{m,\ min.}$ [N/mm²]	Elongation at break A_5 [%]	Charpy impact energy CV (ISO-V) [J/°C]
Fork end (1) connector	G20 Mn 5	1.6220	EN 10340: 2007	all thicknesses	300	500	22	27 / -40
Tension rod (2)	S690Q	1.8931	EN 10025-6: 2009	t ≤ 50 50 < t ≤100 100 < t ≤160	690 650 630	770 760 710	14	27 / -20
Tension rod (2)	Strength class 8.8		EN ISO 898-1: 2013	t ≤ 100 100 < t ≤160	640 630	760 710	12	27 / -20
Tension rod (2)	QT Steel		EN 10083-3: 2006	according strength class S690Q				27 / -20
Tension rod (2)	S460N	1.8901	EN 10025-3: 2004	t ≤ 160	540	700	17	27 / -20
Tension rod (2)	S355J2	1.0577	EN 10025-2: 2004	t ≤ 130 t > 130	355	510 according standard	17	27 / -20
Tension rod (2) (4)	S355J0	1.0553	EN 10025-2: 2004	t ≤ 130 t > 130	355	510 according standard	17	27 / 0
Pin	Strength class 8.8		EN ISO 898-1: 2013	t ≤ 160	640	800	12	27 / -20
Gusset plate / centre disc	S355J2	1.0577	EN 10025-2: 2004	according standard				27 / -20
Turnbuckle / Coupler (3) Type 1 = S355J2 Type 2 = S355J2H Type 3 = S460N Type 4 = 20MnV6+N	S355J2	1.0577	EN 10025-2: 2004	t ≤ 130 t > 130	355	510 according standard	17	27 / -20
	S355J2H	1.0576	EN 10210-1: 2006	according standard				
	S460N	1.8901	EN 10025-3: 2004	t ≤ 160 t > 160	540	700 according standard	17	
	20MnV6+N	1.5217	Not standardized (5)	Wall thickness t ≤ 65mm	390	530	19	
Cross turnbuckle (3) Type 5 = S460N Type 6 = QT Steel	S460N	1.8901	EN 10025-3: 2004	t ≤ 160 t > 160	540	700 according standard	17	27 / -20
	QT Steel		EN 10083-3: 2006	t ≤ 160 t > 160	550 500	800 750	13	27 / -20

(1) Alternatively, other cast steel grades according to EN 10340 may be used if material properties comply with the characteristics of material no. 1.6220.
(2) Design loads (EN 1993-1) are to be determined with the respectively specified values for yield and tensile strength.
(3) Alternatively, other steel grades may be used if the mechanical properties comply with the material characteristics given in the table.
(4) If there are no requirements for impact property at -20 ° C the quality S355J0 may be used.
(5) Details are deposited with Deutsches Institut für Bautechnik.

ASDO Tension Rod System

Material properties of steel components

Annex B2

Component	Steel grade / material			Thickness	Mechanical properties			
	Steel grade/ material	Material no./ Strength class	Technical delivery condition	t [mm]	Yield strength $R_{p0,2,\,min.}$ [N/mm²]	Tensile strength $R_{m,\,min.}$ [N/mm²]	Elongation at break A_5 [%]	Charpy impact energy CV (ISO-V) [J/°C]
Fork end connector	GX2CrNiMoN22-5-3	1.4470 (cast)	EN 10283: 2010	according standard				27 / -20°C
Tension rod	Stainless steel		EN 10088-3: 2014	t ≤ 50	690	770	12	27 / -20°C
				50 < t ≤100	650	760		
Pin	Stainless steel		EN 10088-3: 2014	t ≤ 100	640	800	12	27 / -20°C
prefabricated centre disc	Stainless steel		EN 10088-3: 2014	according strength class S355				27 / -20°C
prefabricated centre disc	S355J2	1.0577	EN 10025-2: 2004	according standard				27 / -20°C
Turnbuckle / Coupler	Stainless steel		EN 10088-3: 2014	t ≤ 160	450	650	14	27 / -20°C
Gusset plate	S355J2	1.0577	EN 10025-2: 2004	according standard				27 / -20°C
Cross turnbuckle	Stainless steel		EN 10088-3: 2014	t ≤ 200	450	650	14	27 / -20°C

(1) Alternatively, other cast steel grades according to EN 10283 may be used if material properties comply with the characteristics of material no. 1.4470.

(2) Alternatively, other steel grades according to EN 10088-3 may be used if the mechanical properties comply with the material characteristics given in the table, however maximum strength class 1.4418. If alternative cast steel grades are used, design loads (EN 1993-1) are to be determined with the respectively specified values for yield and tensile strength.

ASDO Tension Rod System

Material properties of stainless steel components

Annex B3

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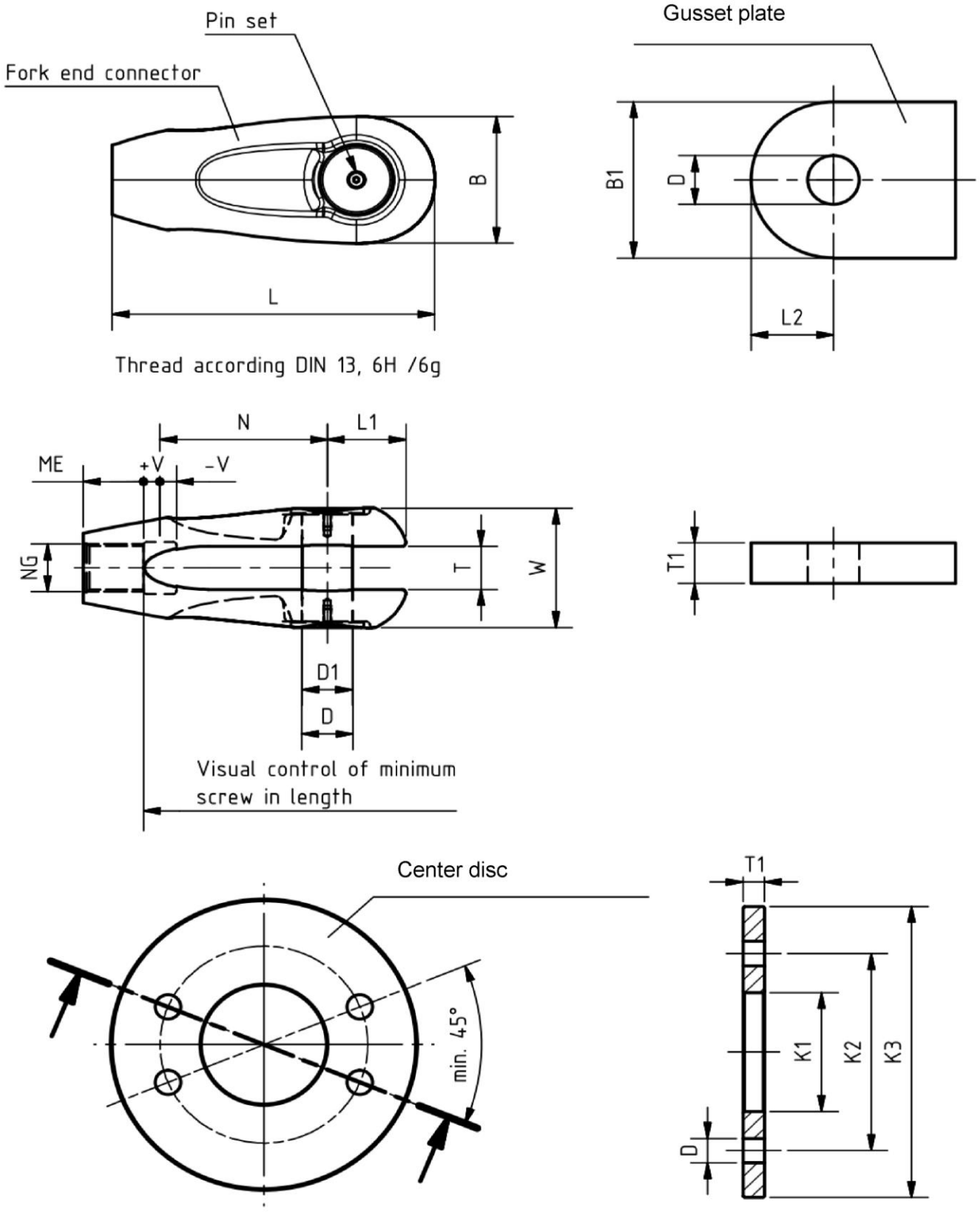

ASDO Tension Rod System	Annex B4
Fork end connector, pin, gusset plate and centre disc	

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Size	Fork end connector									Pin	Gusset plate				Centre disc				
NG	B	L	W	T	L1	N	D	ME	+/-V	D1	B1	L2	T1	D	T1	D	K1	K2	K3
	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]
M 12	33	77	31	12	19	38	13	14	6	12	42	21	10	13	10	13	170	110	60
M 16	44	104	42	17	26	51	17	19	8	16	56	28	15	17	15	17	215	140	80
M 20	53	129	50	18	31	64	21	24	10	20	68	34	15	21	15	21	255	170	100
M 24	65	155	61	23	38	76	25	29	12	24	80	40	20	25	20	25	300	200	120
M 27	73	172	66	23	42	84	28	32	14	27	90	45	20	28	20	28	335	225	135
M 30	81	193	77	28	47	95	32	36	15	30	104	52	25	32	25	32	370	250	150
M 36	98	232	90	33	57	114	38	43	18	36	122	61	30	38	30	38	445	300	180
M 42	114	271	104	38	66	134	44	50	21	42	142	71	35	44	35	44	520	350	210
M 45	122	290	108	38	71	143	47	54	23	45	152	76	35	47	35	47	555	375	225
M 48	130	310	119	44	76	152	50	58	24	48	160	80	40	50	40	50	595	400	240
M 52	139	334	126	44	81	166	54	62	25	52	174	87	40	54	40	54	635	430	260
M 56	150	361	139	49	88	181	58	67	25	56	186	93	45	58	45	58	680	460	280
M 60	159	386	149	54	93	196	62	72	25	60	200	100	50	62	50	62	740	500	300
M 64	172	412	159	59	100	210	66	77	25	64	212	106	55	66	55	66	785	530	320
M 68	182	438	167	59	106	225	70	82	25	68	224	112	55	70	55	70	825	560	340
M 72	193	463	179	64	112	240	74	86	25	72	238	119	60	74	60	74	870	590	360
M 76	203	489	191	69	119	254	78	91	25	76	250	125	65	78	60	78	930	630	380
M 80	219	516	196	74	128	267	82	96	25	80	264	132	70	82	70	82	975	660	400
M 85	230	547	211	79	133	287	87	102	25	85	280	140	75	87	75	87	1045	705	425
M 90	243	579	226	84	140	306	92	108	25	90	296	148	80	92	80	92	1090	740	450
M 95	258	610	237	89	150	321	97	114	25	95	312	156	85	97	85	97	1160	785	475
M 100	271	645	248	94	160	340	102	120	25	100	328	164	90	102	90	102	1205	820	500
M 105	287	677	259	96	167	359	108	126	25	105	346	173	90	108	90	108	1275	865	525
M 110	301	709	271	101	175	377	113	132	25	110	362	181	95	113	95	113	1345	910	550
M 115	316	742	284	106	184	395	118	138	25	115	378	189	100	118	100	118	1390	945	575
M 120	330	773	303	116	191	413	123	144	25	120	394	197	110	123	110	123	1460	990	600
M 130	354	837	327	126	207	449	133	156	25	130	426	213	120	133	120	133	1575	1070	650
M 140	381	901	351	136	222	486	143	168	25	140	458	229	130	143	130	143	1690	1150	700
M 150	410	966	375	146	239	522	153	180	25	150	490	245	140	153	140	153	1810	1230	750
M 160	436	1031	405	156	255	559	163	192	25	160	522	261	150	163	150	163	1925	1310	800
Materials and delivery conditions in accordance with Annexes B2, B3 and text of assessment.																			

ASDO Tension Rod System

Dimensions of fork end connector, pin, gusset plate and centre disc

Annex B5

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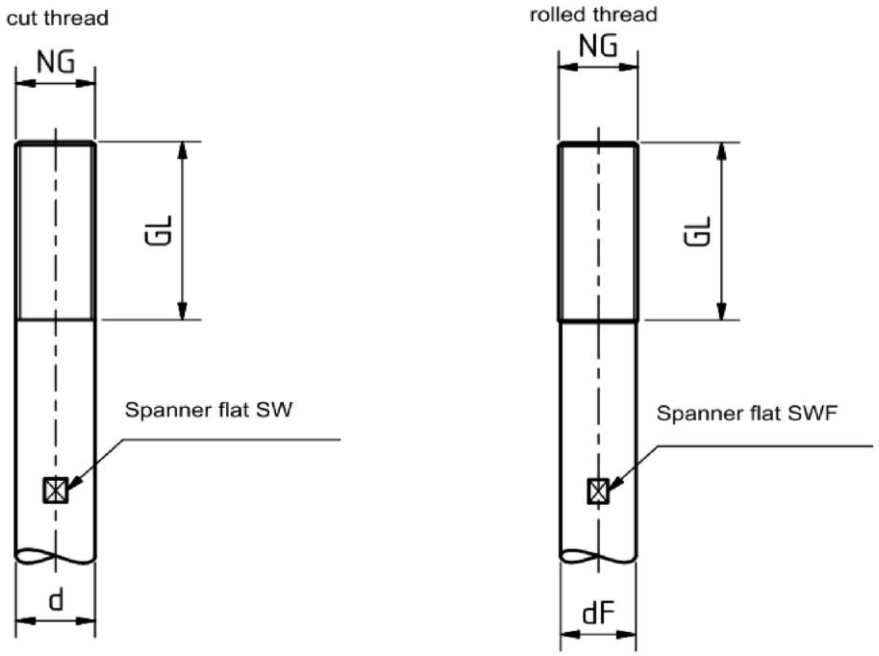
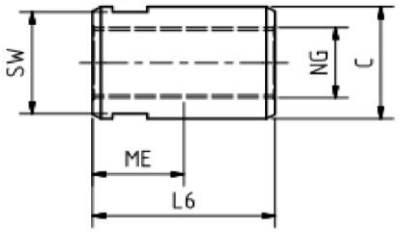
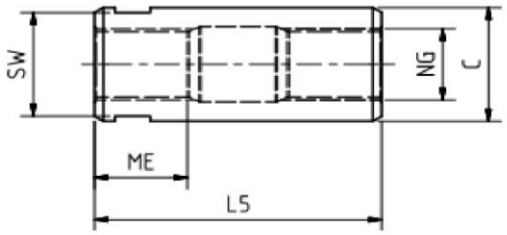
Tension rod
Thread according DIN 13, 6H / 6g medium



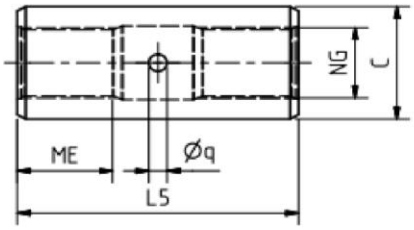
Coupler RH-thread



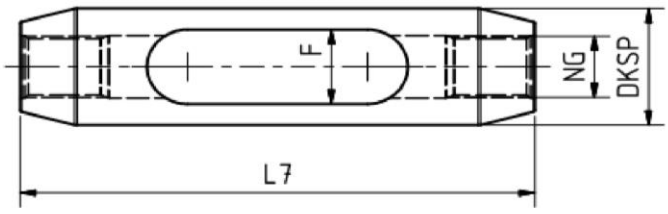
Turnbuckle RH/LH-thread



Turnbuckle RH/LH-thread



Cross turnbuckle RH/LH-thread



ASDO Tension Rod System	Annex B6
Tension rod, coupler, turnbuckle and cross turnbuckle	

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Size	Tension rod					Turnbuckle / Coupler								Cross turnbuckle			
NG	d	SW	dF	SWF	GL	C Type 1	C Type 2	C Tyep 3	C Type 4	L5	L6	ME	SW	DKSP Type 5	DKSP Type 6	L7	G
	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]
M 12	12	10	11	9	38	20	21	20	20	53	29	14	17	24	24	111	16
M 16	16	14	15	13	49	27	27	24	25	70	38	19	22	36	36	153	20
M 20	20	18	18	17	61	36	35	30	32	88	48	24	30	42	42	184	24
M 24	24	22	22	21	73	42	42	36	38	106	58	29	36	48	48	221	30
M 27	27	25	25	24	79	45	48	42	42	119	65	32	41	52	52	245	33
M 30	30	28	28	26	89	52	51	45	48	132	72	36	46	56	56	269	36
M 36	36	34	33	32	106	60	60	52	57	158	86	43	55	68	68	324	44
M 42	42	39	39	37	122	68	70	60	70	185	101	50	60	80	80	306	52
M 45	45	42	42	40	129	72	76	64	70	198	108	54	70	85	85	326	55
M 48	48	45	45	42	144	80	83	68	76	211	115	58	75	95	95	352	58
M 52	52	49	49	46	150	85	89	76	83	225	125	62	80	100	100	374	64
M 56	56	53	52	50	159	90	95	80	89	234	134	67	85	105	105	393	68
M 60	60	57	56	54	164	100	102	90	95	244	144	72	90	115	115	414	72
M 64	64	61	60	58	175	105	108	95	102	254	154	77	95	125	125	439	78
M 68	68	65	64	62	180	110	114	100	108	263	163	82	100	130	130	458	82
M 72	72	69	68	66	185	115	121	115	114	273	173	86	105	140	140	479	88
M 76	76	73	72	70	190	125	127	120	121	282	182	91	110	145	145	499	92
M 80	80	76	76	73	200	130	133	125	127	292	192	96	115	155	155	519	96
M 85	85	81	81	78	205	145	140	130	133	304	204	102	120	165	165	547	103
M 90	90	86	86	83	215	155	152	140	140	326	226	108	135	175	175	573	108
M 95	95	91	91	88	220	165	159	150	152	338	238	114	140	185	185	599	115
M 100	100	96	96	93	230	175	171	155	159	350	250	120	150	195	195	625	120
M 105	105	101	101	98	235	185	178	160	168	387	287	126	155				
M 110	110	106	106	103	240	195	191	165	178	399	299	132	170				
M 115	115	111	111	108	245	205	194	170	194	411	311	138	175				
M 120	120	116	116	113	250	215	203	175	194	423	323	144	185				
M 130	130	126	126	123	265	235	219	190	216	447	347	156	200				
M 140	140	136	136	133	275	250	241	210	229	471	371	168	220				
M 150	150	146	146	143	290	270	254	220	245	495	395	180	235				
M 160	160	156	156	153	300	290	273	235	267	519	419	192	255				

Materials and delivery conditions in accordance with Annex B2 and text of assessment.

ASDO Tension Rod System

Dimension of tension rod, coupler, turnbuckle and cross turnbuckle

Annex B7