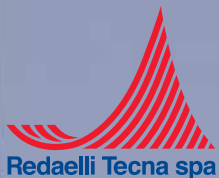


# Macalloy

BAR & CABLE SYSTEMS



## Tensoteci

E:Hh3  
Aug '04



TENSION STRUCTURES

## Macalloy Cable Structures:

Macalloy-Tensoteci Galvanised  
Cable Tendons

Macalloy Guy Linking  
Stainless Steel Cable Tendons



# Tensile Structure Systems

Macalloy Ltd has been the leader in the design, manufacture and supply of threaded bar systems since 1948.

In the early 1980's it pioneered the concept of Tensile Structures and, since this time, has led the world in the development of new systems and in the introduction of new technology in this field.

Now, through a close relationship with Tensoteci a division of Radaelli Tecna Group of companies, Macalloy is able to offer large diameter cable systems in galvanized steel and stainless steel of both locked coil and open spiral strand construction.

Tensoteci cable system  
British Airways London Eye

Architect: David Marks & Julia Barfield

Engineer: Hollandia & Iv-Infra

Contractor: Hollandia



Tensoteci, based in Milan, is Italy's leading manufacturer of steel wire ropes, cables and accessories. Tensoteci, founded in 1890 and part of the Radaelli Tecna Group of companies, supply a range of tensile cable systems in locked coil and open strand construction as standard up to 128mm diameter.

Some of their notable reference sites are the cable systems of the giant London Eye

observation wheel in the UK, the suspension cables system of the Braga Stadium in Portugal designed by Souto de Moura and the Athens Olympic stadium roof designed by Santiago Calatrava.

The partnership between the two well established companies combines years of experience in design, manufacture, erection and stressing of tensile systems. Together this newly formed partnership can offer the

market a complete and comprehensive solution for wide span tensile structures using steel bars and cables.

No other company can offer such a complete package of bar and cable solutions in both carbon and stainless steels for Tension Structure applications to architects, engineers and contractors worldwide.

# Tensile Structure Systems

## Galvanised Cable Range

Macalloy offers both open spiral strand and full locked coil strand in standard diameters up to 88mm and 128mm respectively. Standard end components include fork sockets, cylindrical sockets and bridge sockets.

## Stainless Steel Cable Range

Alongside the new galvanized cable range, Macalloy still offers the stainless steel Macalloy Guy Linking Cable system with swaged ends in diameters up to 26mm as standard and up to 36mm on request. Larger diameters are also available with resin socket ends.

## Carbon and Stainless Steel Bar Tendons

Macalloy's existing tensile structure bar systems include:

- Macalloy 460 (carbon steel bar system)
- Macalloy S460 (stainless steel bar system)
- Macalloy Guy Linking Bar System (stainless steel bar system)

Full details of these systems are found in the Macalloy Tensile Structure System brochure.



Tensoteci cable systems. Cappelle a/d IJssel Rivium Bridge

Architect: Iv-Consult

Engineers: Iv-Infra



Tensoteci cable systems. Braga Stadium, Portugal

Architect: Eduardo Souto de Moura

Engineer: A.F.A

Contractor: Assoc/Soares da Costa Ace



# Macalloy-Tensoteci Galvanised Cable Systems

## Open Spiral Strand (OSS)

The open spiral strands are made from hot dip galvanised high strength steel wires.

The strand is built by several layers of round wires helically wound around the core.

Typical properties of the wires are:

- tensile strength  $f_t=1570$  to 1760 MPa minimum
- proof stress  $R_{p0.2}=1180$  to 1320 MPa minimum
- elongation at break  $A=4\%$  minimum on 250mm gauge length
- the zinc coating and the wire ductility comply with UNI 7304 class A, ISO 2232 class A, DIN 2078 heavy galvanising, ASTM A586 class A, 10264-3 class A, or other standards as required.

## Full Locked Coil Strands (FLC)

The full locked coil strands are made from hot dip galvanised high strength steel wires.

The strand is built by an inner core of round wires and by one or more external layers of Z shaped wires.

The Z shape of the wires is specially made in a self locking formation to give a compact section.

The special shape of the Z shaped wires allows for flat contact surfaces and low contact stresses between the wires.

Typical properties of the wires are:

- tensile strength  $f_t=1570$  to 1660 MPa minimum
- proof stress  $R_{p0.2}=1180$  to 1245 MPa minimum
- elongation at break  $A=4\%$  minimum on 250mm gauge length
- the zinc coating and the wire ductility comply with UNI 7304 class A, ISO 2232 class A, DIN 2078 heavy galvanising, ASTM A586 class A, 10264-3 class A or other standards as required. The minimum zinc coating of the Z shaped wires is 300g/m<sup>2</sup>.

The Z shape of the wires helps to prevent external agents entering inside the cables.

## Tensofill Corrosion Inhibitor

The spiral strands and the locked coil strands are generally filled in the inner layers by Tensofill. This is a corrosion inhibitor compound made by Severe Atmosphere Corrosion Inhibitor, resin and zinc powder, in a grade to optimise the resin anti-corrosion shield and the galvanic protection.

The filler helps to prevent the entry and diffusion of moisture inside the cable and gives additional protection to the galvanised wires.

## Prestretching and Marking

The strands for structural application are usually prestretched in the works, to remove the initial inelastic deformation due to the helical structure of the cables and to stabilise the elastic modulus.

The prestretching operation is executed on a special plant, with a capacity of 5000kN, where the cable is anchored and pulled.

The prestretching is made usually by 4 or more cycles from 10% to 50-60% of the minimum breaking force; after the last cycle the force is adjusted to the specified load to allow measurement of the cable.

The cables are then measured and marked under the specified load for cutting to length and the position of the intermediate clamps are marked, when required.

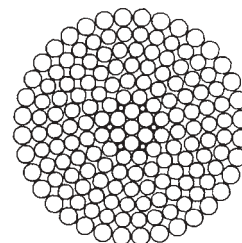
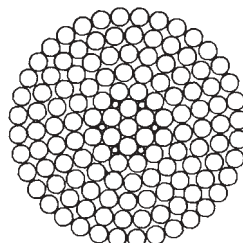
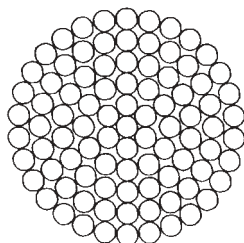
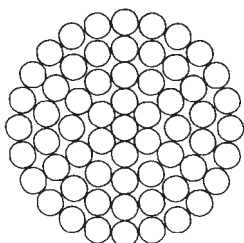
The measurement method takes into account automatic compensation of the thermal elongation, and is performed in monitored thermal conditions.

Defining the lengths is done by ourselves using load-geometry data from the structural model and taking into consideration the actual sizes, offsets and dimensions of the connection pieces.

Additionally the expected long term creep and setting of the anchor ends is considered in the prefabricated lengths.

Table 1: Open Spiral Strand

Diameter (mm)	Cross Section A (mm <sup>2</sup> )	Minimum Break Load MBL (kN)	Elastic Stiffness E-A (MN)	Weight (kg/m)
12	88	135	14.6	0.7
16	157	240	25.9	1.3
20	245	380	40.4	2.0
24	353	545	58.2	2.9
28	480	745	79.3	4.0
32	628	970	104	5.2
36	794	1230	131	6.5
40	981	1520	162	8.1
44	1186	1840	196	9.8
48	1412	2190	233	11.6
52	1657	2570	273	13.7
56	1922	2980	317	15.8
60	2206	3425	364	18.2
64	2477	3815	404	20.4
68	2796	4290	456	23.0
72	3135	4795	511	25.8
76	3493	5325	569	28.8
80	3870	5885	631	31.9
84	4267	6475	695	35.2
88	4683	7090	763	38.6



# Macalloy-Tensoteci Galvanised Cable Systems

## Socketing

The cable ends are terminated by sockets that match the breaking strength of the cable.

There is a wide range of sockets available. They are fixed to the cables by one of the following methods:

- socketing using polyester resin for structural use, cast at room temperature; this method takes the full strength of the cable through the resin interface, without any kind of mechanical grip or stress concentration on the wires, thereby allowing high fatigue

toughness of the cable. The resin forms a solid cone with the cable wires. This cone acts as a wedge inside the socket's conical hole. The resin cast at room temperature also preserves the anticorrosion filler inside the cable near the socket;

- socketing using metal (pure zinc or zamak alloy), melted inside the socket. This method also takes the full strength of the cable;
- swaging is used on small cable sizes, up to approximately 45mm diameter. Here the terminals are pressed onto the cable. Swaging reduces the tendon capacity by around 10%.

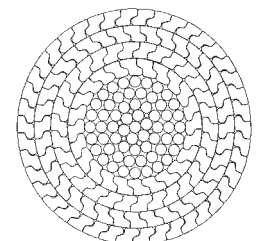
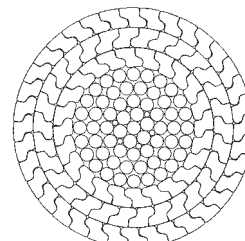
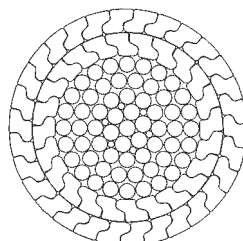
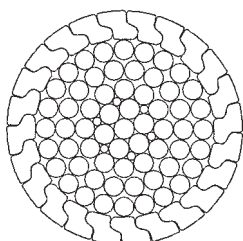
## Corrosion Protection

The corrosion protection of the high strength steel cables is obtained by the following systems combined together:

- hot dip galvanising of the wires; galfan (zinc aluminium) coating of the wires can also be provided;
- internal anticorrosion compound Tensofill surrounding the internal galvanised wires;
- Z shaped external locked coil wires, preventing the entry of external agents;
- The following special protection systems can also be used:
  - a final coat of Tensocoat Wax, made up of Severe Atmosphere Corrosion Inhibitor, resin and aluminium microflakes; this coating is applied during and after the installation of the cables;
  - a final coat of Tensocoat Epoxy, a two part polyamine epoxy with added aluminium microflakes, this coating is applied after the installation of the cables;
  - High Density Polyethylene sheath applied by hot extrusion on the cable surface; this provides complete waterproofing. The HDPE is of a grade suitable for long term reliability.

Table 2: Full Locked Coil Strand

Diameter (mm)	Cross Section A (mm <sup>2</sup> )	Minimum Break Load MBL (kN)	Elastic Stiffness E-A (MN)	Weight (kg/m)
32	681	1015	112	5.6
36	862	1285	142	7.1
40	1077	1605	178	8.9
44	1303	1945	215	10.7
48	1551	2315	256	12.8
52	1841	2750	304	15.2
56	2136	3190	352	17.6
60	2452	3660	405	20.2
64	2789	4165	460	23.0
68	3149	4700	513	26.0
72	3530	5210	575	29.1
76	3933	5790	641	32.4
80	4358	6405	710	35.9
84	4805	7045	783	39.6
88	5274	7720	860	43.5
92	5764	8430	940	47.5
96	6276	9165	1023	51.7
100	6890	10050	1123	56.8
104	7452	10860	1215	61.4
108	8037	11700	1310	66.2
112	8643	12575	1409	71.2
116	9271	13480	1511	76.4
120	9922	14415	1617	81.8
124	10594	15385	1727	87.3
128	11289	16385	1840	93.0



# Macalloy-Tensoteci Galvanised Cable Systems

## Fork Sockets

The fork sockets are made from high strength, hardened and tempered cast steel. Charpy-V impact value is 27J at  $-20\text{ }^{\circ}\text{C}$ .

Surface protection is by hot dip galvanizing to a minimum thickness of  $80\text{ }\mu\text{m}$ . Additional protection can be obtained by applying Epoxy Tensocoat.

Whilst the table gives dimensions of our standard sockets, Macalloy is also able to provide special sockets for specific projects or applications.

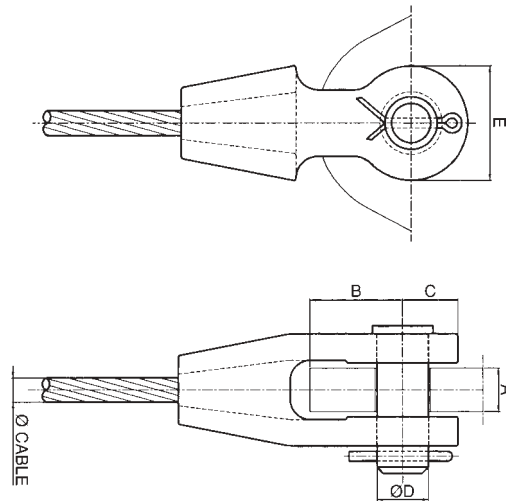


Table 3: Fork Socket Dimensions

Socket Type	Minimum Break Load MBL (kN)	Cable Diameter (mm)	D (mm)	A max (mm)	B max (mm)	C (mm)	E (mm)
F-196	165	10-12	25	22	41	25	49
F-198	250	13-16	31	29	52	29	57
F-104	440	17-20	41	40	73	45	90
F-108	680	21-25	51	47	82	60	120
F-111	980	26-28	57	53	93	65	130
F-115	1220	29-32	63	59	104	72	144
F-118	1470	33-36	70	65	137	80	160
F-120	1960	36-38	76	71	138	88	176
F-125	2550	39-44	89	84	145	100	200
F-128	2740	45-49	95	96	190	108	216
F-130	3530	50-52	108	108	207	118	236
F-132	4410	53-56	121	120	227	132	264
F-135	4700	57-64	127	126	231	138	276
F-138	5100	64-69	133	139	232	142	284
F-140	5880	70-76	140	151	240	148	296
F-142	6860	77-80	152	163	255	170	340
F-144	8580	81-88	178	183	272	181	362
F-146	10790	89-102	190	200	402	220	440
F-150	12260	103-111	250	200	424	280	560
F-160	13240	112-118	275	220	416	300	600
F-170	15690	119-128	290	240	507	325	650

# Macalloy-Tensoteci Galvanised Cable Systems

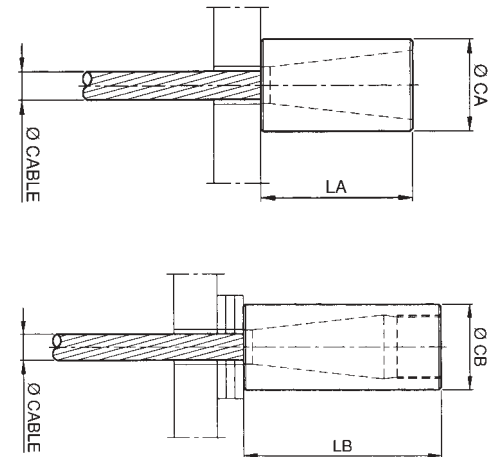


Table 4: Cylindrical Socket Dimensions

Cable Diameter (mm)	CA (mm)	LA (mm)	CB (mm)	LB (mm)
12	40	65	40	100
16	55	85	55	130
20	65	105	65	160
24	75	130	75	190
28	85	150	85	215
32	95	170	95	255
36	110	190	110	295
40	120	210	120	325
44	130	235	130	360
48	145	255	145	390
52	155	275	155	430
56	165	295	165	460
60	180	315	180	485
64	190	340	190	525
68	200	360	200	550
72	210	380	210	585
76	225	400	225	615
80	235	420	235	645
84	245	445	245	680
88	260	465	260	705
92	270	485	270	745
96	280	505	280	775
100	295	525	295	800
104	305	550	305	840
108	315	570	315	875
112	325	590	325	905
116	340	610	340	935
120	350	630	350	965
124	360	655	360	1000
128	370	675	370	1030

## Cylindrical Sockets

The cylindrical sockets and nuts are made from high strength NiCrMo hardened and tempered alloy steel. Charpy-V impact value is 27J at  $-20^{\circ}\text{C}$ .

Surface protection is by hot dip galvanizing to a minimum thickness of  $80\ \mu\text{m}$ . Additional protection can be obtained by applying Epoxy Tensocoat. After installation, threads are protected with Tensocoat Wax.



# Macalloy-Tensoteci Galvanised Cable Systems

## Cylindrical Sockets

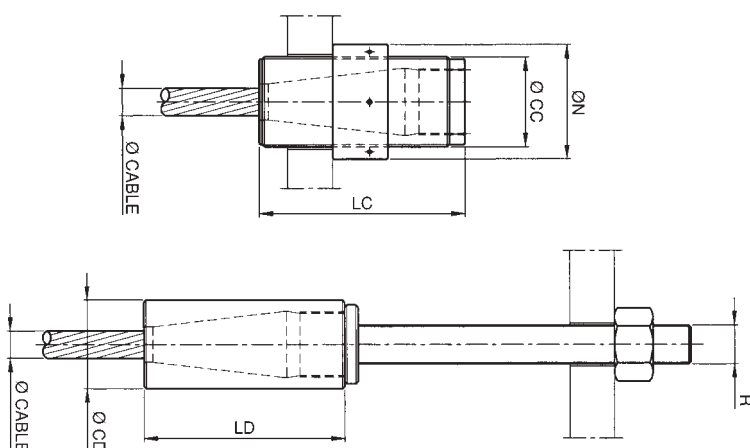
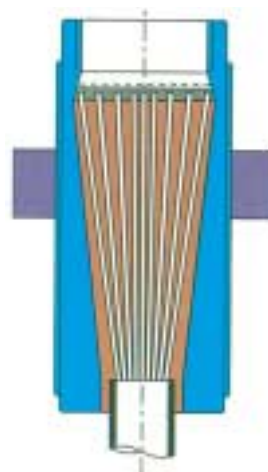


Table 5: Cylindrical Socket Dimensions

Cable Diameter (mm)	CC (mm)	LC (mm)	N (mm)	CD (mm)	LD (mm)	R (mm)
12	45	95	55	40	100	18
16	55	125	70	55	130	24
20	70	155	85	65	160	27
24	80	185	100	75	190	33
28	90	215	115	85	215	39
32	100	245	130	95	255	45
36	110	275	145	110	295	48
40	125	305	155	120	325	56
44	135	335	175	130	360	60
48	150	365	190	145	390	68
52	160	395	205	155	430	76
56	175	425	220	165	460	80
60	185	455	235	180	485	85
64	200	485	250	190	525	90
68	210	515	265	200	550	95
72	220	545	280	210	585	110
76	235	575	295	225	615	115
80	245	605	310	235	645	120
84	260	635	325	245	680	125
88	270	670	340	260	705	130
92	285	695	355	270	745	135
96	295	725	370	280	775	140
100	305	755	385	295	800	145
104	320	785	405	305	840	150
108	330	820	420	315	875	160
112	345	845	435	325	905	165
116	355	875	450	340	935	170
120	370	905	465	350	965	175
124	380	935	480	360	1000	180
128	395	970	495	370	1030	185



# Macalloy-Tensoteci Galvanised Cable Systems

## Bridge Sockets

The bridge sockets and pins are made from high strength NiCrMo hardened and tempered alloy steel. Charpy-V impact value is 27J at  $-20^{\circ}\text{C}$ .

Surface protection is by hot dip galvanizing to a minimum thickness of  $80\ \mu\text{m}$ . Additional protection can be obtained by applying Epoxy Tensocoat.

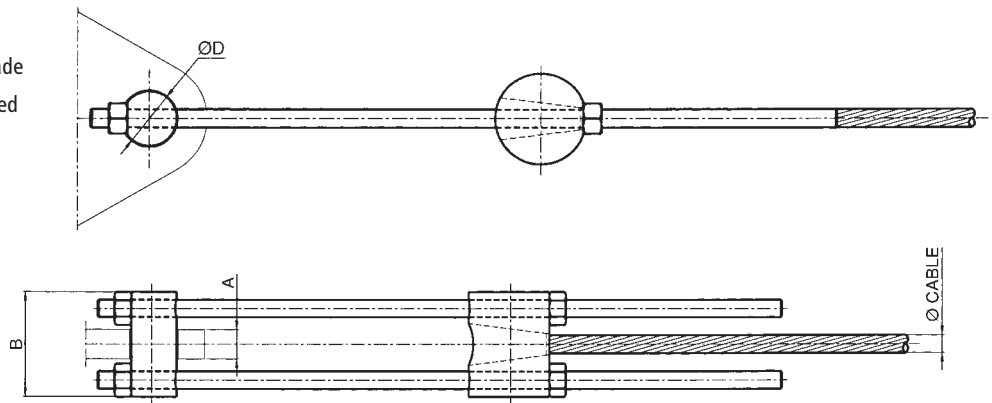


Table 6: Bridge Socket Dimensions

Cable Diameter (mm)	D (mm)	A max (mm)	B (mm)
12	35	35	90
16	45	45	120
20	55	55	145
24	65	60	170
28	80	65	190
32	90	75	210
36	100	75	240
40	110	75	255
44	120	80	270
48	130	90	310
52	145	95	325
56	155	95	340
60	170	100	360
64	180	110	395
68	190	110	410
72	200	115	420
76	210	125	445
80	220	130	460
84	230	130	490
88	240	135	505
92	265	135	545
96	275	140	560
100	285	140	585
104	295	145	595
108	305	150	615
112	320	150	640
116	330	160	665
120	345	160	690
124	355	165	710
128	360	180	720



# Macalloy Guy Linking Stainless Cable Systems

## Macalloy Guy Linking Stainless Cable Systems

### Cable

Wire cable undergoes two types of stretch under load – an initial stretch and a conventional elastic stretch. The initial stretch is dependent upon cable construction and is caused by individual wires bedding down into a loaded position. This initial stretch can be between 0.10 and 0.75% of the cable length, depending on the magnitude and frequency of loading, and should always be considered when designing tendons.

There are 3 different types of stainless cables offered by Macalloy.

The most common strand used is the **1 x 19 spiral strand**. The wires have a smooth bright finish and the cable has moderate initial stretch properties. All our cable tendon fittings are designed to match the minimum breaking load of the 1 x 19 strand cable.

**Compact Strand** offers a 30% increase in breaking load over the conventional 1x19 strand and a much lower initial stretch. It also has a higher elastic modulus making it ideal for use where high strength and low stretch is required.

**7x19 strand** is constructed from 7 strands each in turn constructed from 19 wires. It is the least stiff of cables that can be swaged and is ideal in situations where flexibility is a primary requirement

### Young's Modulus of the Cable

The apparent Young's Modulus (E) of the Guy Linking Cable systems are:

1 x 19 Strand	107 kN/mm <sup>2</sup>
Compact Strand	133 kN/mm <sup>2</sup>
7 x 19 Strand	85 kN/mm <sup>2</sup>

The elastic stretch (*d*) of a cable may be calculated by use of the following formula:

$$d = \frac{\text{Load (kN)} \times \text{Length (mm)}}{E \text{ (kN/mm}^2\text{)} \times \text{Cross Sectional Area (mm}^2\text{)}}$$

Please note that the above E values have been established empirically. No cable will behave completely elastically and the apparent E value will consequently change over different stress ranges. Accurate stiffness values can only be calculated using a reduced cross sectional area. Please consult our technical department for further details if necessary.

### Components

As with the Guy Linking bar system, all components are made from austenitic

stainless steel Grade 316 to BS 970. The fittings are swaged to the end of the cable, providing a connection strength that exceeds the breaking load of the cable. The swaging process is usually performed under factory conditions to ensure the correct cable length is achieved.

All components for our cable systems are designed to match the minimum break load of the 1 x 19 strand cable. If fittings are required to match the minimum break load of compact strand, please seek advice from the Macalloy technical department with regard to component sizes.

As detailed below table 7, there are 3 types of standard tendons:

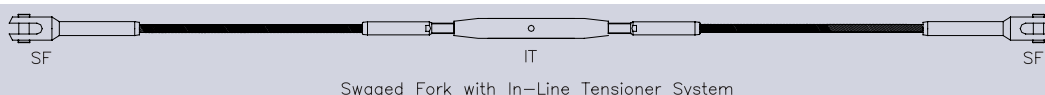
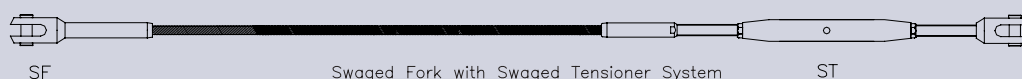
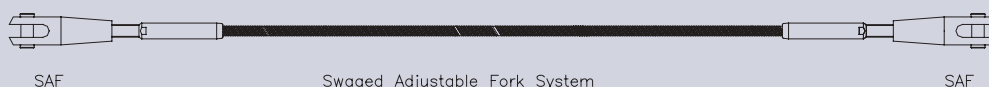
- The swaged adjustable fork system
- the swaged fork with swaged tensioner system
- the swaged fork with in-line tensioner.

For applications where forks are not required, tendons may also be supplied with a simple LH/RH swaged stud at either end. Shorter M8 metric threaded studs are also available for balustrade applications.

Dimensions are detailed in table 8. Additional components and fittings are available on request. These include toggles, dome nuts, standard nuts, spherical seats, etc.

Table 7: Minimum Break Loads for Guy Linking Strand & Cable

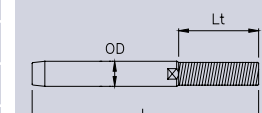
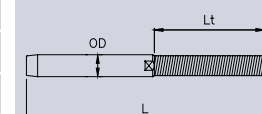
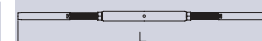
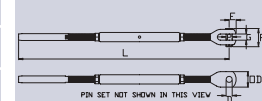
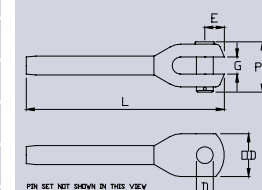
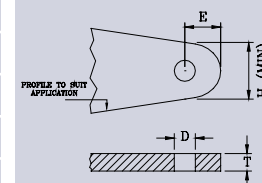
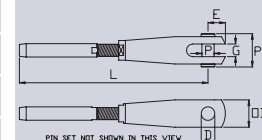
Nominal Cable Dia.	mm	3	4	5	6	7	8	10	12	14	16	19	22	26
1 x 19 Strand	kN	7.1	12.6	19.6	28.2	34.8	45.5	71.1	102.0	139.0	182.0	212.0	285.0	398.0
Compact Strand	kN		17.4	23.9	34.8	48.1	60.3	95.0	141.2	189.2	251.0	313.7		
7 x 19 Cable	kN	5.0	8.9	13.9	20.0	27.3	35.6	55.6	80.0	109.0	143.1			



# Macalloy Guy Linking Stainless Cable Systems

## Table 6: Component Dimensions - Guy Linking Cable

Nominal Cable Dia.	mm	3	4	5	6	7	8	10	12	14	16	19	22	26
<b>Swaged Adjustable Fork Ref</b>		SAF3	SAF4	SAF5	SAF6	SAF7	SAF8	SAF10	SAF12	SAF14	SAF16	SAF19	SAF22	SAF26
<b>L</b>	mm	111	122	150	180	201	213	282	332	350	400	434	509	572
<b>Adjustment +/-</b>	mm	12	12	16	20	22	22	32	36	36	45	45	55	60
<b>G</b>	mm	7	7	8.5	10	12	12	17	21	21	26.5	26.5	35	36.5
<b>D Dia.</b>	mm	6.9	6.9	8.5	9.5	11.8	11.8	16.4	19.5	19.5	26	26	33.6	36
<b>E</b>	mm	8.5	8.5	11.5	12	18	18	21	26.5	26.5	36	36	48	52
<b>OD</b>	mm	16	16	19	22.2	28.6	28.6	38.1	47.5	47.5	57.2	57.2	76.2	82.5
<b>P Dia.</b>	mm	6.4	6.4	8	9	11.4	11.4	15.5	18.8	18.8	25.5	25.5	32	35.2
<b>PL</b>	mm	21.6	21.6	25.3	27.7	34.1	34.1	44.6	56.1	56.1	69.8	69.8	92	98
<b>Gusset Plate Ref. **</b>		GP6	GP6	GP8	GP10	GP11	GP11	GP16	GP19	GP19	GP25	GP25	GP32	GP35
<b>T (thickness)</b>	mm	6	6	6	8	10	10	15	16	16	25	25	30	35
<b>D Dia.</b>	mm	7	7	9	10	12.5	12.5	16.5	19	19	26.5	26.5	33	36.5
<b>E</b>	mm	11	11	15	17	20	20	23	30	30	32	32	40	44
<b>H</b>	mm	17	17	24	27	30	30	36	46	46	52	52	66	71
<b>Swaged Fork Ref</b>		SF3	SF4	SF5	SF6	SF7	SF8	SF10	SF12	SF14	SF16	SF19	SF22	SF26
<b>L</b>	mm	70	83	97	113	128	140	174	227	258	295	342	391	451
<b>G</b>	mm	6.3	8	10	11	12.7	12.7	16	19	22.2	25.4	28.6	32	35
<b>D Dia.</b>	mm	6.1	8.1	9.7	11.2	12.1	12.1	16.1	19.2	22.4	25.7	28.5	32.2	35.2
<b>E</b>	mm	7	9	11	12	15	15	18	23	26	31	33	39	43
<b>OD</b>	mm	14.3	18	22.2	25.4	28.6	28.6	38.1	47.6	54	63.5	69.9	76.2	82.5
<b>P Dia.</b>	mm	5.9	7.9	9.5	10.8	11.8	11.8	15.8	18.7	21.9	25.1	27.9	31.6	34.6
<b>PL</b>	mm	20.4	24.3	29.6	33	37	37	47.6	57.6	63.7	75	81.1	91.1	97.7
<b>Swaged Tensioner Ref</b>		ST3	ST4	ST5	ST6	ST7	ST8	ST10	ST12	ST14	ST16	ST19	ST22	ST26
<b>L</b>	mm	206	237	287	319	375	400	482	577	656	761	870	965	1105
<b>Adjustment +/-</b>	mm	32	37	47	50	62	62	65	77	90	105	120	132	145
<b>G</b>	mm	6.3	8	10	11	12.7	12.7	16	19	22.2	25.4	28.6	32	35
<b>D Dia.</b>	mm	6.1	8.1	9.7	11.2	12.1	12.1	16.1	19.2	22.4	25.7	28.5	32.2	35.2
<b>E</b>	mm	7	9	11	12	15	15	18	23	26	31	33	39	43
<b>OD</b>	mm	14.3	18	22.2	25.4	28.6	28.6	38.1	47.6	54	63.5	69.9	76.2	82.5
<b>P Dia.</b>	mm	5.9	7.9	9.5	10.8	11.8	11.8	15.8	18.7	21.9	25.1	27.9	31.6	34.6
<b>PL</b>	mm	20.4	24.3	29.6	33	37	37	47.6	57.6	63.7	75	81.1	91.1	97.7
<b>In-Line Tensioner Ref</b>		IT3	IT4	IT5	IT6	IT7	IT8	IT10	IT12	IT14	IT16	IT19	IT22	IT26
<b>L</b>	mm	230	265	275	360	420	445	545	670	780	900	1020	1150	1325
<b>Adjustment +/-</b>	mm	32	37	47	50	62	62	65	77	90	105	120	132	145
<b>Swaged Stud Ref</b>		SS3	SS4	SS5	SS6	SS7	SS8	SS10	SS12	SS14	SS16	SS19	SS22	SS26
<b>L</b>	mm	83	93.5	115	137	154	166	218	254	272	310	344	394	447
<b>Lt</b>	mm	40	40	52	64	71	71	103	116	116	146	146	180	196
<b>OD</b>	mm	6.3	7.5	9.1	12.5	14.3	16.1	17.8	21.4	25	28.1	34.5	40.4	46
<b>Balustrade Swaged Stud Ref</b>		BSS3	BSS4	BSS5*										
<b>L</b>	mm	83	87	98										
<b>Lt</b>	mm	38	38	38										
<b>OD</b>	mm	6.3	7.5	9.1										



\* Max Break Load of the BSS5 Stud is 17.4kN \*\* For swaged adjustable fork only

# Cable Structure Systems



Tensoteci cable systems. Olympic Stadium, Athens

Architect: Santiago Calatrava

Contractor: Costruzioni Cimolai Armando SPA



Nokia HQ, Finland

Macalloy Ltd Local Representative:



This publication provides the technical details currently used by Macalloy Ltd in the manufacture of its components. The company reserves the right to amend technical details as and where necessary in line with its policy of continuous development

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