Products & Services

Post Tensioning

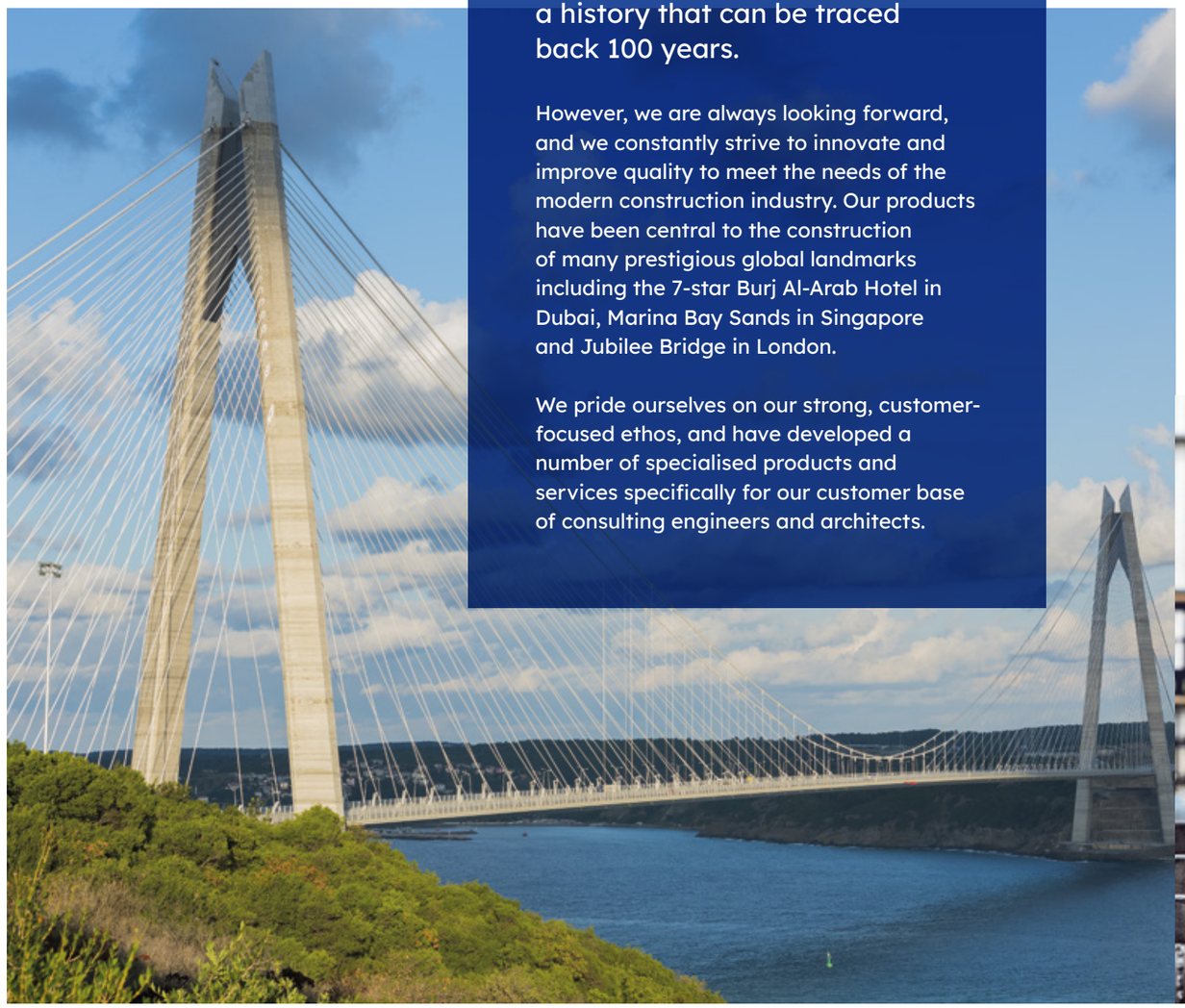
Macalloy 100 years 1921-2021

Macalloy are global leaders in the manufacture of threaded steel tension bars and cable systems.

Based in the heart of the UK's steelmaking industry, we have a history that can be traced back 100 years.

However, we are always looking forward, and we constantly strive to innovate and improve quality to meet the needs of the modern construction industry. Our products have been central to the construction of many prestigious global landmarks including the 7-star Burj Al-Arab Hotel in Dubai, Marina Bay Sands in Singapore and Jubilee Bridge in London.

We pride ourselves on our strong, customer-focused ethos, and have developed a number of specialised products and services specifically for our customer base of consulting engineers and architects.



Yavuz Sultan Selim Bridge, Istanbul.

Why work with us?

- Leading suppliers to the construction industry for over 100 years
- Exporting worldwide since the 1960s
- Industry experts in steel threaded bar and cable systems
- Innovative solutions to challenges in the construction industry
- Home of the PT Bar
- Originators of the Tension Structure System
- Technical support from our experienced design and engineering team
- Internally and externally audited for quality
- Internationally-recognised award winners
- Holders of European and worldwide technical product approvals
- Often imitated but never equalled

Macalloy Site Services

Macalloy Site Services personnel can also provide ON-SITE SUPPORT, including undertaking stressing, training local staff and providing supervision. We can provide a range of EQUIPMENT to assist with the installation of post tensioning bars, including hydraulic jacks, specialised pullers and torque wrenches.

Macalloy 1030 Post Tensioning System

Macalloy was the first company in the world to develop a post-tensioning bar system in the 1940s. The product has since evolved to include a unique fatigue-resistant thread form that provides low lock-off losses on stressing.

Macalloy 1030 Post Tension bars are high-strength, carbon chrome steel bars with superior fatigue properties. They provide an ultimate tensile strength of 1030 N/mm^2.

The bars are available in various diameters and lengths of up to 11.8m. Longer lengths can be achieved by joining bars together with couplers. Custom sizes are available. For more details, please refer to the data sheet.

Bars are provided with cold rolled threads for part or full length. We can also supply a range of accessories including nuts, washers, end plates and ducts.

For superior corrosion protection, Macalloy can supply bars with a factory-applied Denso Tape. This is a grease-impregnated tape, which has technical and cost-saving benefits over traditional duct and grout solutions.

Macalloy S1030 Post Tensioning System

Stainless Macalloy S1030 bars are made from precipitation-hardened stainless steel.

They are available in diameters of 20mm to 75mm and lengths of 6m. Again, longer lengths can be achieved by joining bars together with couplers, and custom sizes are available on request.

Macalloy S1030 has excellent corrosion properties, similar to grades 1.4305 (303) and 1.4301 (304) austenitic stainless-steel bars. In industrial atmospheres, some surface discolouration may occur over time.

Macalloy S1030 is a martensitic nickel-chrome alloy steel, hardened during manufacture to attain the specified properties.

For more information on the mechanical properties of both Macalloy 1030 and S1030 bars, please refer to the data sheet.

GUARANTEED STEEL QUALITY

At Macalloy, we're committed to playing our part in the shift towards a more sustainable future for global construction. Where possible, we buy 'green steel' in order to help our environment and reduce carbon emissions.

Our manufacturing process is based on recycled steel scrap and a Nordic, fossil-free electricity mix. As a result, the carbon footprint of our steel bars is 80% lower than the global average.

All bars are hot rolled. Diameters from 25mm to 50mm are cold worked by stretching. The stretching load and permanent elongation are determined by preliminary tests and the bars' properties are monitored during production to ensure that they comply with BS4486.

Bars of 75mm diameter are heat treated after rolling at a controlled temperature and time, to ensure that the steel achieves the mechanical properties shown in Table 1.

We carry out rigorous inspection and testing, both during and after treatment, to ensure consistent tensile properties. The mechanical performance of the bar is monitored through the tensile testing of machined specimens rather than section testing.

TABLE 1: MECHANICAL PROPERTIES

Grade	Nominal Ultimate Tensile Strength	Nominal 0.1% Proof Stress	Minimum Elongation	Approximate Modulus of Elasticity
	N/mm^2	N/mm^2	%	kN/mm^2
Macalloy 1030 25-40mm	1030	835	6	170*
Macalloy 1030 50-75mm	1030	835	6	205
Macalloy S1030 20-75mm	1030	835	10	185

*Secant Modulus of Elasticity in range 5-70% UTS

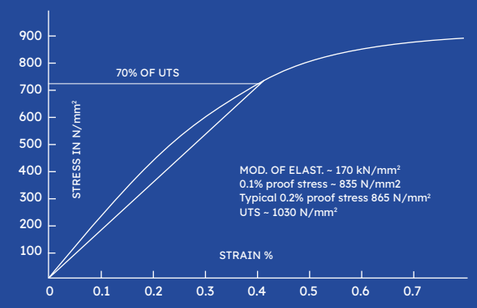
QUALITY CONTROL

- Macalloy's quality assurance system complies with BS EN ISO 9001.
- Macalloy 1030 bars are independently approved to the requirements of BS4486.
- The Macalloy 1030 system up to 40mm is independently approved to the requirements of EAD160004-00-0301.
- It is a prerequisite that the bars comply with prEN 10138.
- The Macalloy 1030 Post Tensioning System European Technical Approval document ETA-21/0054 is available as a separate document.
- The details within this brochure meet the current British and European Standards. The system also meets the National Standards in France.
- In accordance with the requirements of EAD 160004-00-0301, we have a factory production control test plan, and we routinely test bars and fittings in accordance with this document.
- Proof Loading: our in-house facilities allow for load test tendon assemblies up to 2500kN. Greater capacities are load tested externally.

STRENGTH

The specified characteristic failing loads and 0.1% proof loads for Macalloy and Macalloy S1030 bar steels are shown in Table 3. Bars can be supplied with nuts, washers, plates, or couplers as required. All fittings are designed to exceed the failing load of the threaded bars.

TYPICAL STRESS STRAIN DIAGRAM FOR
COLD WORKED MACALLOY 1030 BAR (25-40MM)



WORKING LOAD FACTORS

The working load factor used in a design is determined by our engineers but will normally be that specified in the appropriate Standard.

For pre-stressed concrete construction, the current standard for buildings is BS8110 and for bridges BS5400, which suggest an initial pre-stressing force of 70% of the characteristic failing load.

For ties and similar applications in structural steel construction, the requirements of BS5950: Parts 1 and 2 apply.

Maximum pre-stress forces in accordance with EN 1992-1- 1: 2004 Eurocode 2: Design of concrete structures, are given in the Macalloy 1030 Post Tensioning System European Technical document ETA-21/0054.

Ground anchorage design is dealt with in BS8081, which gives recommended load factors for permanent and temporary applications.

PROPERTIES

Extensive data and test reports on our bars and components are available from Macalloy's Technical Department. The main properties of the 1030 bars are:

FATIGUE – threaded assemblies have a fatigue resistance in excess of two million cycles of loading, over a tensile stress range of 590-670 N/mm², exceeding the requirements set out in ETAG 013.

RELAXATION – prEN 10138 requires a 4% maximum loss of stress due to relaxation in a bar loaded to 70% of its characteristic failure load, after 1000 hours at room temperature. This is comfortably achieved by Macalloy's 1030 bars, with typical results below 3.0%.

ANCHORAGE STRENGTH – in accordance with the requirements of ETAG 013, we carry out anchorage efficiency tests to verify that the failing load in the anchorage is not less than 95% of the actual failing load in the parent bar, or 95% of the specified characteristic failure load. Anchorage testing also verifies that the ultimate failure occurs in the bar and is not influenced by the anchorage or coupler.

STRESS CORROSION – Macalloy 1030 bars have been subjected to the F.I.P. standard stress corrosion test. No bars failed during the 200-hour duration of the test. Subsequent tensile tests to failure showed no significant reduction in the ultimate or 0.1% proof stresses.

STRESS CORROSION

Stress corrosion testing has also been conducted in accordance with PR EN 10138-4: 2005-2009 and satisfies the requirements in full. Under normal circumstances, Macalloy 1030 isn't susceptible to stress corrosion. Macalloy 1030 is, of course, subject to surface corrosion when exposed to moisture, and deep corrosion pitting is harmful.

For more information, please contact technical@macalloy.com.

PROTECTION AGAINST CORROSION

For normal pre-stressed concrete construction, the alkaline environment (provided by a layer of cement grout injected into the duct enclosing the bar) gives good protection.

If bars are used in any exposed application, corrosion protection is essential for Macalloy 1030 and can be advantageous for Macalloy S1030. The type of protection is determined by the exposure conditions, appearance and cost. Options include:

- Paint systems (primer and one or more finishing coats)
- Grease-impregnated tape wrapping
- Adhesive-coated plastic tape wrapping
- Shrink wrap
- Plastic tubing
- Ridged plastic tubing, with injected grease or grout.
- Thermal metal spray

Macalloy 1030 should never be galvanised.

Two or more of these systems can be combined to enhance protection. Particular care is always needed at end connections and coupled joints, to ensure continuity of protection over the whole tendon. To find out more, contact technical@macalloy.com.

WELDING

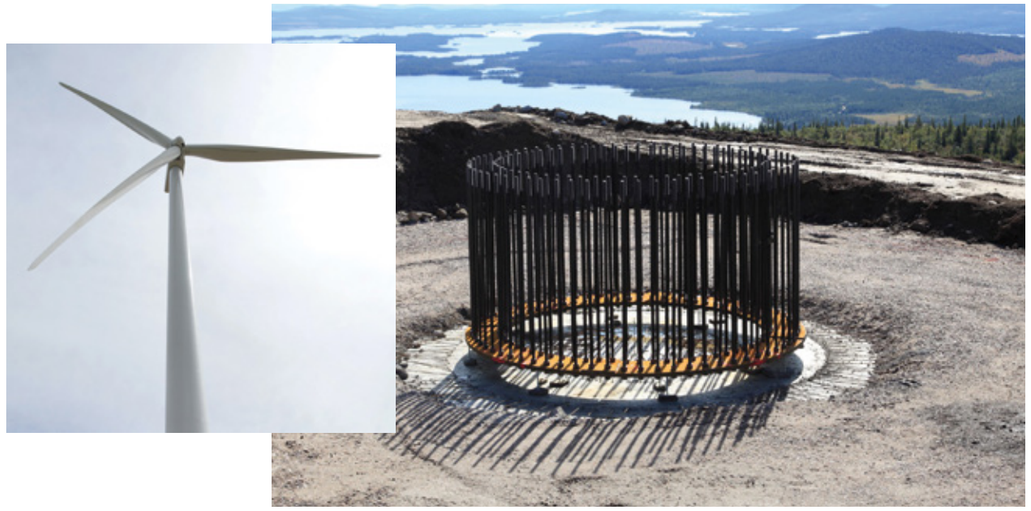
Macalloy 1030 and Macalloy S1030 must not be welded, subjected to high local heating or splashed with weld metal.

THREADS

A coarse thread is cold rolled directly on to the bar. Bars can be end threaded or fully threaded. The bond value of the coarse thread, when cast into concrete, or grouted into a preformed hole, complies with requirements for a Class 2 deformed bar.
This is as per 8110-1:1997 Section 3.12.8.

Short, fully threaded bars can be used for short tendons and bolts, as loss of load due to 'take up' in the threads on transfer of load, is minimised by the controlled limits on clearance, between internal and external threads.

KL8 Footbridge, near Poznan, Poland.



Wind Turbines, Uljabuouda, Sweden.

TORQUE LOADINGS

Macalloy 1030 bars are also used for non-post tensioned concrete applications, which require a relatively small tensioning load.

For these applications, it is possible to develop a load in a Macalloy bar, up to 25% of the characteristic failure load. This is achieved by applying a predetermined torque to the Macalloy nut.

Torque wrenches are available from Macalloy that have a dial indicating the torque value exerted, or it can be preset to slip at a specified torque value.

The axial tension, induced by a given torque, depends on the diameter and pitch of the threads and on the friction within the threads and between nut, washer and end plate.

Accuracy of the tensile force cannot be expected to be more than ±25%. The relationship between the torque applied to a nut bearing onto a standard washer and the resultant load, is shown in table 2.

TABLE 2

K Values for Macalloy Coarse Threads

Torque (Nm) = $\frac{P \times D}{K}$

Where

P is desired axial load in kN

D is the nominal bar diameter in mm

K is a constant obtained by test measurements

Bar Diameter (mm)	K
25	4.1
26.5	4.3
32	4.7
36	4.9
40	4.5
50	4.1

ANCHORAGE ZONE REINFORCEMENT

Due to the compressive load applied through the end plates, bursting tensile forces are induced in the concrete immediately behind the anchorage end plates. Reinforcement in the form of links, helices, or a combination of these, should be provided in each end block.

The design of the anchorage reinforcement is covered by Section 4.1 of BS8110 and described in greater detail by CIRIA GUIDE 1 June 1976.

Macalloy does not design or supply the helical reinforcement.

A more detailed explanation of the Macalloy Post Tensioning System, including Anchorage Zone Reinforcement, is available in the Macalloy Design Data Handbook.

Contact technical@macalloy.com for further information.

DETAILING

There are many possible permutations to achieve the required outcome, and advice is available from our Technical Department. Figure 1 shows typical tendon assemblies. A more detailed explanation of the Macalloy Post Tensioning System is available in the Macalloy 1030 European Technical Approval document ETA-21/0054.

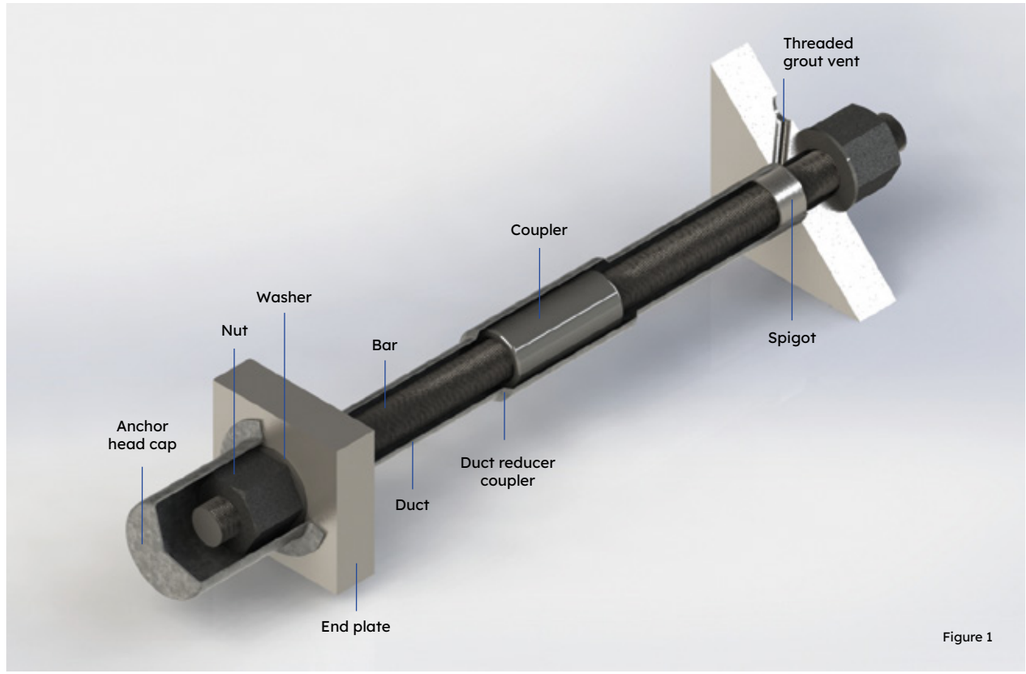


Figure 1

Macalloy bars were initially developed for use in pre-stressed concrete construction, but have been adapted for many structural applications, including...

- Stressed connections – concrete-to-concrete / concrete-to-steel / steel-to-steel
- Pre-stressed block and brick construction
- Anchor bolts for tension ties
- Holding down bolts
- Friction grip bolts and clamps
- Hangers
- Structural steel frame ties
- Ground and rock anchorages
- High strength portal, ground or sheet pile ties
- Temporary or partial pre-stressing
- Pile testing

YAVUZ SULTAN SELIM BRIDGE, TURKEY, also known as the 3rd Bosphoros Bridge, will link the European side and the Asia side. It is thought to have the highest lateral towers at 322 metres high. Macalloy has supplied the 1030 Post Tensioning Macalloy Bar System (20mm - 75mm) and metal ducting. Our engineers worked with the main con-tractor Hyundai in order for us to create special plates to go alongside the Macalloy bar in order to accommodate design of the bridge.

SHEIKH ZAYED BRIDGE, named after former president Sheikh Zayed bin Sultan Al Nahyan, in Abu Dhabi was completed in 2010. Designed by Zaha Hadid, the striking bridge has a two-way four lane highway bridge and features cantilevered road decks suspended from symmetrical steel arches. Macalloy 1030 bar in carbon steel was provided and was used to connect the arch to the deck.

AL WAHDA ARCHES dominate the blue-sky landscape of Qatar's capital, DOHA. Standing 100m tall, the structure is constructed of 9,000 tonnes of steel, while the arches are clad with Limra Limestone. Construction of the dual arches presented an engineering challenge given the angles and size of the project. Macalloy were actively involved supplying 1030 BARS in 75MM to secure the foundations and Hydraulic Jack units to stress the bars.

ETA DANMARK

ETA - 21/0053 Tension Rod Systems
BSEN ISO 9001: 2015

MADE IN SHEFFIELD

Macalloy 100 years 1921-2021

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Caxton Way, Dinnington, Sheffield, S25 3QE, U.K.

Macalloy 1030 Stainless and Carbon Post Tensioning Systems

Technical Data

TABLE 1				
Grade	**Nominal 0.1% Proof Stress**	**Nominal Ultimate Tensile Strength**	**Minimum Elongation**	**Approximate Modulus of Elasticity**
	N/mm^2	N/mm^2	%	kN/mm^2
Macalloy 1030 25-40 (Carbon)	835	1030	6	170*
Macalloy 1030 50-75 (Carbon)	835	1030	6	205
Macalloy S1030 20-75 (Stainless)	835	1030	10	185

*Secant Modulus of Elasticity in range 5 – 70% UTS

TABLE 2							
Nominal Diameter	**Nominal Prestress at 70%**	**Nominal 0.1% Proof Load**	**Nominal Failing Load**	**Major Thread Diameter**	**Unthreaded Section Diameter**	**Cross Sectional Area**	**Mass**
mm	kN	kN	kN	mm	mm	mm^2	Kg/m
20*	226	262	323	22	20.3	322	2.57
25	354	410	506	28.9	26	530	4.2
26.5†	398	460	569	30.4	27.5	572	4.49
32	580	670	828	36.2	33.1	847	6.65
36	734	850	1049	40.2	37.1	1075	8.44
40	907	1050	1295	45.3	41.2	1320	10.36
50	1415	1639	2022	54.8	50.9	1963	15.66
62	2176	2521	3109	67.4	63.3	3117	24.47
75	3018	3495	4311	77.2	73.4	4185	32.86

*Available in Stainless only †Available in Carbon only

Macalloy
Threaded Bar Systems Trusted Worldwide

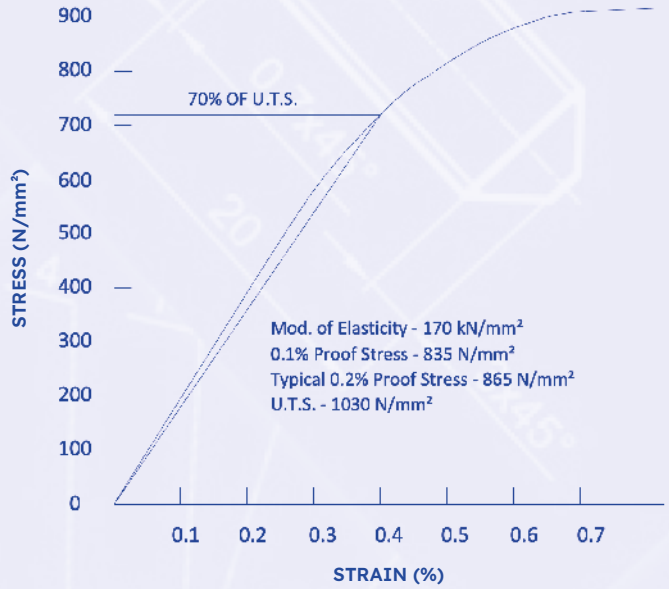


Figure 1: Typical Stress Strain Graph for Macalloy 1030 bar (25-40mm)

TABLE 3

K Values for Macalloy Coarse Threads

Torque (Nm) = $\frac{P \times D}{K}$

Where

P is desired axial load in kN

D is the nominal bar diameter in mm

K is a constant obtained by test measurements

Bar Diameter	K
mm	
25	4.1
26.5	4.3
32	4.7
36	4.9
40	4.5
50	4.1

TABLE 4

	Physical Parameters									
	Item	**Unit**	**Nominal Bar Diameter**							
			20	25	26.5	32	36	40	50	62	75
Flat Nuts	**Carbon**		**-**	**FN25**	**FN26.5**	**FN32**	**FN36**	**FN40**	**FN50**	**FN62**	**FN75**
	Stainless		**FSSN20**	**FSSN25**	**-**	**FSSN32**	**FSSN36**	**FSSN40**	**FSSN50**	**-**	**FSSN75**
Carbon	Length	mm	-	34.5	38.5	43	48	53	73.5	95	100
	Width Across Flats (DIA. For 62 & 75mm)	mm	-	46	50	56	62	72	90	123	135
Stainless	Length	mm	25	32	-	40	47	50	70	-	100
	Width Across Flats (DIA. For 50 & 75mm)	mm	41.3	47.3	-	56.4	60.3	63.5	101.6	-	135

TABLE 4 (CONTINUED)											
Flat Washers	**Carbon**		**-**	**FSW25**	**FSW26.5**	**FSW32**	**FSW36**	**FSW40**	**FSW50**	**FSW62**	**FSW75**
	Stainless		**FSSW20**	**FSSW25**	**-**	**FSSW32**	**FSSW36**	**FSSW40**	**FSSW50**	**-**	**FSSW75**
	Outside Diameter	mm	50	60	65	70	75	90	105	FLAT WASHER NOT REQUIRED	
	Thickness	mm	5	5	5	5	5	5	5		
Couplers	**Carbon**		**-**	**FC25**	**FC26.5**	**FC32**	**FC36**	**FC40**	**FC50**	**FC62**	**FC75**
	Stainless		**FSSC20**	**FSSC25**	**-**	**FSSC32**	**FSSC36**	**FSSC40**	**FSSC50**	**-**	**FSSC75**
	Outside Diameter	mm	35	42.5	42.5	50	57.5	62.5	76	95	110
	Length – Carbon	mm	-	85	90	115	130	140	170	210	230
	Length – Stainless	mm	65	80	-	95	105	120	160	-	210
End Plates	**Carbon**		**-**	**FPP25**	**FPP26.5**	**FPP32**	**FPP36**	**FPP40**	**FPP50**	**FPP62**	**FPP75**
	Stainless		**FSSP20**	**FSSP25**	**-**	**FSSP32**	**FSSP36**	**FSSP40**	**FSSP50**	**-**	**FSSP75**
	Length	mm	100	100	110	125	140	160	200	260	300
	Width	mm	100	100	110	125	140	160	200	260	300
	Thickness – standard	mm	25	40	40	50	50	60	60	70	75
	Hole Diameter	mm	24	34	36	41	45	51	61	72	82
	Thickness – threaded	mm	-	40	40	50	60	60	70	90	110
Ducts*	**Recommended Duct ID**	**mm**	**30**	**38**	**40**	**48**	**54**	**60**	**75**	**93**	**109**
Threads	**Pitch**	**mm**	**2.5**	**6**	**6**	**6**	**6**	**8**	**8**	**8**	**8**
Standard Thread Length (See Fig. 2)	**Length**										
	S1 Jacking End	mm	250	250	250	250	250	250	250	360	360
	S1 Dead End	mm	100	100	100	100	100	100	100	160	160
	Coupler	mm	40	45	50	60	65	75	90	110	150
	X1 (Min.)	mm	75	90	100	120	125	140	175	215	240
	X2 (Min.)	mm	42	49	53	57	62	71	91	110	116
	X3 (Min.)	mm	12	12	12	12	12	16	16	16	16

*Note duct sizes do not accommodate couplers

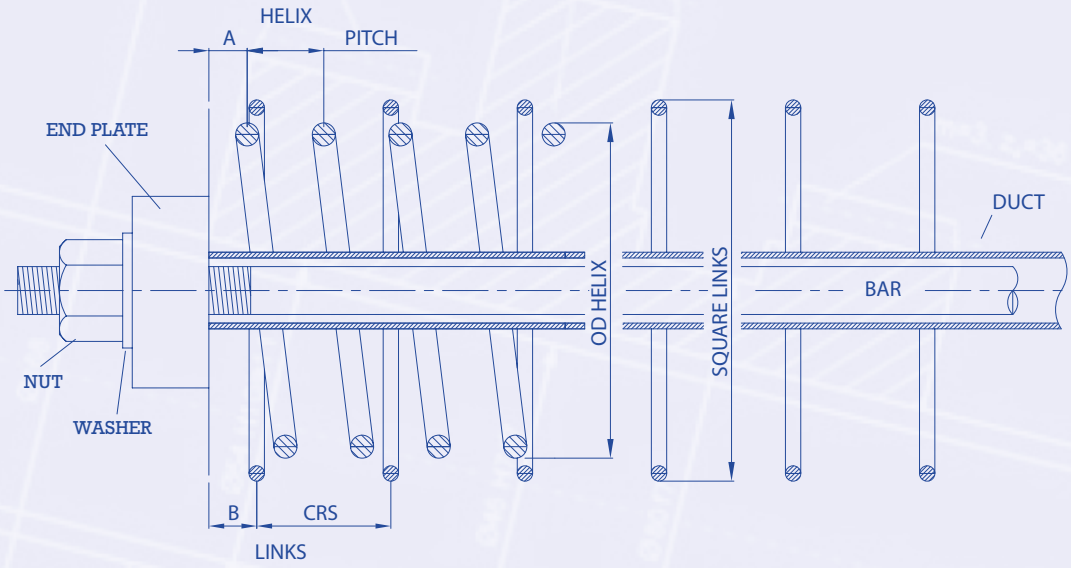
Figure 2: End thread dimensions

X1 = Live End
X2 = Dead End
X3 = Length of Bar past Nut or Threaded Plate
= 12mm for 6mm Pitch
= 16mm for 8mm Pitch

S1 = Live End Thread
S2 = Dead End Thread

TABLE 5											
REINFORCEMENT DETAILS											
Bar Dia.	HELIX					LINKS					Recommended Duct I.D
	Bar	A	Pitch (mm)	OD	Turns (mm)	Bar	B	CRS (mm)	SQU	Number	
25	12	20	40	175	4	8	25	70	199	6	38
26.5	12	20	40	180	4	8	25	70	205	6	40
32	12	20	40	190	5	8	30	70	216	7	48
36	12	20	40	210	6	8	30	70	235	7	54
40	12	20	40	240	7	10	35	75	265	8	60
50	12	20	40	300	8	12	40	80	330	9	75
62	12	30	50	400	8	16	50	80	490	10	93
75	12	30	50	450	8	16	50	100	490	10	109

Figure 3: Typical end block reinforcement



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