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MEMBER OF EOTA



## European Technical Assessment ETA-21/0053 of 2021/01/01

### I General Part

**Technical Assessment Body issuing the ETA and designated according to Article 29 of the Regulation (EU) No 305/2011: ETA-Danmark A/S**

**Trade name of the construction product:**

Tension Rod System: Macalloy 355, 460, S460, 520 and S520

**Product family to which the above construction product belongs:**

Structural Metallic Products and Ancillaries

**Manufacturer:**

McCalls Special Products Ltd  
t/a Macalloy  
Caxton Way  
Dinnington  
Sheffield S25 3QE

**Manufacturing plant:**

McCalls Special Products Ltd  
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**This European Technical Assessment contains:**

26 pages including 2 annexes which form an integral part of the document

**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, edition March 2016

**This version replaces:**

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## 1 Technical description of the product

The Macalloy Tension Rod System (355, 460, S460, 520 and S520) is a prefabricated tension rod system used as a kit, comprising:

- steel or stainless steel pin connectors with screwed end caps
- steel and stainless steel bars (tension rods) of different sizes, with external threads
- cast steel or stainless steel fork end connectors with two eye loops and internal thread
- steel or stainless steel gusset plates or centre discs
- steel or stainless steel threaded sleeves (couplers, turnbuckles) with metric ISO threads M10 to M100.
- cast steel or stainless steel spade end connectors with a single eye loop and internal thread

The tension rods are connected to the corresponding structure by the fork end connectors. The fork end connectors are connected to the corresponding gusset plates or centre discs by double shear pin connections. The tension rods are connected to each other by the sleeves.

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

## 2 Specification of the intended use(s) in accordance with the applicable European Assessment Document (hereinafter EAD)

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 installed system must be accessible (in order) to facilitate replacement of individual components at any time.

The intended use comprises, for instance, the suspension of (glazed) roof structures or vertical glazing, 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 struts. The compression struts with a strength class lower 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 Annexes A and B.

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 or the Technical Assessment Body, 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 system.

### 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 the Annexes must correspond to the respective values and information laid down in the technical documentation to this European Technical Assessment.

3.1.2 Fork and connector, spade end connectors, pin connectors, gusset plate, centre disc, threaded sleeve (couplers and turnbuckles) and nuts

Essential characteristic	Performance
Geometry including tolerances Dimensions including tolerances Thread including tolerances	See Figures B2 to B14
Material	See Tables B1 to B3
Load bearing capacity Resistance to corrosion	See Annex A, A.1

##### 3.1.3 Tension rod

Essential characteristic	Performance
Nominal rod diameter Thread including tolerances	See Figures B2 to B14
Yield strength Tensile strength Material	See Tables B1 to B3
Tension resistance Compression force Resistance to corrosion	See Annex A, A.1 and A.2

#### 3.2 Safety in case of fire (BWR 2)

Tension rod, fork end connector, spade end connectors, pin connectors, gusset plate, centre disc, threaded sleeve (couplers and turnbuckles) and 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)

Please refer to BWR 1 for details.

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

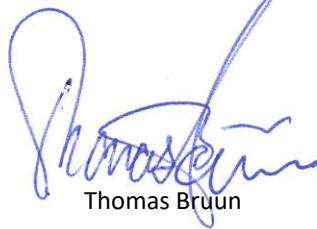
In accordance with European Assessment Document EAD No. 200032-00-0602, the applicable European legal act is: 98/214/EC.

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 ETA-Danmark A/S .

Issued in Copenhagen on 2021-01-01 by



Thomas Bruun

Managing Director, ETA-Danmark

## ANNEX A

Annex A applies to the prefabricated tension rod system described in the main body of the ETA.

### A.1 Assumptions concerning design

The design of the tension rod system is carried out by the designer of the structure, who is experienced in the field of steel structures, under the following conditions:

- the loading is static or quasi-static according to EN 1990 : 2002 and fatigue verification
- the tension rod system is not used when constructions are susceptible to vibrations under wind loads, or when wind-induced cross vibrations of the entire construction appear
- dimensions, material properties and screw-in depths "E" given in Figures B2 to B14 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 tension resistance of the entire tension rod system*

The design value of the tension resistance,  $F_{t,RD}$ , of the entire tension rod system (tension rods, fork end connectors including pins, couplers, turnbuckles, centre discs and gusset plates) is the minimum value of: the design tension resistance of the tension rod,  $F_{t,RD, Tension Rod}$ ; the design tension resistance of the turnbuckle,  $F_{t,RD, Turnbuckle}$ ; and the design bearing resistance of the gusset plate or centre disc,  $F_{b,Rd, Gusset plate/Centre disc}$ .

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

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

where:

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

A<sub>s</sub> is the threaded part tensile-stress area of the tension rod

f<sub>y,k</sub> is the characteristic value of the yield strength of the tension rod material according to R<sub>p0,2</sub> given in Tables B1 to B3.

f<sub>u,k</sub> characteristic value of the tensile strength of the tension rod material according to R<sub>m</sub> given in Tables B1 to B3.

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

where:

A is the net cross section of the unthreaded part of the turnbuckle

f<sub>y,k</sub> is the characteristic value of the yield strength of the turnbuckle material according to R<sub>p0,2</sub> given in Tables B1 to B3.

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

where:

T<sub>1</sub> is the thickness of gusset plate and centre disk according to Figure B5

D<sub>1</sub> is the pin diameter

f<sub>y,k</sub> is the characteristic value of the yield strength of the gusset plate or central disc material according to R<sub>p0,2</sub> given in Tables B1 to B3.

Recommended minimum values<sup>(1)</sup> for the partial safety factors  $\gamma_{M0}$  and  $\gamma_{M2}$ :

$\gamma_{M0}$ : 1.0 (for steel)

$\gamma_{M0}$ : 1.1 (for stainless steel)

$\gamma_{M2}$ : 1.25.

(1) These values should be used in cases where no values are given in the national Regulations of the Member States where the tension rod system is used or in the respective National Annex to Eurocode 3.

*Designed values of the compression force rods*

The design value of the compression force,  $F_{c,RD}$ , of tension rods in combination with fork end connectors according to Figure B2 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:

$$F_{c,RD} = \left[ \frac{\gamma_{M2}}{A_S \cdot f_{u,c}} + \frac{\left\{ \frac{T - T1}{2} + \frac{L - L1}{50} \right\} \cdot \gamma_{M0}}{W_{pl,S} \cdot f_{y,c}} \right]^{-1}$$

where:

$A_S$  is the tensile stress area of the thread

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

$f_{y,c}$  is the 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

$f_{u,c}$  is the 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, T1, L and L1 are stated in Figures B2, B5 and B6.

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

$\gamma_{M0}$ : 1.0 (for steel)

$\gamma_{M0}$ : 1.1 (for stainless steel)

$\gamma_{M2}$ : 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 as a consequence of the 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:

- installation is carried out such that the tension rod system is accessible for repair or maintenance at any time
- installation is only carried out according to the manufacturer's instructions. The manufacturer hands over the assembly instructions to the assembler. Prior to installation, all components of the tension rod system must be checked to ensure their condition is undamaged and free of corrosion. Damaged components must not be used
- the installer must ensure the minimum screw-in depth "E" is respected
- 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 fork end connectors should be kept in plane and perpendicular to each other on all Macalloy systems.

## ANNEX B

Annex B applies to the prefabricated tension rod system described in the main body of the ETA.

Figure B1 System components

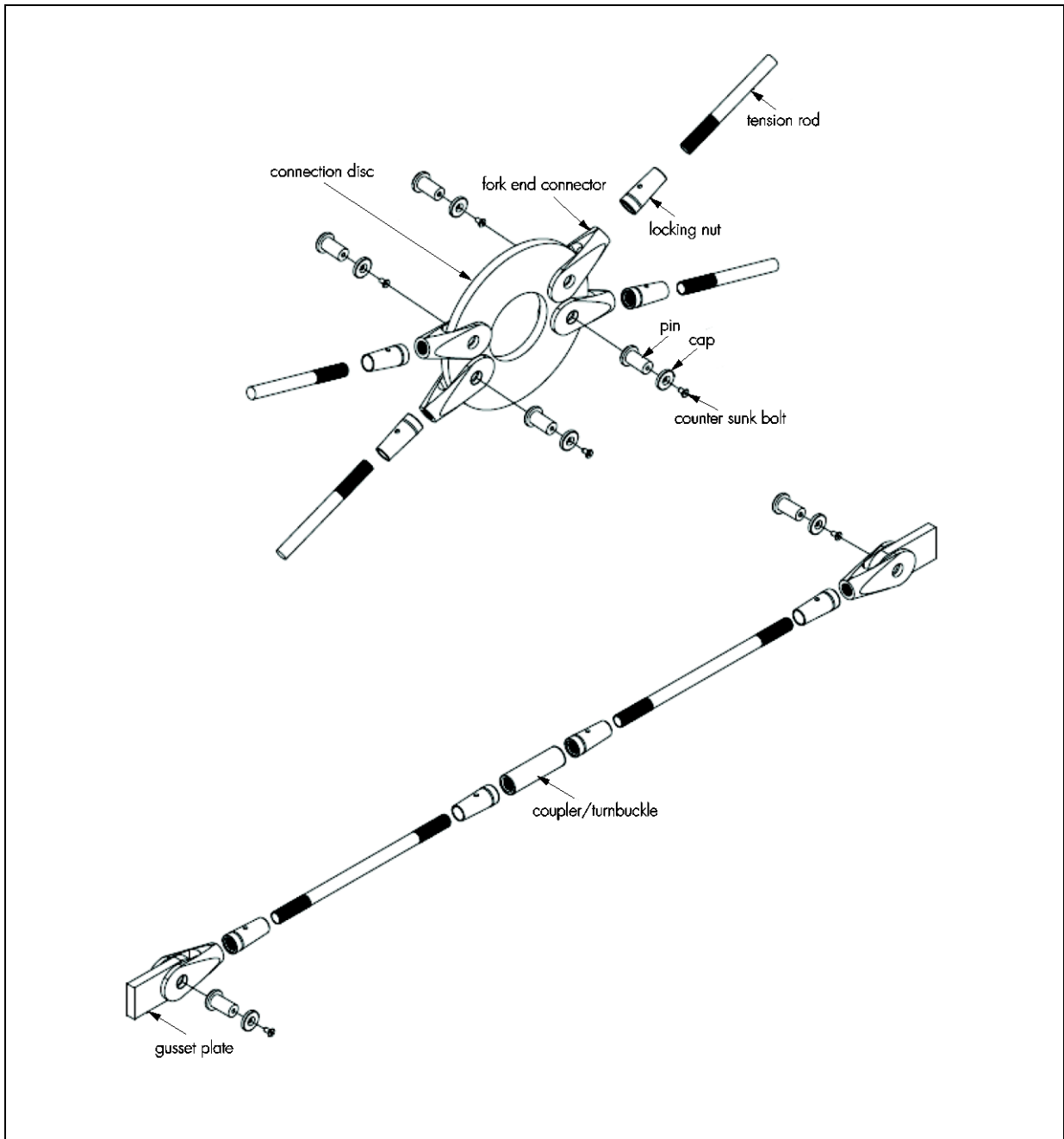




Table B1 – Macalloy Tension Rod System S355

Component	Figure refs	System size	Material	Technical delivery condition	Mechanical properties (minimum values)	
					Yield Strength R <sub>p0.2</sub> [N·mm <sup>2</sup> ]	Tensile Strength R <sub>m</sub> [N·mm <sup>2</sup> ]
Fork End Connector	B2	M10 to M100	G20Mn5 G20NiMoCr4	according to technical documentation <sup>(1)</sup>	355	600
		M20 to M56	S355J2G3	according to technical documentation <sup>(1)</sup> EN 10250-2 : 1999	380 <sup>(3)</sup>	550
Spade-End Connectors	B6	M10 to M56	G20Mn5 G20NiMoCr4	according to technical documentation <sup>(1)</sup>	335	600
Pin	B3	M10 to M16	8.8	according to technical documentation <sup>(1)</sup>	665	800
		M20 to M100	8.8		685	822
Tension rod	B8 B9, B12	M10 to M36	S355J2	according to technical documentation <sup>(1)</sup>	355	490
Coupler		M42 to M76	S355J2	according to technical documentation <sup>(1)</sup>	335	470
Turnbuckle		M85 to M100	S355J2	according to technical documentation <sup>(1)</sup>	315	470
Gusset plate	B5	M10 to M100	≥S355 <sup>(2)</sup>	at least steel grade S355 or higher (EN 1993-1-1 : 2010)	according to EN 1993-1-1 : 2010	

(1) The technical documentation is deposited at ETA-Danmark A/S and contains specifications for the chemical composition as well as values for the elongation after fracture A<sub>5</sub> and the Charpy impact value ISO-V.

(2) At least steel grade S355 or higher strength (according to EN 1993-1-1 : 2005)

(3) R<sub>e</sub>

Table B2 – Macalloy Tension Rod System 460, S460

Component	Figure refs	System size	Material	Technical delivery condition	Mechanical properties (minimum values)	
					Yield strength R <sub>p0.2</sub> [N·mm <sup>2</sup> ]	Tensile strength R <sub>m</sub> [N·mm <sup>2</sup> ]
Fork End Connector	B2	S460 M10 to M76	Stainless Steel Cast 4A	according to technical documentation <sup>(1)</sup>	335	600
		460 M10 to M100	G20Mn5 G20NiMoCr4	according to technical documentation <sup>(1)</sup>	375	600
		460 M20 to M56	S355J2G3	according to technical documentation <sup>(1)</sup> EN 10250-2 : 1999	380 <sup>(3)</sup>	550
Spade End Connector	B6	S460 M10 to M76	Stainless Steel Cast 4A	according to technical documentation <sup>(1)</sup>	355	600
		460 M10 to M100	G20Mn5 G20NiMoCr4			
Pin	B2	S460 M10 to M24	316S11 316S13 316S31 316S33	according to technical documentation <sup>(1)</sup>	640	800
			1.4462	EN 10088-3 : 2005 <sup>(3)</sup>		
		S460 M30 to M76	7M Stainless Steel 431	according to technical documentation <sup>(1)</sup>	835 640	1030 800
		460 M10 to M100	8.8 40Cr	according to technical documentation <sup>(1)</sup>	665	800
Tension Rod	B7, B10, B11	S460 M10 to M76	316S11 316S13 S316S31 316S33	according to technical documentation <sup>(1)</sup>	460	610
1.4460 1.4462 1.4507 F51			EN 10088-3 : 2005 <sup>(3)</sup>			
Coupler Turnbuckle		460 M10 to M100	460	according to technical documentation <sup>(1)</sup>	460	610
Gusset plate	B5	S460 M10 to M76	≥ S355 <sup>(2)</sup>	according to technical documentation <sup>(1)</sup>	Acc. To technical documentation <sup>(1)</sup>	
		460 M10 to M100	≥ S355 <sup>(2)</sup>	EN 1993-1-1 : 2005	EN 1993-1-1 : 2005	

(1) The technical documentation is deposited at ETA-Danmark A/S and contains specifications for the chemical composition as well as values for the elongation after fracture A<sub>5</sub> and the Charpy impact value ISO-V.

(2) At least steel grade S355 or higher strength (according to EN 1993-1-1 : 2005)

(3) R<sub>e</sub>

Table B3 – Macalloy Tension Rod System 520, S520

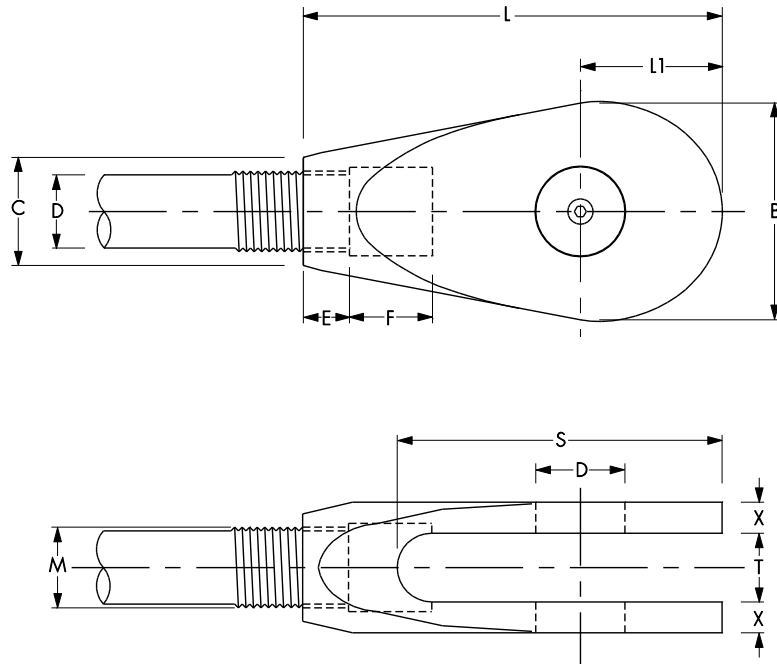
Component	Figure refs	System size	Material	Technical delivery condition	Mechanical properties (minimum values)	
					Yield strength R <sub>p0.2</sub> [N·mm <sup>2</sup> ]	Tensile strength R <sub>m</sub> [N·mm <sup>2</sup> ]
Fork End Connector	B2	S520 M10 to M76	Stainless Steel Cast 4A	according to technical documentation <sup>(1)</sup>	335	600
		520 M10 to M100	G20Mn5 G20NiMoCr4	according to technical documentation <sup>(1)</sup>		
Spade End Connector	B6	S520 M10 to M56	Stainless Steel Cast 4A	according to technical documentation <sup>(1)</sup>	355	600
		520 M10 to M56	G20Mn5 G20NiMoCr4			
Pin	B3, B4	S520 M10 to M24	316S11 316S13 316S31 316S33	according to technical documentation <sup>(1)</sup>	640	800
			1.4462	EN 10088-3:2005 <sup>(3)</sup>		
		S520 M30 to M76	7M Stainless Steel 431	according to technical documentation <sup>(1)</sup>	835 640	1030 800
		520 M10 to M16	8.8 40Cr	according to technical documentation <sup>(1)</sup>	665	800
		520 M20 to M100	8.8 40Cr	according to technical documentation <sup>(1)</sup>	685	882
Tension Rod Coupler Turnbuckle	B7, B10, B11	S520 M10 to M76	316S11 316S13 S316S31 316S33	according to technical documentation <sup>(1)</sup>	520	690
			1.4460 1.4462 1.4507 F51	EN 10088-3 : 2005 <sup>(3)</sup>		
		520 M10 to M100	460 Grade #45 40Cr	according to technical documentation <sup>(1)</sup>	520	690
Gusset plate	B5	S520 M10 to M76	≥ S355 <sup>(2)</sup>	according to technical documentation <sup>(1)</sup>	according to technical documentation <sup>(1)</sup>	
		520 M10 to M100	≥ S355 <sup>(2)</sup>	EN 1993-1-1 : 2005	EN 1993-1-1 : 2005	

(1) The technical documentation is deposited at ETA-Danmark A/S and contains specifications for the chemical composition as well as values for the elongation after fracture A<sub>5</sub> and the Charpy impact value ISO-V.

(2) At least steel grade S355 or higher strength (according to EN 1993-1-1 : 2005)

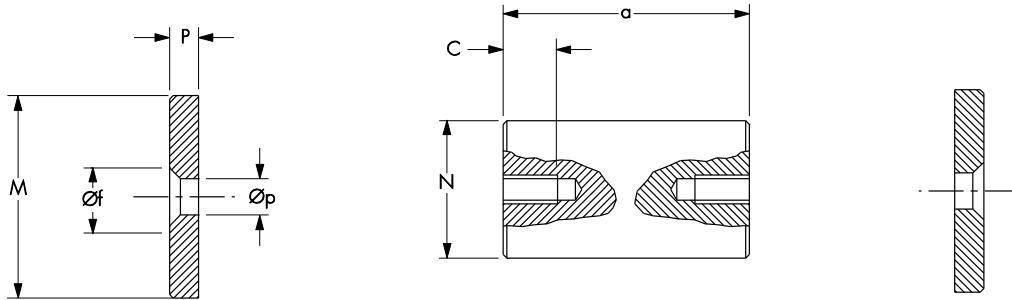
(3) R<sub>e</sub>

**Figure B2 Dimensions of Fork End Connectors:**  
**Systems 335 / 460 / 520 (M10 to M100), Systems S460 / S520 (M10 to M76)**



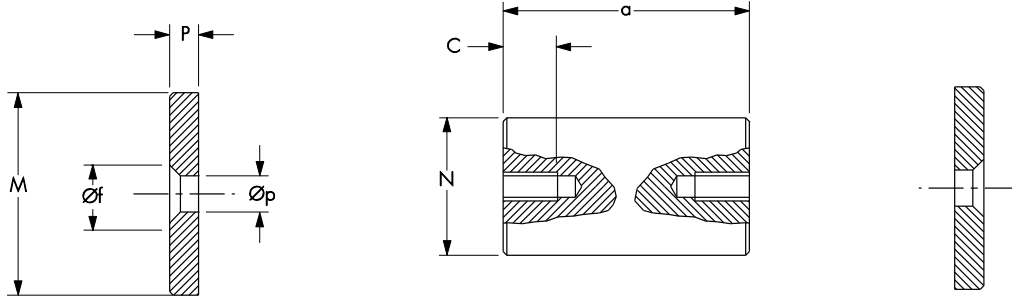
Thread M	M10	M12	M16	M20	M24	M30	M36	M42	M48	M56	M64	M76	M85	M90	M100
L (mm)	63	75	99	122	148	178	204	232	266	314	348	410	459	489	555
B (mm)	30	34	45	53	64	81	93	109	123	147	169	201	236	248	289
C (mm)	17	19	25	29	35	44	52	60	69	80	91	108	121	129	143
E (mm)	12	14	18	24	27	32	38	44	50	58	66	78	87	92	102
F (mm)	8	10	14	16	22	28	34	41	46	55	49	49	49	49	49
T (mm)	11	12	15	19	24	26	34	39	44	49	59	76	78	86	91
D (mm)	11.5	13	17	21.5	25.5	31.5	37.5	43.5	49.5	57.5	65.5	78.5	91.5	96.5	111.5
S (mm)	46	54	70	85	104	127	148	167	191	227	259	309	349	374	430
X (mm)	4	4.5	6	8.5	9.5	11.5	14.5	17.5	21	23.5	27.5	34.5	37	41	41
L1 (mm)	18	22	29	34	42	53	61	70	81	97	111	132	153	162	188

Figure B3 Dimensions of Pins for Standard Forks and Spade End Connectors:  
Systems 335 / 460 / 520 (M10 to M100)



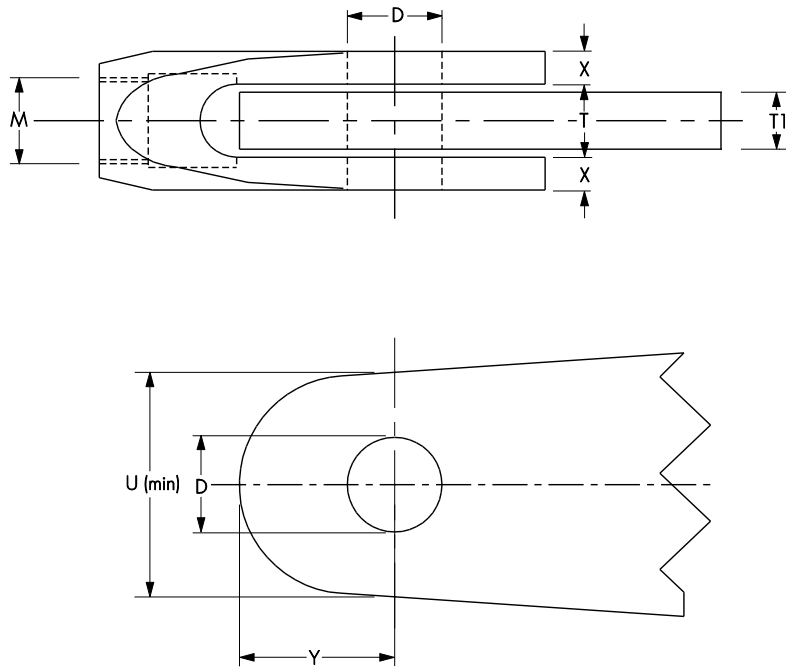
Thread M	M10	M12	M16	M20	M24	M30	M36	M42	M48	M56	M64	M76	M85	M90	M100
Screw	10	10	10	16	16	16	16	20	25	25	25	25	25	25	25
a (mm)	22	24	30	39	46	52	66	78	91	100	120	151	158	175	180
c (mm)	7	7	7	12	12	12	12	14	18	18	18	18	18	18	18
Øf	9	9	11.2	13.4	13.4	13.4	13.4	17.9	22.4	22.4	22.4	22.4	22.4	22.4	22.4
M (mm)	15	18	24	28	31	40	45	55	65	75	85	95	105	110	120
N (mm)	10.5	12	16	20	24	29	35	41	47	54.5	62.5	75.5	89	93	108
P (mm)	4	4	4	5	5	5	5	8	10	10	10	10	10	10	10
Øp	4.5	4.5	5.5	6.5	6.5	6.5	6.5	9	12	12	12	12	12	12	12

Figure B4 Dimensions of Pins for Standard Forks:  
Systems S460 / S520 (M10 to M76)



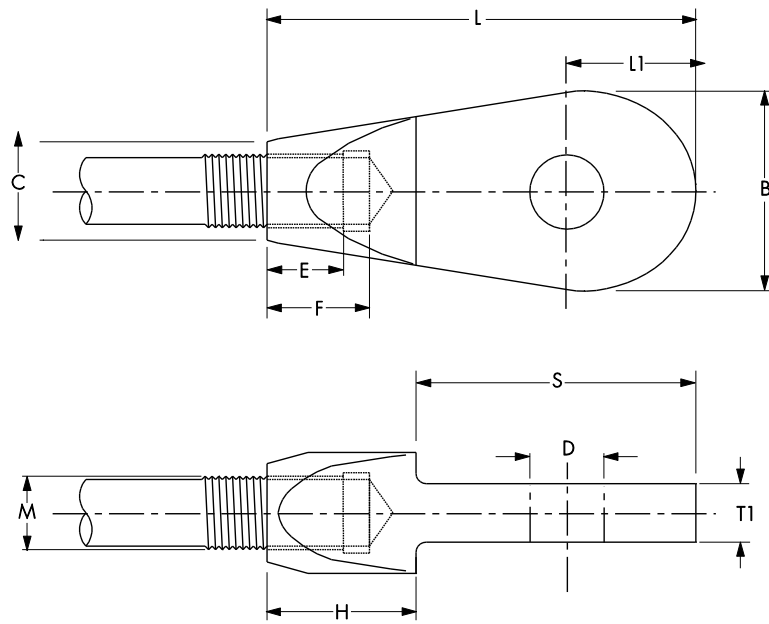
Thread M	M10	M12	M16	M20	M24	M30	M36	M42	M48	M56	M64	M76
Screw	10	10	10	16	16	16	16	20	25	25	25	25
a (mm)	22	24	30	39	46	52	66	78	91	100	120	151
c (mm)	7	7	7	12	12	12	12	14	18	18	18	18
Øf	9	9	11.2	13.4	13.4	13.4	13.4	17.9	22.4	22.4	22.4	22.4
M (mm)	15	17	22	27	31	40	45	55	60	70	80	95
N (mm)	11	12.5	16.5	20.5	24.5	30	36	42	48	56	63.5	76.5
P (mm)	4	4	4	5	5	5	5	8	10	10	10	10
Øp	4.5	4.5	5.5	6.5	6.5	6.5	6.5	9	12	12	12	12

**Figure B5 Dimensions of Gusset Plates for Standard Forks:**  
**Systems 355 / 460 / 520 (M10 to M100), Systems S460 / S520 (M10 to M76)**



Thread M	M10	M12	M16	M20	M24	M30	M36	M42	M48	M56	M64	M76	M85	M90	M100
T1 (mm)	10	10	12	15	20	22	30	35	40	45	55	70	70	80	85
T (mm)	11	12	15	19	24	26	34	39	44	49	59	76	78	86	91
D (mm)	11.5	13	17	21.4	25.5	31.5	37.5	43.5	49.5	57.5	65.5	78.5	91.5	96.5	111.5
S (mm)	46	54	70	85	104	127	148	167	191	227	259	309	349	374	430
X (mm)	4	4.5	6	8.5	9.5	11.5	14.5	17.5	21	23.5	27.5	34.5	37	41	41
U (mm)	28	34	48	60	68	90	103	118	135	163	180	211	259	266	317
Y (mm)	18	22	30	37	43	56	64	74	84	101	112	132	160	166	196

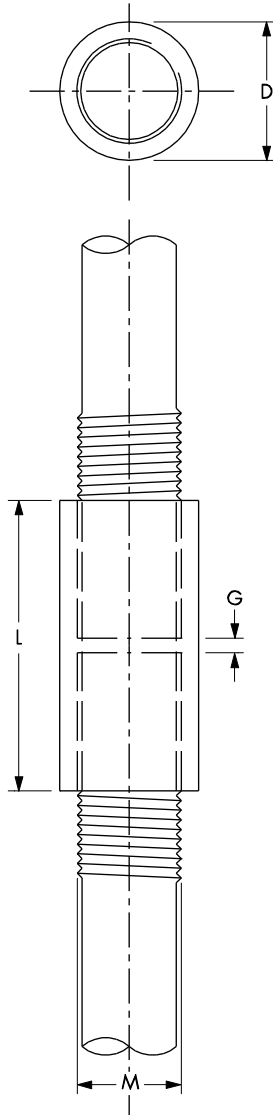
Figure B6 Dimensions of Spade End Connectors:  
Systems 460 / 520 / S460 / S520 (M10 to M56)



Thread M	M10	M12	M16	M20	M24	M30	M36	M42	M48	M56
L (mm)	78	92	118	147	174	213	249	284	321	365
B (mm)	28	32	44	51	62	80	94	107	122	147
C (mm)	17	19	25	29	35	43	52	60	68	80
E (mm)	20	24	32	22	26	34	38	44	50	58
F (mm)	26	30	40	40	48	62	72	84	96	112
H (mm)	32	38	48	60	70	85	100	115	127	150
D (mm)	11.5	13	17.5	21.5	25.5	31.5	37.5	43.5	49.5	57.5
S (mm)	46	54	70	87	104	128	149	169	194	215
T1 (mm)	8	9	12	15	20	22	30	35	40	45
L1 (mm)	17.5	21.5	29	33	41	52	61	69	80	96

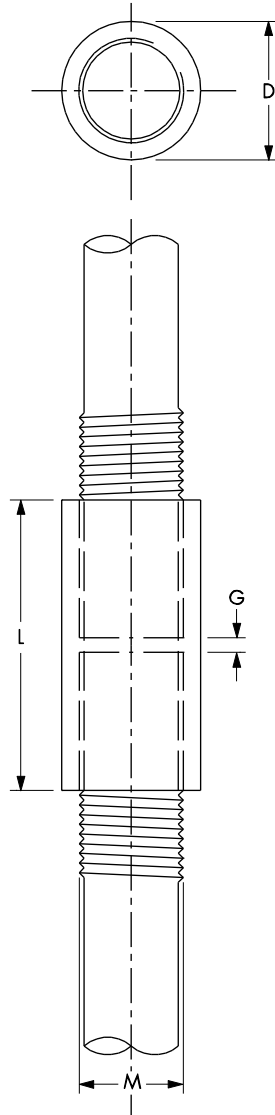


Figure B7 Dimensions of Couplers:  
Systems 460 / 520 (M10 to M100), Systems S460 / S520 (M10 to 76)



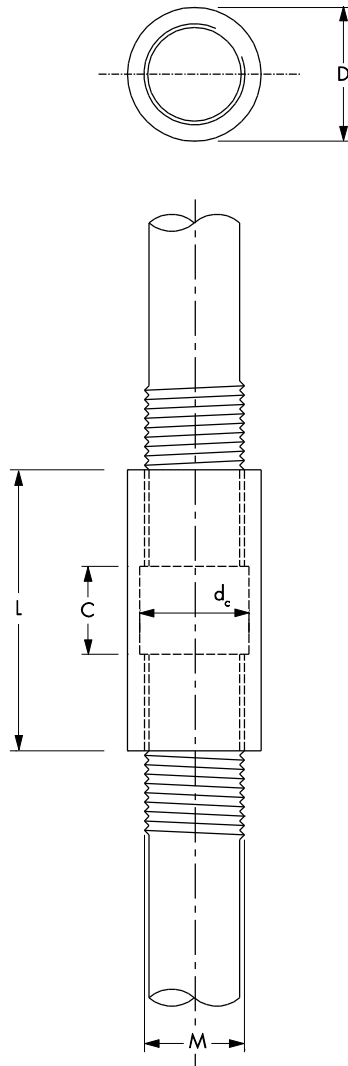
Thread M	M10	M12	M16	M20	M24	M30	M36	M42	M48	M56	M64	M76	M85	M90	M100
D (mm)	17	19	25	29	35	43	52	60	68	80	91	108	121	129	143
G (mm)	$1 \leq G \leq 5$														
L (mm)	25	29	37	45	53	65	77	89	101	117	133	157	175	185	205

Figure B8 Dimensions of Couplers:  
System 355 (M10 to M100)



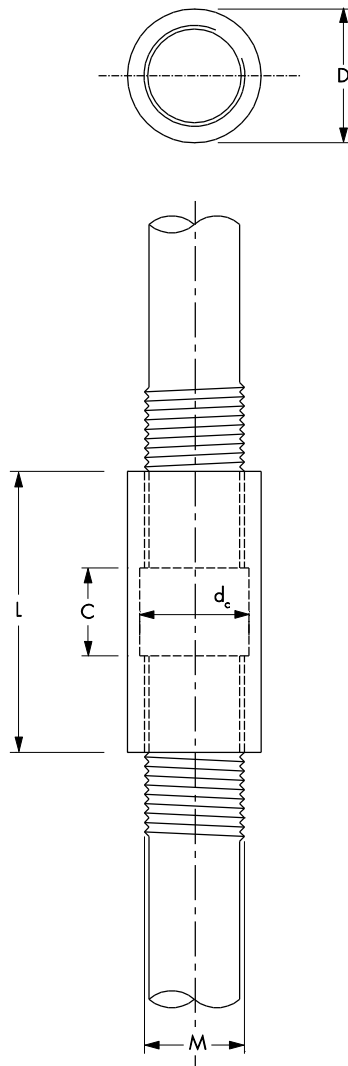
Thread M	M10	M12	M16	M20	M24	M30	M36	M42	M48	M56	M64	M76	M85	M90	M100
D (mm)	17	20	26	32	38	47	56	66	75	87	99	119	135	143	160
G (mm)	$1 \leq G \leq 5$														
L (mm)	25	29	37	45	53	65	77	89	101	117	133	157	175	185	205

Figure B9 Dimensions of Turnbuckles:  
Systems 355 (M10 to M100)



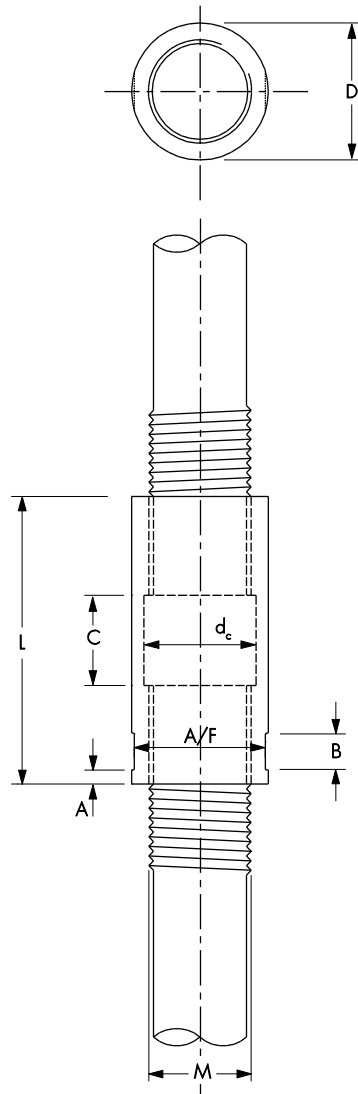
Thread M	M10	M12	M16	M20	M24	M30	M36	M42	M48	M56	M64	M76	M85	M90	M100
d <sub>c</sub> (mm)	12	14	18	22	26	32	38	44	50	58	66	78	87	92	102
C (mm)	50	50	50	50	50	100	100	100	100	100	100	100	100	100	100
D (mm)	17	20	26	32	38	47	56	66	75	87	99	119	135	143	160
L (mm)	74	78	86	90	98	160	172	184	196	212	228	252	270	280	300

Figure B10 Dimensions of Turnbuckles:  
Systems 460 / 520 (M10 to M100), Systems S460 / S520 (M10 to M76)



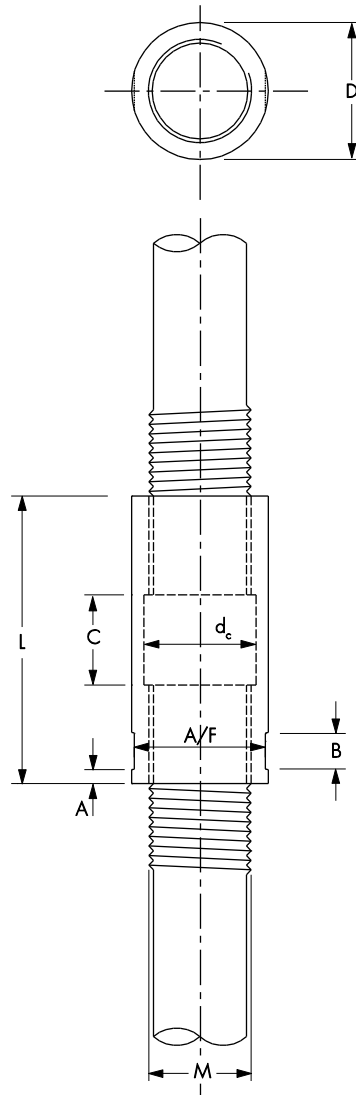
Thread M	M10	M12	M16	M20	M24	M30	M36	M42	M48	M56	M64	M76	M85	M90	M100
d <sub>c</sub> (mm)	12	14	18	22	26	32	38	44	50	58	66	78	87	92	102
C (mm)	50	50	50	50	50	100	100	100	100	100	100	100	100	100	100
D (mm)	17	19	25	29	35	43	52	60	68	80	91	108	121	129	143
L (mm)	74	78	86	90	98	160	172	184	196	212	228	252	270	280	300

Figure B11 Dimensions of Turnbuckles with Spanner Flats:  
Systems 460 / 520 (M10 to M100), Systems S460 / S520 (M10 to M76)



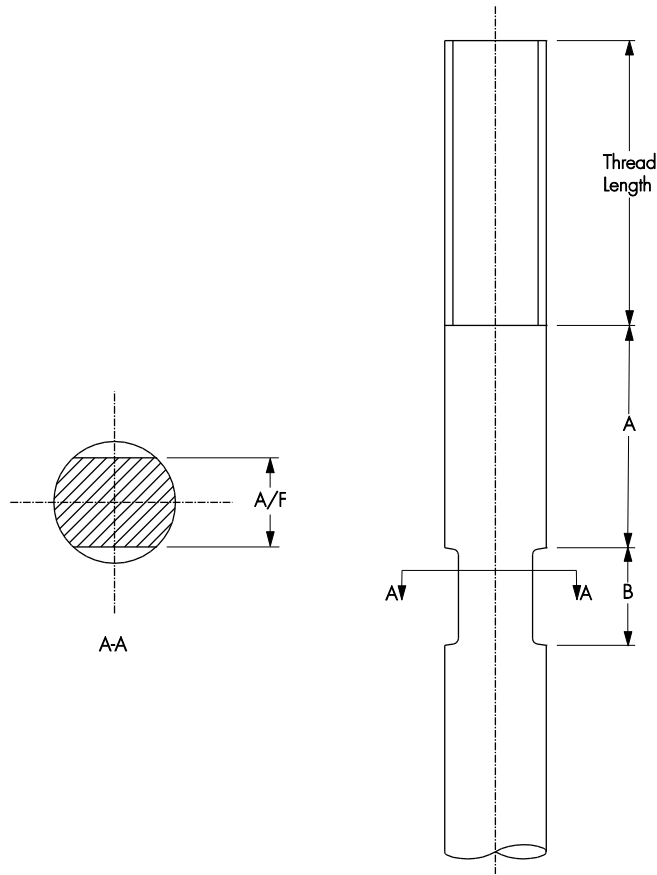
Thread M	M10	M12	M16	M20	M24	M30	M36	M42	M48	M56	M64	M76	M85	M90	M100
dc (mm)	12	14	18	22	26	32	38	44	50	58	66	78	87	92	102
C (mm)	50	50	50	50	50	100	100	100	100	100	100	100	100	100	100
D (mm)	17	20	26	32	38	47	56	66	75	87	99	119	135	143	160
L (mm)	74	78	86	90	98	160	172	184	196	212	228	252	270	280	300

Figure B12 Dimensions of Turnbuckles with Spanner Flats:  
System 355 (M10 to M100)



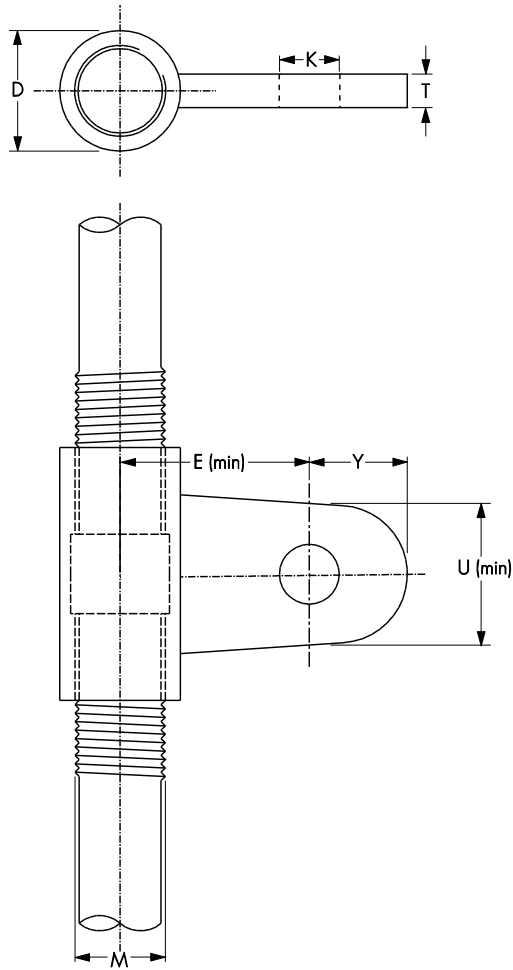
Thread M	M10	M12	M16	M20	M24	M30	M36	M42	M48	M56	M64	M76	M85	M90	M100
dc (mm)	12	14	18	22	26	32	38	44	50	58	66	78	87	92	102
A/F (mm)	15	18	22	29	31	40	48	58	67	79	91	110	126	134	150
A (mm)	4	4	5	5	5	5	5	10	10	10	10	15	15	15	15
B (mm)	8	8	10	10	16	16	20	32	32	32	32	32	38	38	38
C (mm)	50	50	50	50	50	100	100	100	100	100	100	100	100	100	100
D (mm)	17	20	26	32	38	47	56	66	75	87	99	119	135	143	160
L (mm)	74	78	86	90	98	160	172	184	196	212	228	252	270	280	300

**Figure B13 Dimensions of Spanner Flats:**  
**Systems 355 / 460 / 520 (M10 to M100), Systems S460 / S520 (M10 to M76)**



Thread M	M10	M12	M16	M20	M24	M30	M36	M42	M48	M56	M64	M76	M85	M90	M100
A (mm)	110	130	150	180	200	240	280	320	350	390	440	500	550	575	625
B (mm)	20	20	20	25	25	25	25	25	32	32	40	40	50	50	50
A/F (mm)	8	9	12	16	19	25	30	36	42	48	57	68	77	81	90

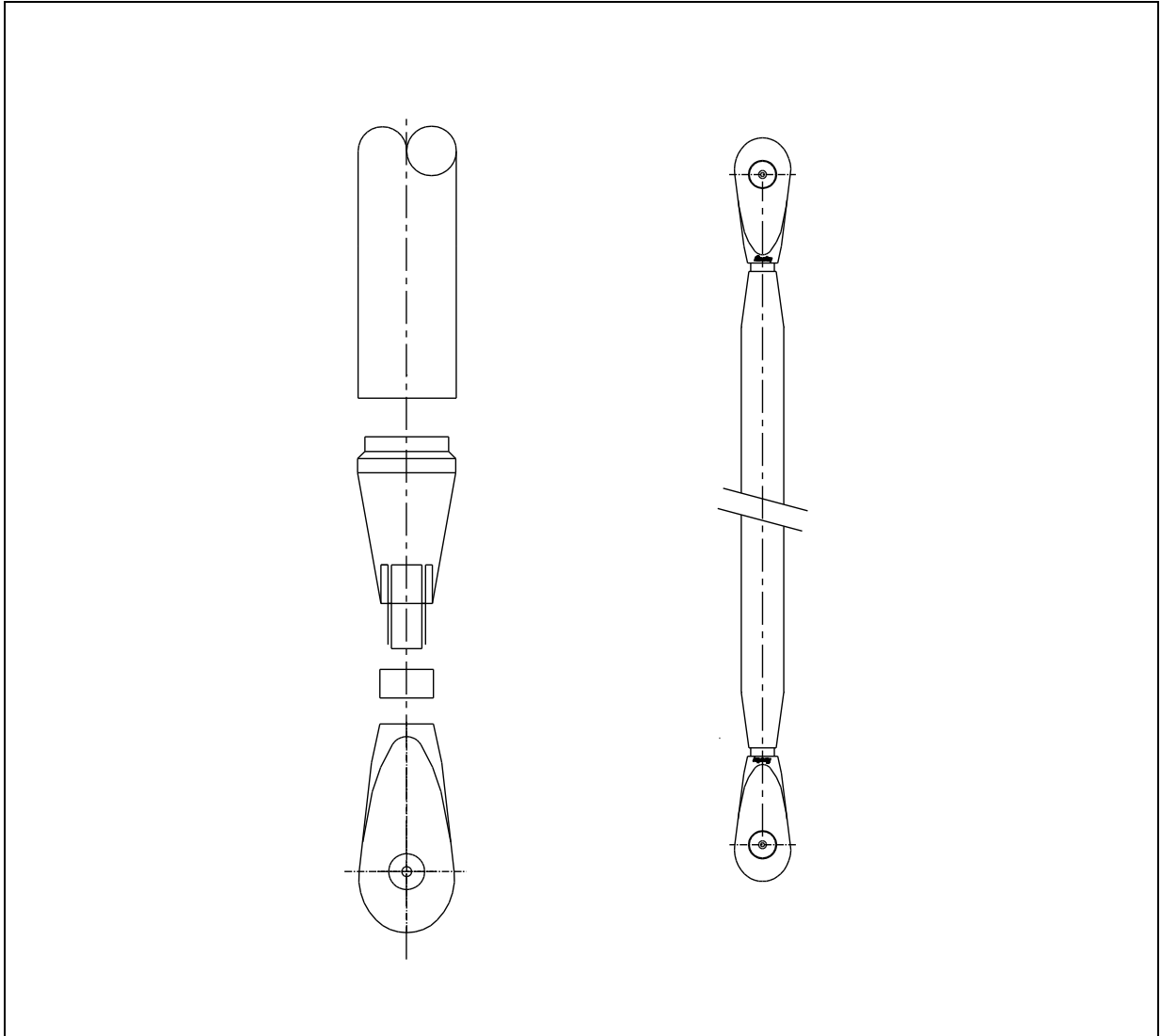
Figure B14 Dimensions of Fin Plates for Turnbuckles:  
Systems 355 (M10 to M100), Systems S460 / S520 (M10 to M76)



Thread M	M10	M12	M16	M20	M24	M30	M36	M42	M48	M56	M64	M76	M85	M90	M100
Y (mm)	18	22	30	37	43	56	64	74	84	101	112	132	160	166	196
U (MIN) (mm)	28	34	48	60	68	90	103	118	135	163	180	211	259	266	317
E (MIN) (mm)	28	32	39	44	52	63	71	80	91	107	121	142	163	172	198
D (mm)	17	20	26	32	38	47	56	66	75	87	99	119	135	143	160
K (mm)	11.5	13	17	21.4	25.5	31.5	37.5	43.5	49.5	57.5	65.5	78.5	91.5	96.5	111.5
T (mm)	10	10	12	15	20	22	30	35	40	45	55	70	70	80	85



Figure B15 Assembly combinations dependent on material grade and system



**Table B4** - Assembly Combinations dependent on Material Grade and System

	tension rod 355 M10 to M100	tension rod 460 M10 to M100	tension rod 520 M10 to M100	tension rod S460 M10 to M76	tension rod S460 M10 to M76
fork carbon/stainless steel M10 to M100 Figure B2	possible	possible	possible	–	–
architectural pin 8.8 M10 to M100 Figure B6, B3	possible	possible	possible	–	–
coupler 460/520 M10 to M100 Figure B8	possible	possible	possible	–	–
coupler 355 M10 to M100 Figure B10	possible	possible	possible	–	–
turnbuckle 460/520 M10 to M100 Figure B9	possible	possible	possible	–	–
turnbuckle 355 M10 to M100 Figure B11	possible	possible	possible	–	–
spanner flats 355/460/520/S460/S520 Figure B13	possible	possible	possible	possible	possible
spade-ends carbon/stainless steel M10 to M100 Figure B7	possible	possible	possible	–	–
fork stainless cast A4 M10 to M76 Figure B2	–	–	–	possible	possible
architectural pin 316/1.4462 M10 to M76 Figure B6, B3	–	–	–	possible	possible
Coupler S460/S520 M10 to M76 Figure B10	–	–	–	possible	possible
turnbuckle S460/S520 M10 to M76 Figure B9	–	–	–	possible	possible