

Approval body for construction products  
and types of construction

Bautechnisches Prüfamt

An institution established by the Federal and  
Laender Governments



## European Technical Assessment

**ETA-18/0104**  
**of 19 April 2018**

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

Tension rod systems HMR 750

Product family  
to which the construction product belongs

Tension rod system

Manufacturer

HMR Jacob GmbH Metallwaren  
Gewerbefeld 2  
94501 Aldersbach-Uttigkofen  
DEUTSCHLAND

Manufacturing plant

HMR Jacob GmbH Metallwaren  
Industriestraße 5  
94486 Osterhofen  
DEUTSCHLAND

This European Technical Assessment  
contains

25 pages including 20 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

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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 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 fork end connectors with two eye loops and internal thread. The fork end connectors are connected by double shear pin connections to corresponding steel gusset plates or connection discs. The tension rods are connected to each other by steel threaded sleeves (turnbuckles, couplers, cross couplers).

The tension rod system comprises tension rods, fork end connectors, steel gusset plates, connection discs, threaded sleeves and pins with metric ISO threads M 12 to M 100.

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.

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<sup>1</sup> to this European technical assessment.

### 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 with 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 B17.

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.

<sup>1</sup> 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.

### 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 Fork end connector, gusset plate, connection disc, threaded sleeve, nuts

Essential characteristic	Performance
Geometry incl. tolerances	See Annexes B4 to B16
Dimensions incl. tolerances	
Thread incl. tolerances	
Material	See Annex B17
Load bearing capacity	See Annex A, A.1
Resistance to corrosion	

##### 3.1.2 Tension rod

Essential characteristic	Performance
Nominal rod diameter	See Annexes B2 to B3
Thread incl. tolerances	
Yield strength	See Annex B17
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, connection disc, threaded sleeve (couplers and (cross) turnbuckles), nuts

Essential characteristic	Performance
Reaction to fire	Class A1 according with 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.

**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 19 April 2018 by Deutsches Institut für Bautechnik

BD Dipl.-Ing. Andreas Kummerow  
Head of Department

*beglaubigt:*  
Schult

## 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 with 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.<sup>1</sup>

Dimensions, material properties and screw-in lengths given in Annex B 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 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.

#### 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, connection discs and gusset plates) is the minimum value of the design tension resistance  $F_{t, RD, \text{Tension Rod}}$  of the tension rod, the design tension resistance  $F_{t, RD, \text{Threaded sleeve}}$  of the threaded sleeve and the design bearing resistance  $F_{b, Rd, \text{Gusset Plate/Connection disc}}$  of the gusset plate or connection disc.

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

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

$A$  = minimum value of the 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 with  $R_{p0,2}$  given in Annex B17

$f_{u, k}$  = characteristic value of the tensile strength of the tension rod material according with  $R_m$  given in Annex B17

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

$A$  = net cross section of the unthreaded part of the threaded sleeve

$f_{y, k}$  = characteristic value of the yield strength of the threaded sleeve material according with  $R_{p0,2}$  given in Annex B17

$$F_{b, Rd, \text{Gusset Plate/Connection}} = 1.5 \cdot A_L \cdot B_D \cdot f_{y, k} / \gamma_{M0}$$

$A_L$  = thickness of gusset plate (according with Annex B5) or connection disk (according with Annex B9 ( $K_L = A_L$ ))

$B_D$  = pin diameter according with Annex B7

<sup>1</sup> 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 or connection disk according with  $R_{p0,2}$  given in Annexes B17

$\gamma_{M0}$  = 1.0

$\gamma_{M2}$  = 1.25

The values given for the partial safety factors  $\gamma_{M0}$  and  $\gamma_{M2}$  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 given in Annex B 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 with Annexes B14 to B16 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 with EN 1993-1-1:2005.

The strength class of the compression struts 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:

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

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 with 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 with product standard

The dimensions of  $G$ ,  $A_L$ ,  $A$  (length fork ends) and  $D$  are stated in Annexes B4 and B5.

Recommended values for the partial safety factors  $\gamma_{M0}$  and  $\gamma_{M2}$  are:

$\gamma_{M0}$  = 1.00

$\gamma_{M2}$  = 1.25

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

In addition EN 1993-1-1:2005 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 with 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 (given by corresponding holes) given in Annex B 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.

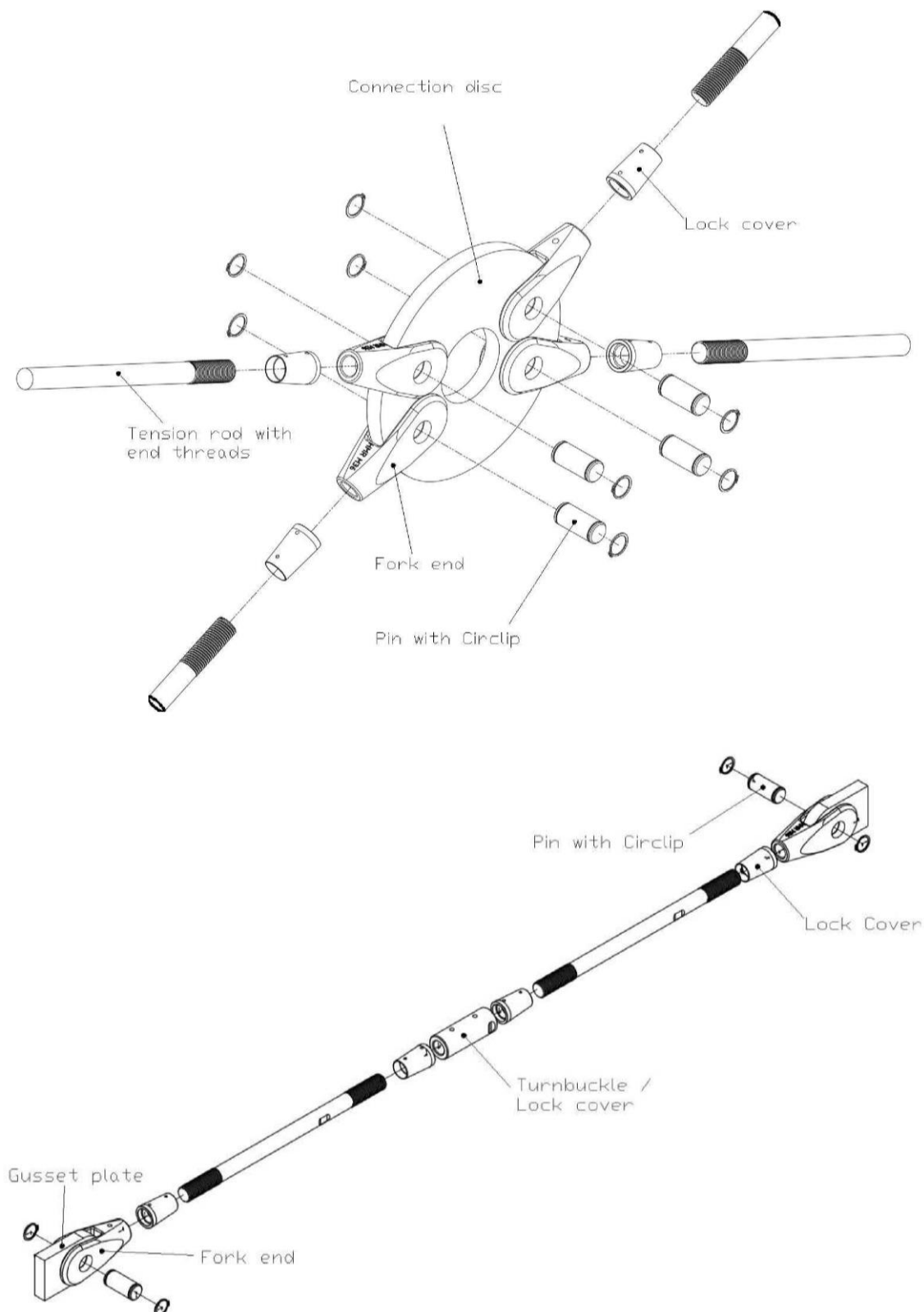
## A.3 Indications to the manufacturer

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 according with Annex B) 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, threaded sleeve, connection discs and gusset plates).

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

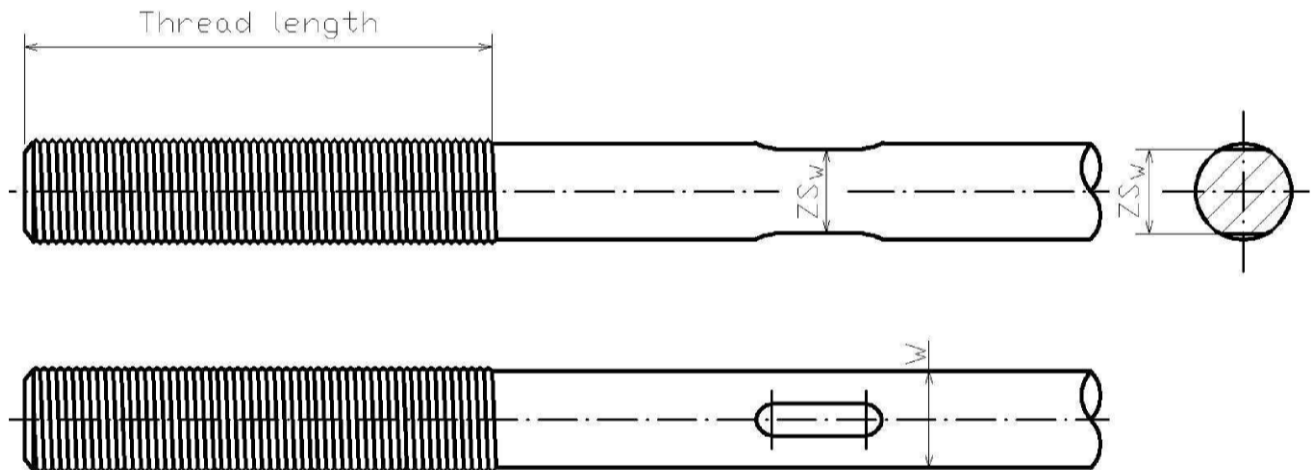




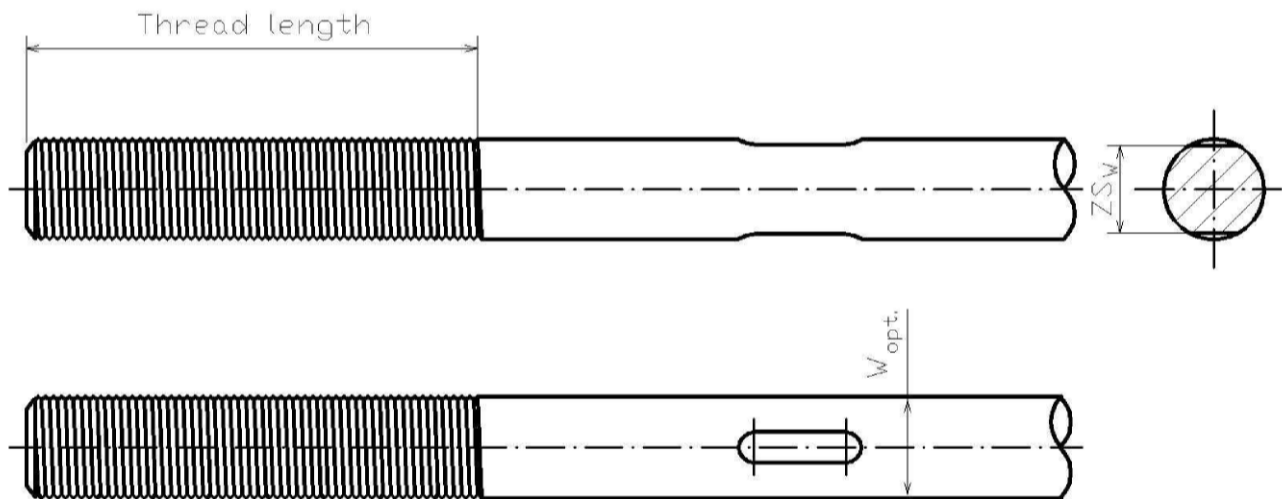
### HMR Tension Rod System 750

System Components  
For Bar Material Grades S355, S460 and HMR 750

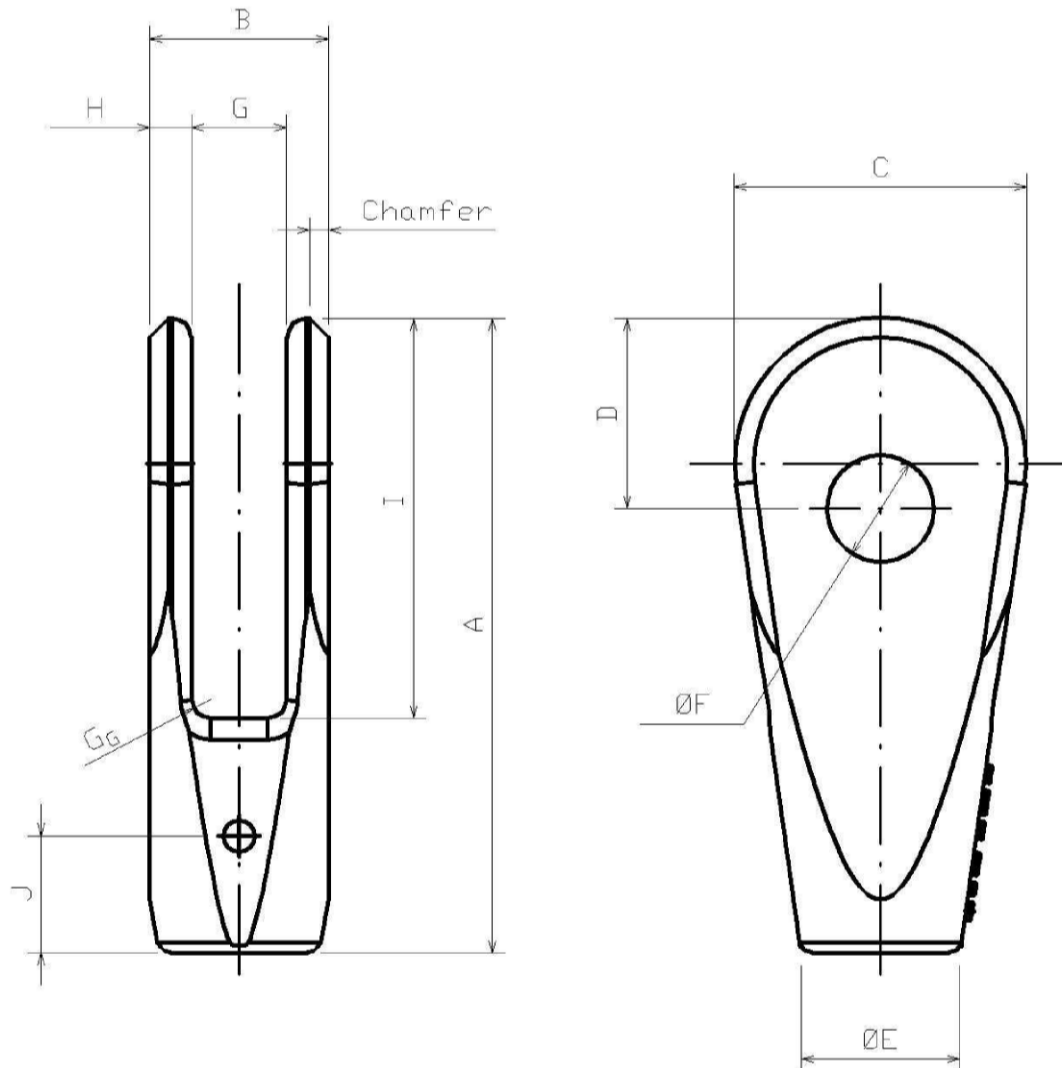
Annex B 1



	Tension Rod with rolled threads (with / without spanner flat)													
X	M12	M16	M20	M24	M30	M36	M42	M48	M56	M64	M76	M85	M90	M100
W (mm) => Bar Ø	12	15	19	23	28	34	40	45	54	62	74	83	88	100
ZS <sub>w</sub> (mm)														
Width across flats	10	13	16	20	25	30	36	42	49	56	68	78	82	91
A <sub>Bar</sub> (mm <sup>2</sup> )	113	177	284	415	616	908	1257	1590	2290	3019	4301	5411	6082	7854
A <sub>Thread</sub> (mm <sup>2</sup> )	84	156	244	352	560	816	1120	1473	2143	2850	4099	5184	5842	7275
A <sub>Net</sub> (mm <sup>2</sup> )	104	166	262	392	590	864	1209	1557	2213	2911	4183	5315	5953	7602
HMR Tension Rod System 750												Annex B 2		
Dimensions of Tension Rod with rolled threads For Bar Material Grades S355, S460 and HMR 750 with and without spanner flat														



	<i>Tension Rod with cut thread (with / without spanner flat)</i>													
X	M12	M16	M20	M24	M30	M36	M42	M48	M56	M64	M76	M85	M90	M100
W <sub>opt.</sub>	12	16	20	24	30	36	42	48	56	64	76	85	90	100
ZS <sub>w</sub> (mm) => Width across flats	10	13	16	20	25	30	36	42	49	56	68	78	82	91
HMR Tension Rod System 750												Annex B 3		
Dimensions of Tension Rod with cut threads For Bar Material Grades S355, S460 and HMR 750 with and without spanner flat														



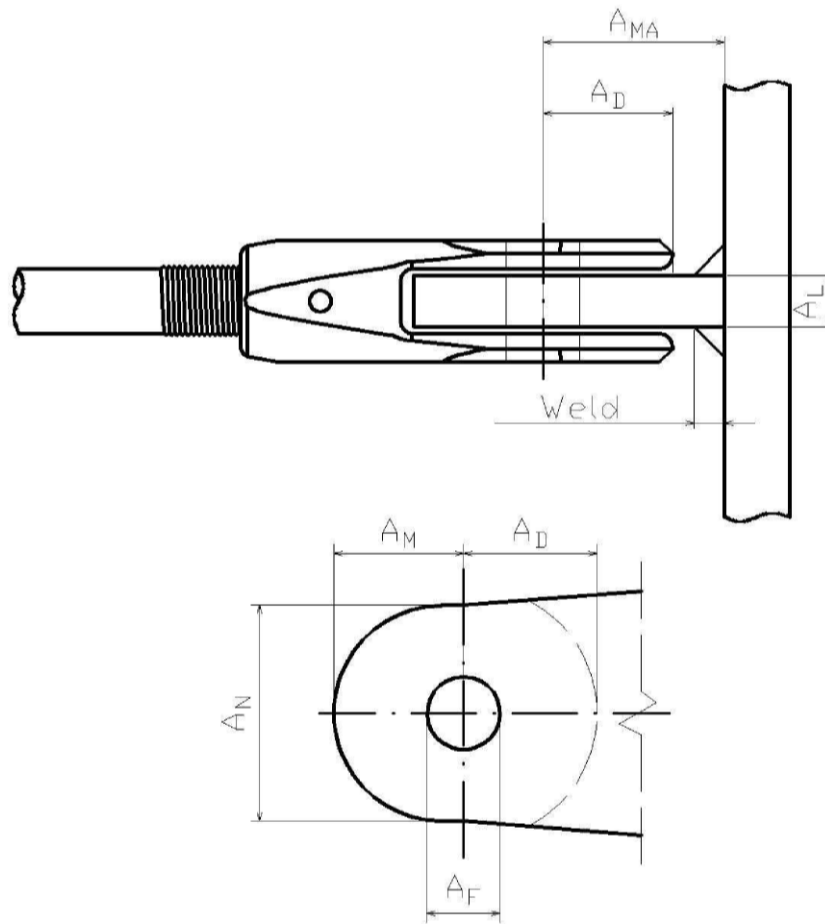
### Fork End

X	M12	M16	M20	M24	M30	M36	M42	M48	M56	M64	M76	M85	M90	M100
A (mm)	77	100	122	144	181	210	246	279	334	378	444	509	534	611
B (mm)	22.0	28.2	36.8	44.0	50.4	65.0	76.6	89.2	99.8	119.6	150.0	155.4	174.2	179.2
C (mm)	35	46	55	66	83	97	112	127	151	174	207	243	255	298
D (mm)	23	30	36	44	55	64	72	83	100	115	136	153	163	188
E (mm)	19	25	29	35	44	52	60	69	80	91	108	121	129	143
G (mm)	12	15	18	23	25	33	38	43	48	59	74	74	84	89
I (mm)	48	63	77	91	116	133	157	178	217	245	287	334	349	406

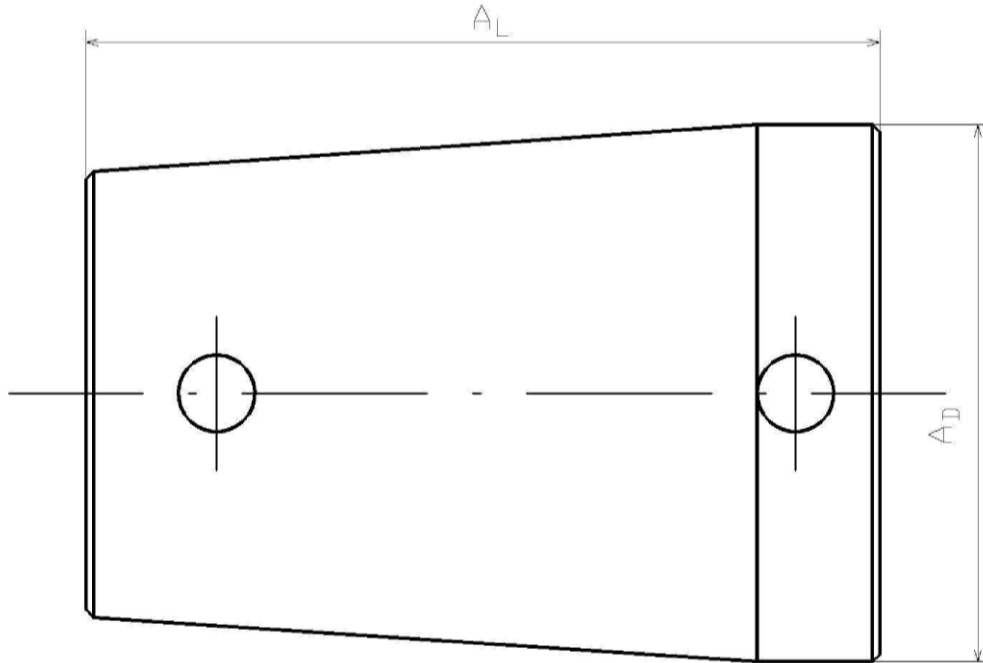
### HMR Tension Rod System 750

Dimensions of Fork Ends  
For Bar Material Grades S355, S460 and HMR 750

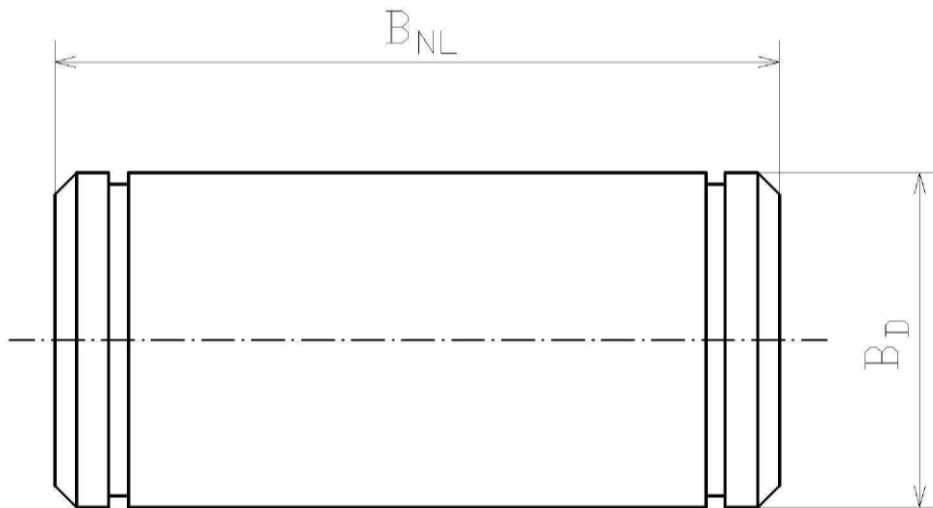
### Annex B 4



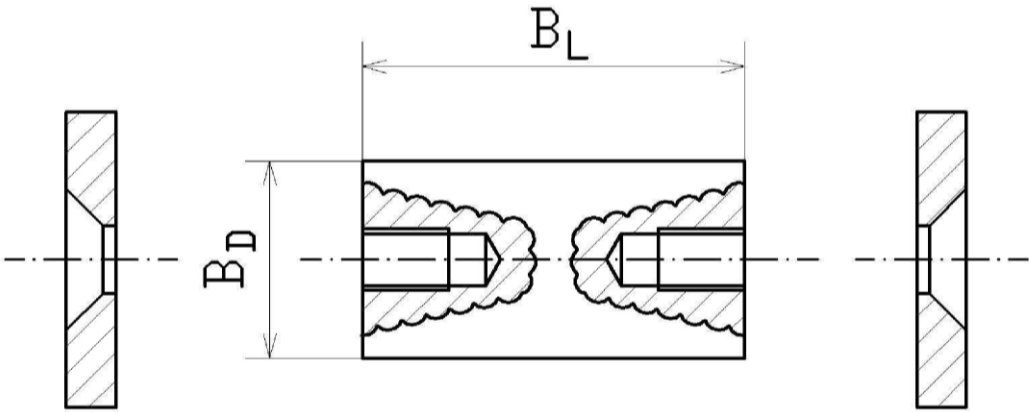
	Gusset Plate													
X Thread (M)	M12	M16	M20	M24	M30	M36	M42	M48	M56	M64	M76	M85	M90	M100
A <sub>L</sub> (mm) =Thickness	10	12	15	20	22	30	35	40	45	55	70	70	80	85
A <sub>F</sub> (mm) => Pin Hole Diameter Ø (± 0,50 mm)	13	17	23	27	33	39	45	51	60	68	80	93	98	113
A <sub>M</sub> (mm) => Clearance (+2/-0mm)	22	30	37	43	56	64	79	89	109	122	143	171	176	206
A <sub>N</sub> (mm) => Minimum Width	35	50	60	70	90	105	128	147	178	198	232	280	288	338
A <sub>D</sub> (mm) => Refers to dimension D see table fork	23	30	36	44	55	64	72	83	100	115	136	153	163	188
A <sub>MA</sub> (mm) => Recommended minimum clearance	38	48	58	74	88	108	124	142	167	196	240	257	281	314
HMR Tension Rod System 750												Annex B 5		
Dimensions of Gusset Plate Grade S355 For Bar Material Grades S355, S460 and HMR 750														



	Lock Cover													
X	M 12	M 16	M 20	M 24	M 30	M 36	M 42	M 48	M 56	M 64	M 76	M 85	M 90	M 100
AD (mm)	19	25	29	35	44	52	60	69	80	91	108	121	129	143
AL (mm)	36.3	44.4	51.0	57.6	67.0	80.4	89.8	99.2	110.4	120.6	135.4	148.0	152.0	161.0
HMR Tension Rod System 750												Annex B 6		
Dimensions of Lock Cover Grade S355 For Bar Material Grades S355, S460 and HMR 750														



	Pin with circlip DIN 471													
X	M12	M16	M20	M24	M30	M36	M42	M48	M56	M64	M76	M85	M90	M100
B <sub>D</sub> (mm)	12.0	16.0	21.0	25.0	31.0	37.0	43.0	49.0	58.0	66.0	78.0	91.0	95.0	110.0
B <sub>NL</sub> (mm)	31.6	38.8	49.0	57.2	67.0	82.2	96.8	112.0	122.6	145.4	175.8	183.2	203.0	211.2
HMR Tension Rod System 750												Annex B 7		
Dimensions of Pin with circlip For Bar Material Grades S355, S460 and HMR 750														



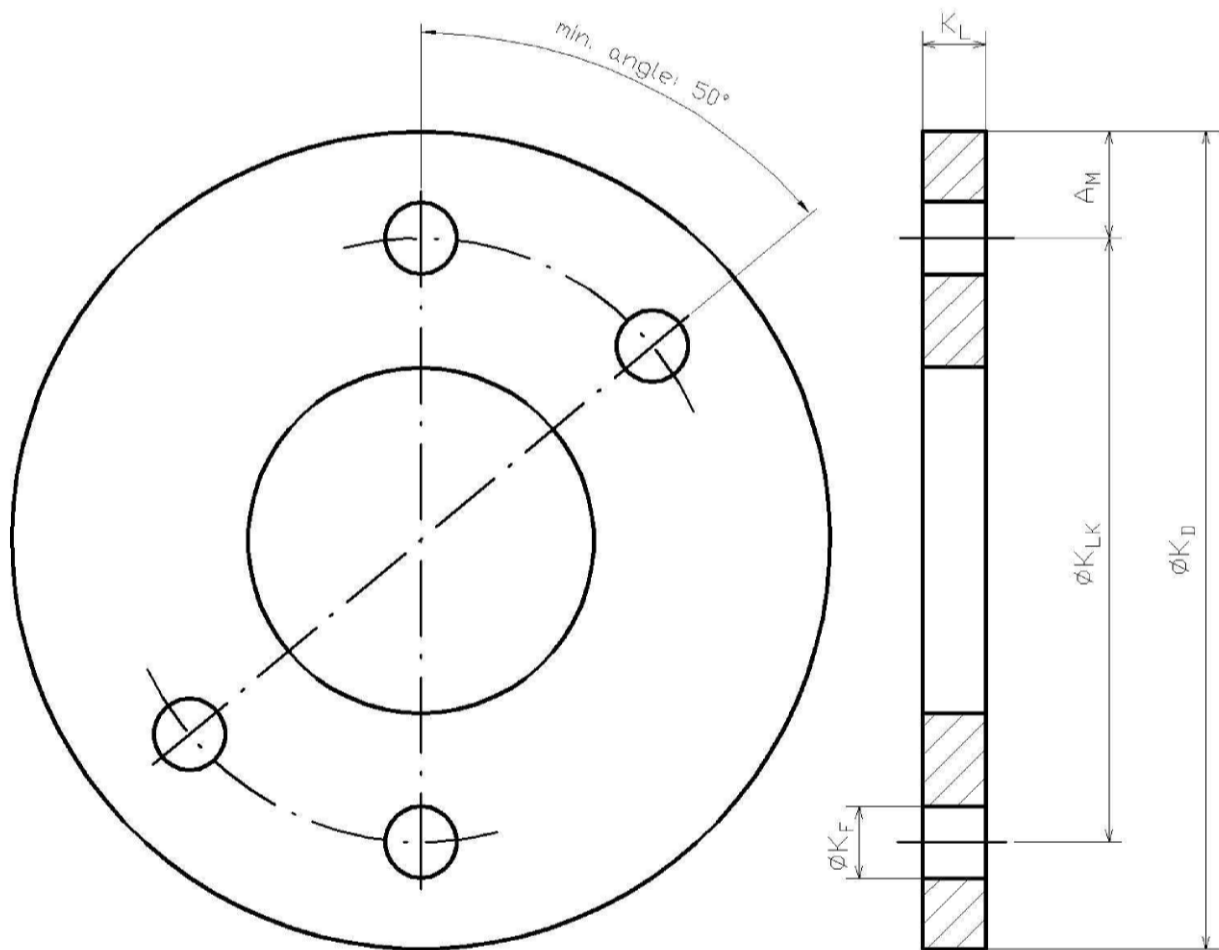
	Pin with washer													
X	M12	M16	M20	M24	M30	M36	M42	M48	M56	M64	M76	M85	M90	M100
B <sub>D</sub> (mm)	12.0	16.0	21.0	25.0	31.0	37.0	43.0	49.0	58.0	66.0	78.0	91.0	95.0	110.0
B <sub>L</sub> (mm)	25	31	40	47	53	68	81	93	104	126	156	161	181	186

HMR Tension Rod System 750

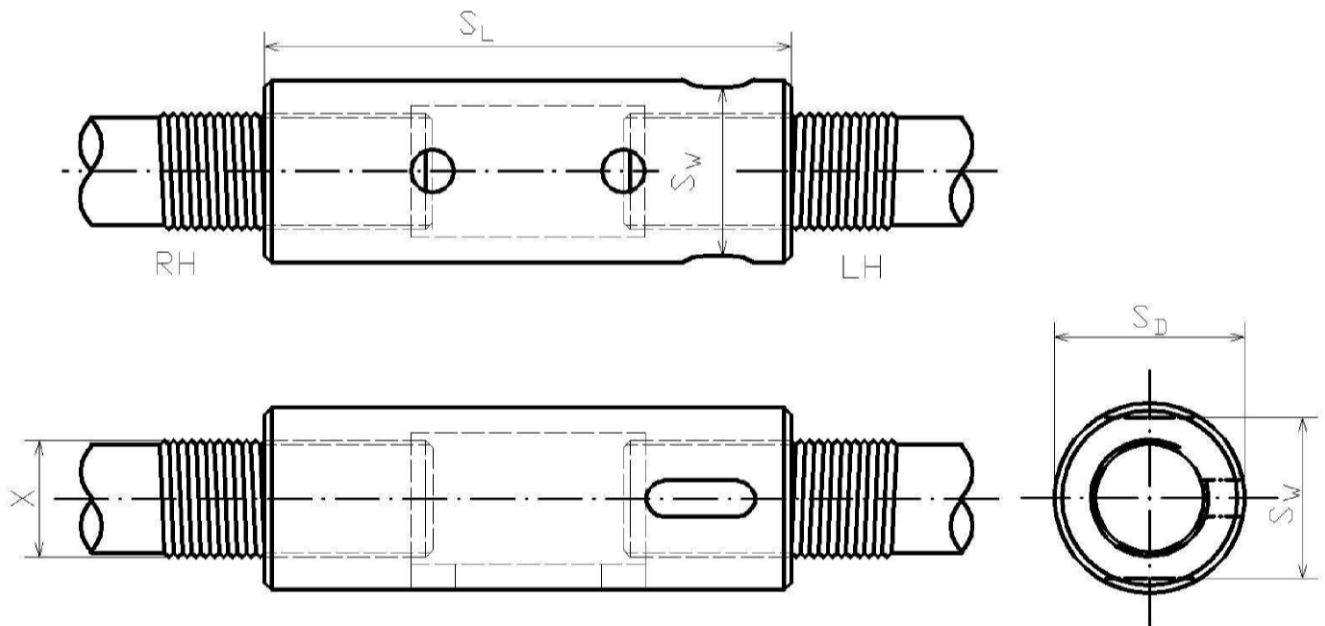
Dimensions of Pin with washer  
For Bar Material Grades S355, S460 and HMR 750

Annex B 8

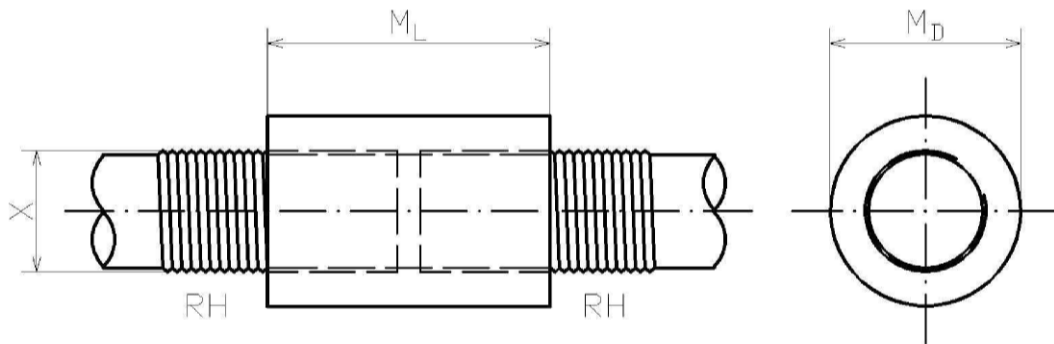




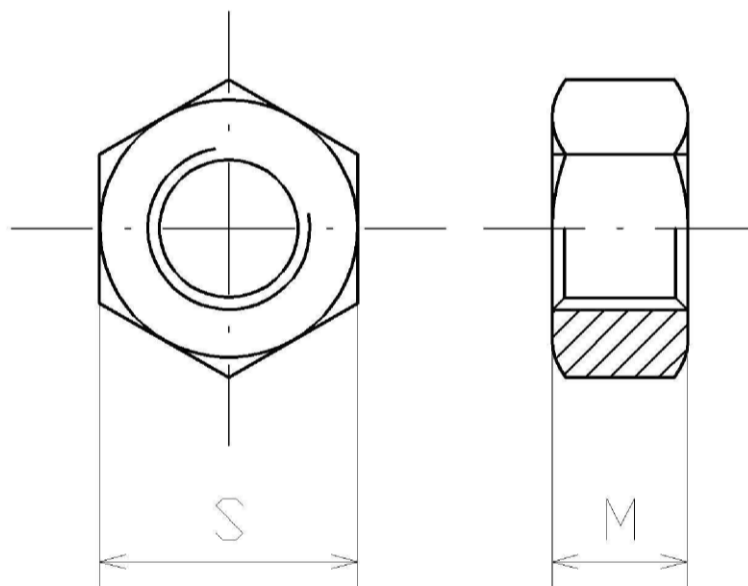
	Connection Disc													
X	M12	M16	M20	M24	M30	M36	M42	M48	M56	M64	M76	M85	M90	M100
K <sub>L</sub> (mm) => Thickness = AL	10	12	15	20	22	30	35	40	45	55	70	70	80	85
K <sub>F</sub> (mm) => Pin Hole Ø (± 0,50 mm) = AF	13	17	23	27	33	39	45	51	60	68	80	93	98	113
K <sub>D</sub> (mm) => Overall Ø	151	196	233	274	350	402	477	541	644	740	869	1029	1071	1243
Inner Ø Disc	50	70	80	90	120	140	160	180	230	250	300	350	375	400
K <sub>LK</sub> (mm) => Outer Holes Ø	107	136	159	188	238	274	319	363	426	496	583	687	719	831
HMR Tension Rod System 750												Annex B 9		
Dimensions of Connection Disc, Grade S355 For Bar Material Grades S355, S460 and HMR 750														



	Turnbuckle													
X	M12	M16	M20	M24	M30	M36	M42	M48	M56	M64	M76	M85	M90	M100
S <sub>D</sub> (mm)	20	26	32	38	47	57	67	76	90	103	122	137	145	161
S <sub>L</sub> (mm)	64	82	90	108	120	152	164	176	212	228	252	270	300	320
S <sub>w</sub> (mm)	18	23	28	32	41	50	60	70	80	92	112	125	135	150
HMR Tension Rod System 750												Annex B 10		
Dimensions of Turnbuckle, Grade S355 For Bar Material Grades S355, S460 and HMR 750														



	<i>Coupler</i>													
X Gewinde (M)	M12	M16	M20	M24	M30	M36	M42	M48	M56	M64	M76	M85	M90	M100
MD (mm) => Outside Ø	20	26	32	38	47	56	66	75	87	99	119	135	143	160
ML (mm) => Length	32	40	48	56	68	80	92	104	120	136	160	178	188	208
HMR Tension Rod System 750												Annex B 11		
Dimensions of Coupler, Grade S355 For Bar Material Grades S355, S460 and HMR 750														



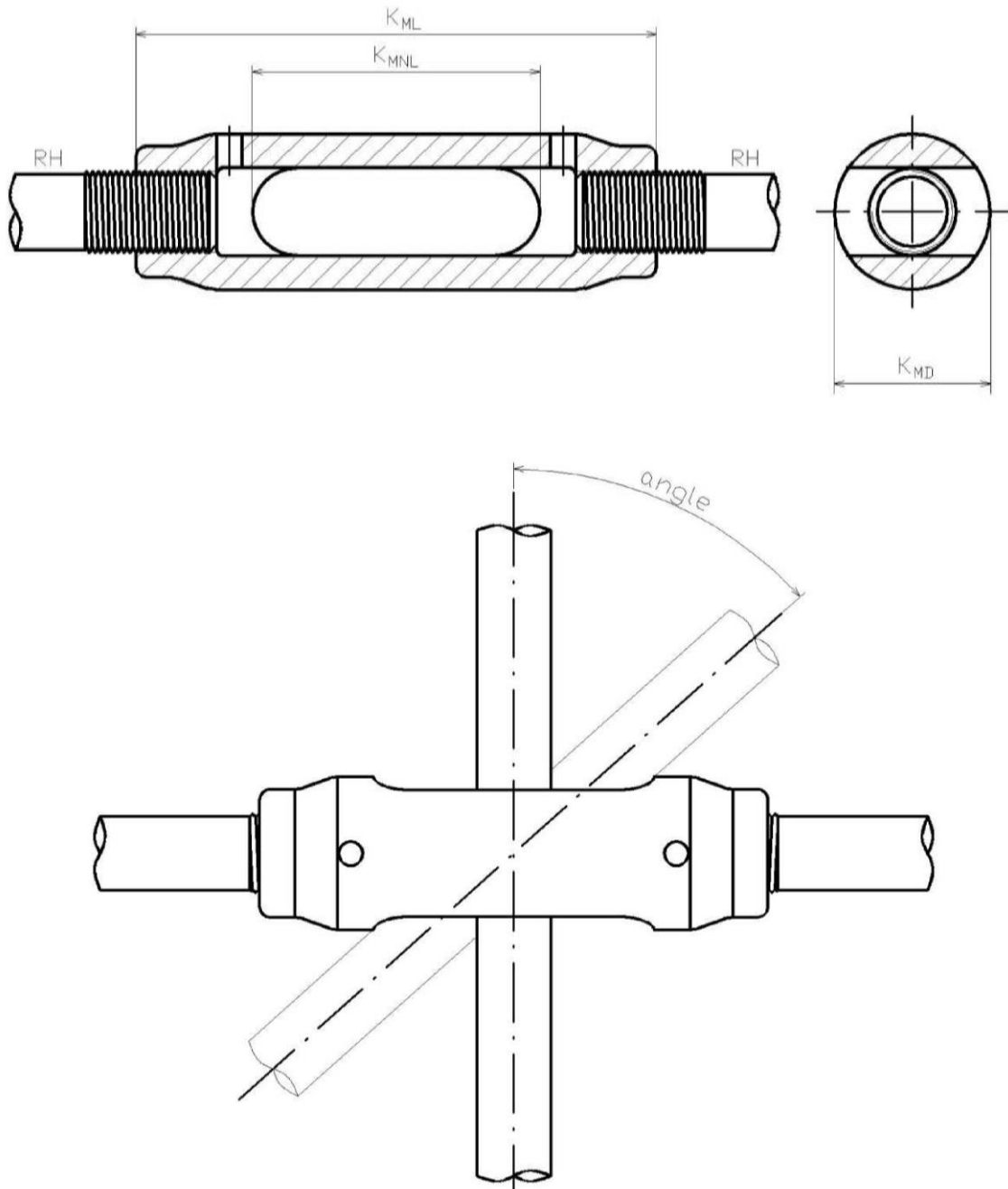
### Hexagon Nut

X	M12	M16	M20	M24	M30	M36	M42	M48	M56	M64	M76	M85	M90	M100
s (mm)	19	24	30	36	46	55	65	75	90	100	120	140	150	165
m (mm)	10	13	16	19	24	29	34	38	60	65	80	90	90	100

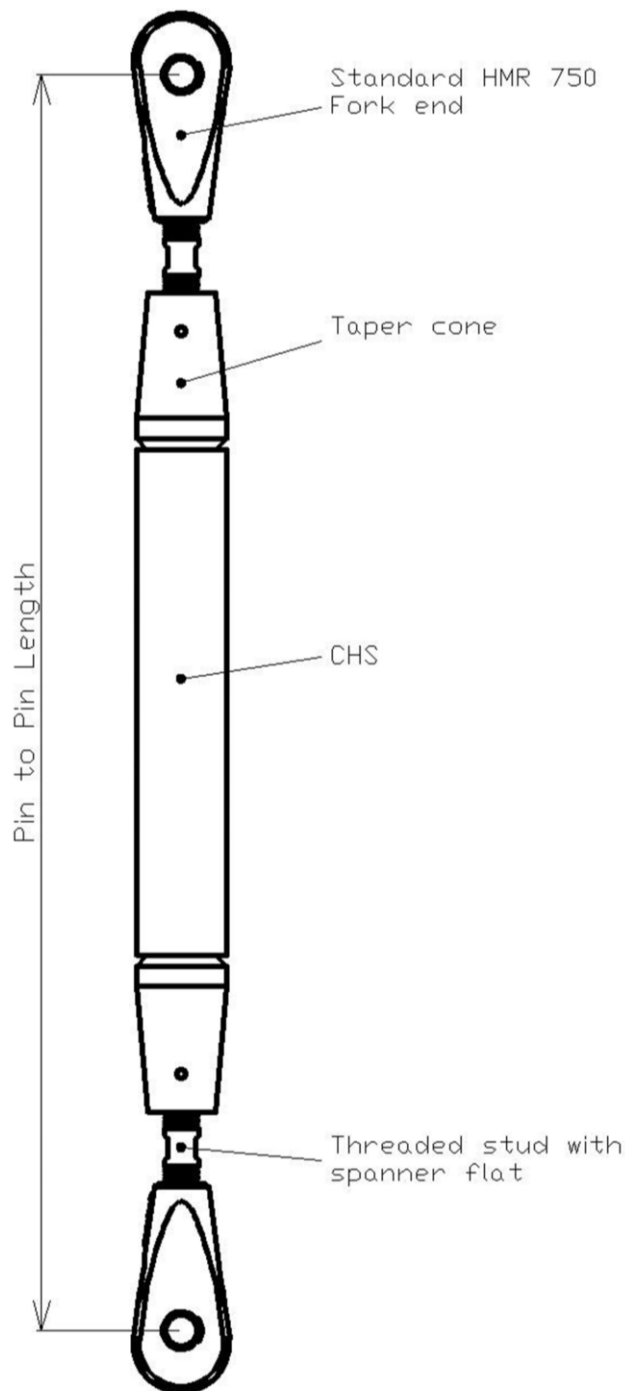
### HMR Tension Rod System 750

Dimensions of Hexagon Nut  
For Bar Material Grades S355, S460 and HMR 750

Annex B 12

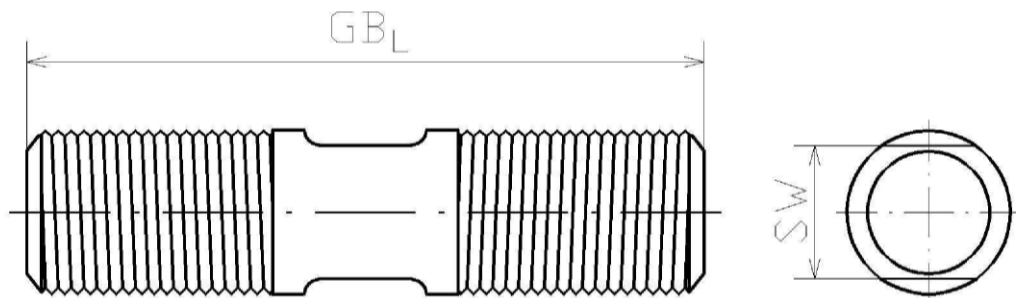


	<i>Cross Coupler</i>													
X	M12	M16	M20	M24	M30	M36	M42	M48	M56	M64	M76	M85	M90	M100
KMD (mm) => Overall Ø	23	31	38	46	57	69	81	92	110	125	149	168	178	198
KML (mm) => Length	76	103	124	149	181	219	258	290	343	318	376	417	444	494
KMNL (mm) => Slot Length	42	57	70	85	105	127	149	169	201	155	184	207	219	244
Max. angle	45°	45°	45°	45°	45°	45°	45°	45°	45°	30°	30°	30°	30°	30°
<b>HMR Tension Rod System 750</b>												<b>Annex B 13</b>		
Dimensions of Cross Coupler, Grade S355 For Bar Material Grades S355, S460 and HMR 750														

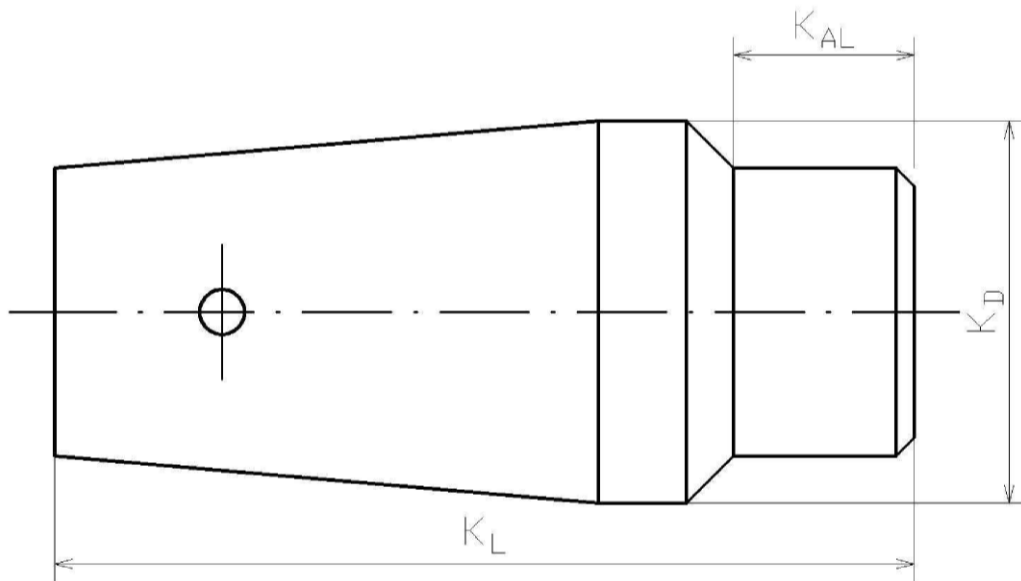


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HMR Compression Strut System 750	Annex B 14
System Components for Compression Strut System	



	<i>Threaded Stud</i>													
X	M12	M16	M20	M24	M30	M36	M42	M48	M56	M64	M76	M85	M90	M100
GB <sub>L</sub> (mm)	51	66	78	96	114	138	164	189	213	237	273	315	330	360
SW (mm)	10	13	16	20	25	30	36	42	49	56	68	78	82	91
HMR Compression Strut System 750												Annex B 15		
Threaded Stud with spanner flat for Adjustable Compression Strut System with Fork Ends														



***Taper Cone for Adjustable Compression Strut System***

X	M12	M16	M20	M24	M30	M36	M42	M48	M56	M64	M76	M85	M90	M100
$K_L$ (mm)	88.4	95.2	102.0	108.8	136.0	146.2	156.4	166.6	197.2	210.8	231.2	263.5	272.0	289.0
$K_D$ (mm)	33.7	42.4	48.3/60.3	76.1	88.9	114.3	139.7	168.3	193.7	219.1	244.5	273/323.9	323.9	323.9
$K_{AL}$ (mm)	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0

**Tension rod systems HMR 750**

Taper Cone for Adjustable Compression Strut System with Fork Ends

**Annex B 16**



Component	Steel grade	Material No.	Standard	Nominal thickness	Yield strength	tensile strength	Elongation	Notched bar impact work
				(mm)	Re/R <sub>p0,2 min</sub> (N/mm <sup>2</sup> )	R <sub>m min</sub> (N/mm <sup>2</sup> )	A <sub>5</sub> (%)	KV (Iso-V) (J/°C)
Fork end	G20Mn5	1.6220	EN 10340:2007	M12-M36	300	550	20	27/-30°
				M42-M100	300	575	20	27/-30°
Tension rod	S355J2	1.0577	EN 10025-2:2004	t ≤ 36	355	490	17	27 / -20°
				36 < t ≤ 105	335	470	17	27 / -20°
	S460N	1.8901	EN 10025-2:2004	t ≤ 36	460	540	17	27 / -20°
				36 < t ≤ 105	430	530	17	27 / -20°
	HMR 750	1.8901	Details are deposited with DiBt	t ≤ 36	540	720	17	27 / -20°
	HMR 750	1.5217	Details are deposited with DiBt	36 < t ≤ 105	540	750	12	40 / -20°
Pin	Grade 8.8		EN ISO 898-1:2013	M12-M100	640	800	12	27 / -20°
	S355J2	1.0577	EN 10025-2:2004	t ≤ 36	355	490	17	27 / -20°
				36 < t ≤ 105	335	470	17	27 / -20°
Gusset plate	S355J2	1.0577	EN 10025-2:2004	t ≤ 36	355	490	17	27 / -20°
				36 < t ≤ 105	335	470	17	27 / -20°
Connection disc	S355J2	1.0577	EN 10025-2:2004	t ≤ 36	355	490	17	27 / -20°
				36 < t ≤ 105	335	470	17	27 / -20°
Turnbuckle	S355J2	1.0577	EN 10025-2:2004	t ≤ 36	355	490	17	27 / -20°
				36 < t ≤ 105	335	470	17	27 / -20°
Coupler	S355J2	1.0577	EN 10025-2:2004	t ≤ 36	355	490	17	27 / -20°
				36 < t ≤ 105	335	470	17	27 / -20°
Cross coupler	S355J2	1.0577	EN 10025-2:2004	t ≤ 36	355	490	17	27 / -20°
				36 < t ≤ 105	335	470	17	27 / -20°
Lock cover	S355J2	1.0577	EN 10025-2:2004	t ≤ 36	355	490	17	27 / -20°
				36 < t ≤ 105	335	470	17	27 / -20°
Hexagon nut	Grade 8		DIN 934	M12-M48	according to standard			
	S355J2	1.0577	EN 10025-2:2004	M12-M100	335	470	17	27 / -20°
CHS Compression strut	S355J2H	1.0539	EN 102010-1	t ≤ 40	355	490	17	27 / -20°
				40 < t ≤ 100	335	470	17	27 / -20°
	S355J2H	1.0539	EN 102019-1	t ≤ 40	355	490	17	27 / -20°
Tapered cone Compression strut	S355J2	1.0577	EN 10025-2:2004	M12	355	490	17	27 / -20°
				M16 - M30	335	470	17	27 / -20°
				M36 - M100	265	450	17	27 / -20°
Threaded stud Compression strut	Grade 8.8		EN ISO 898-1:2013	M12-M100	640	800	12	27 / -20°
Tension rod systems HMR 750							Annex B 17	
Material properties of steel components								