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Welsh National Assembly Building, Cardiff



# Structural Tie Bar System DST520

## Introduction

Daver Steels are specialist manufacturers of CE marked threaded bars for structural and architectural applications. We have been supplying tension rods since 1996 and can offer assistance to architects, designers and the end user.

The DST520 tie rod system is produced in carbon or stainless steel, both with characteristic yield strengths of 520N/mm<sup>2</sup>. The DST520 system provides a technical solution to your tie rod requirements, and our knowledge facilitates the supply of bespoke engineered solutions.

For applications which require an aesthetically pleasing solution for compressive loads we have designed an architectural compression strut system which allows adjustment of the overall length. The compression strut system is covered by our CE marking and the design calculations are validated by consultant structural engineers.

We stock carbon and stainless steel, grade 10.9 bars which can be end or fully threaded, in lengths up to 12m. DSHT bars are available for applications requiring high strength, large diameter, long threaded bars such as holding down bolts, structural bolting or temporary works.

Our advanced in-house CNC machine shop provides a custom manufacturing capability, to compliment our standard system components. All our products are covered by CE marking and our rigorous quality policy.

## Forks

Daver Steels uphold the highest standards with our investment cast carbon and stainless steel forks.

- Carbon steel forks supplied galvanised as standard for our carbon steel system
- Duplex forks supplied bright polished as standard for our stainless steel system
- Additional NDT can be performed on request, along with 3.2 certification and 100% NDT X-Ray test

## Threads

All our threads are cold rolled and are suitable for dynamic applications to match our EXC4 status. The nature of a rolled thread gives greater fatigue resistance.

## Spanner Flats

Tie bars can be supplied with spanner flats, but this is not as standard. To prevent brittle fracture spanner flats are applied after galvanising.

## Bar

DST520 bar is a high strength steel ranging in diameters from 12mm to 100mm. Bars are available upto 12m in a single length (longer lengths available on request) and have metric threads applied by cold rolling the thread form onto the bar. Bar is available in both carbon and stainless steel grades.

### Carbon Steel - Grade 520

- 520N/mm<sup>2</sup> yield stress
- High strength, weldable, structural steel 27J Charpy V at -20°C, as standard
- Stocked in 12m lengths with rolled metric threads to BS3643. Longer lengths are available on request.
- Can be supplied self colour, painted or galvanised

### Stainless Steel - Grade 520

- 520N/mm<sup>2</sup> 0.2% yield stress
- High strength cold drawn 316 stainless steel or F51 duplex stainless steel, EU origin
- Stocked in 6m lengths with rolled metric threads to BS3643. Longer lengths are available on request
- Usually offered as a 'satin' equivalent finish

For areas of higher corrosion exposure bright polished F51 stainless steel tendons are recommended.





Ordsall Chord Railway Bridge, Manchester



Remote load monitoring pins



Spherical roller bearings fitted to connection plate



# Tie Bar Arrangements

## Bar Diameters & Properties

### T1 Bar Properties

| Grade 520 Carbon Steel Bar  |    | M12 | M16 | M20 | M24 | M30 | M36 | M42 | M48 | M56  | M64  | M76  | M90  | M100 |
|-----------------------------|----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|
| Yield stress (bar material) | kN | 520 | 520 | 520 | 520 | 520 | 520 | 520 | 520 | 520  | 520  | 520  | 520  | 520  |
| Yield load                  | kN | 44  | 82  | 127 | 184 | 292 | 425 | 583 | 766 | 1056 | 1392 | 1999 | 2879 | 3605 |
| Design load to EC3          | kN | 39  | 73  | 115 | 165 | 263 | 382 | 525 | 689 | 950  | 1252 | 1820 | 2631 | 3294 |
| Nominal bar diameter        | mm | 12  | 15  | 19  | 22  | 28  | 34  | 39  | 45  | 52   | 60   | 72   | 85   | 97   |
| Maximum single bar length   | m  | 6   | 12  | 12  | 12  | 12  | 12  | 12  | 12  | 12   | 12   | 12   | 12   | 12   |

| Grade 520 Stainless Steel Bar |    | M12 | M16 | M20 | M24 | M30 | M36 | M42 | M48 | M56  |
|-------------------------------|----|-----|-----|-----|-----|-----|-----|-----|-----|------|
| Yield stress (bar material)   | kN | 520 | 520 | 520 | 520 | 520 | 520 | 520 | 520 | 520  |
| Yield load                    | kN | 44  | 82  | 127 | 184 | 292 | 425 | 583 | 766 | 1056 |
| Design load to EC3            | kN | 39  | 73  | 115 | 165 | 263 | 382 | 525 | 689 | 950  |
| Nominal bar diameter          | mm | 11  | 15  | 19  | 22  | 28  | 34  | 39  | 45  | 52   |
| Maximum single bar length     | m  | 6+  | 6+  | 6+  | 6+  | 6+  | 6   | 6   | 6   | 6    |

Design load to EC3

$$N_{Rd} = \min \{ A \cdot f_y / \gamma_{M1}; 0.9 \cdot A_{net} \cdot f_u / \gamma_{M2} \}$$

as per EN1993-1 with partial factors  $\gamma_{M0} = 1.1$  &  $\gamma_{M2} = 1.25$

Please contact our technical team for more information

The options shown here are generic arrangements  
Please contact us about bespoke solutions.

See Table 3 (page 12) to ensure that there is  
sufficient adjustment for the application.

### Fork - Fork

The simplest form of tendon comprises a bar with a left hand and right hand threaded fork at opposite ends. Once installed, the tendon can be adjusted in length by turning the bar.

### Fork - Turnbuckle - Fork

Generally, for longer length tendons where fork to fork tendons do not give adequate length adjustment or the overall length exceeds the maximum single bar length. A turnbuckle gives +/- 50mm adjustment for M20 and above.

Where excessive sag in a horizontal bar is anticipated, a welded connection cleat can be made to the turnbuckle for hanger and stay bars to be connected. Longer turnbuckles can also be machined, together with jacking lockcovers for applications where the bars need to be stressed after installation.

For applications requiring jacking, please specify on your enquiry.





# Surface Finishes



Buenquerencia Footbridge, Toledo, Spain

The DST520 tie bar & compression strut system can be finished to suit specified requirements in the following grades.

## Carbon Steel

We stock galvanised forks and fittings as standard for our carbon steel system. The following surface finishes are available:

- Shot blast and primed; painted piece small and reassembled for site top coat
- Galvanised; bar threads are brushed after galvanising in accordance with BS EN 1461 and fitting threads are cut after galvanising to ensure free running. Alternatively, bar threads can be applied after galvanising and cold zinc applied (Zinga).  
NB: Due to the nature of the galvanising process, the visual finish of galvanised product is variable. If a high level of aesthetic finish is required, systems should be subsequently painted after a suitable primer has been applied.
- Galvanised and painted to customer specifications
- Self colour
- Powder coated (length restrictions)
- Thermal spray zinc acc to ISO 22063

### Notes

- If shot blasting, painting or galvanising is performed by others, please ensure that all threads are protected. Daver Steels cannot accept any responsibility for free running of threads once treated by others.
- Due to the welding required on compression struts and their shape, it is not advised to supply galvanised. Thermal zinc spray or paint systems should be considered.
- DSHT bar is high strength quench and tempered steel, and therefore should not be galvanised

## Stainless Steel

For our stainless steel system we stock bright polished forks, satin finished bar and fittings as standard. We can offer the following finishes upon request:

- Satin finish
  - forks - satin polished
  - locking thread covers & pins - fine machined
  - bar - 240 Grit machine finish
- Bright polished
  - forks & fittings hand polished to a bright finish
  - bar machined finish to a bright polish

Stainless steel is corrosion resistant. However it is not completely maintenance-free in all environments. For example in coastal, swimming pool and leisure environments stainless steel requires cleaning with a proprietary cleaner to remove light surface corrosion. The time interval between cleaning will be determined by the severity of the exposure.

The DST520 stainless steel system should only be used in a chlorine environment after full consideration of the associated risks of stress corrosion cracking.

Where stainless steel fittings are in contact with carbon steel, bi-metallic corrosion may take place under certain conditions. To prevent this isolation coatings and washers can be supplied for the pins on request.







New York Times Tower, USA

## Site Requirements

- When installed, DST520 tension bars and compression struts must be within 0.5° alignment from the plane (Fig. 1).
- DST520 forks must be installed at each end in the same plane, forks cannot be at 90° and must be inline (Fig. 2).
- If there are concerns about the angular alignment on site, we can supply special forks, pins and connection plates which include spherical bearings to account for misalignment or movement during the service life of the tendon.



Fig 1. Fork alignment max 0.5°

## Site Installation

For rapid installation on site, DST520 tendons are pre-assembled in the factory and set to their nominal pin-to-pin length. The tendons are then ready for immediate incorporation into the structure and generally require no site assembly, saving valuable time. To install follow the steps below.

### General

- connection plates should be manufactured in minimum grade S355J2 steel; for dimensional detail see pages 14 & 15.
- for external applications, corrosion protection is recommended (e.g. hot dip galvanizing, painting etc)
- assembly and adjustment of fittings should be performed when the system is straight and not heavily loaded (long lengths may require intermediate supports)
- pins are to be connected without impact or drifting
- pin set screws should be secured using Loctite or equivalent chemical locking compound after installation
- tendons longer than 12m will be split into transportable lengths and some site assembly will be required. Ensure all components are fitted to the bar and the nominal pin-to-pin length has been set
- during the assembly process, it is crucial that no threads are exposed after the lockcovers, this ensures there is adequate thread engagement for loadbearing, at least 1 x diameter of the thread.

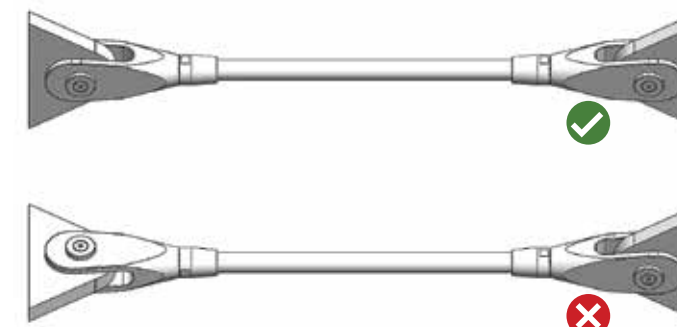


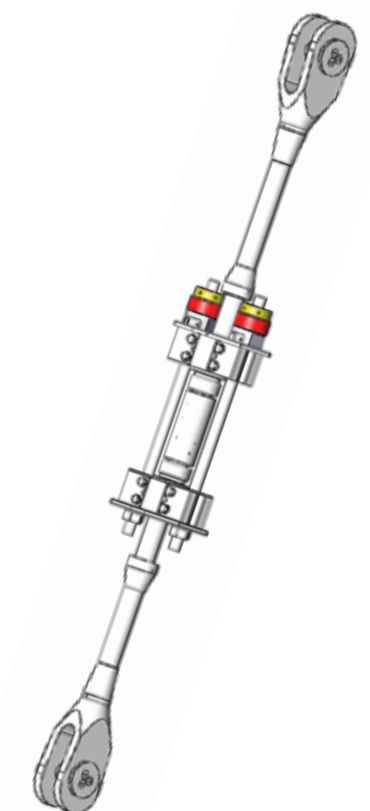
Fig 2. Forks must be installed in the same plane



Fig 3. Jacking turnbuckle arrangement with extra fittings

## Site Stressing

Certain applications may require tendons to be stressed after installation. This can be performed provided jacking turnbuckles (Fig. 3) have been specified. Daver Steels offer a robust and easy-to-use range of jacking equipment to provide a simple solution to the stressing of tendons which can be performed by most competent steel erectors.







The Saddle Bar, Aintree Racecourse



English Institute of Sport, Sheffield



Peréz Art Museum, Miami, USA



## Fatigue

Daver Steels routinely fatigue test complete tendons using standard parts to ensure the high performance of our system. Custom tests to suit the clients specific needs can be arranged. Below is a representative selection of some of our test results..

All tests have been carried out using standard DST520 forks, bars, pins and couplers/turnbuckles and have been conducted by calibrated labs at 4-5Hz frequency.

Final static load tests after the fatigue tests exceed our minimum stated break load capacities and have failed as designed – in the bar.

Plotting of the below results onto Figure 15 of BS5400 part 10 shows that Daver Steels DST520 bar system can be considered as being at least equivalent to class F for fatigue calculation purposes.

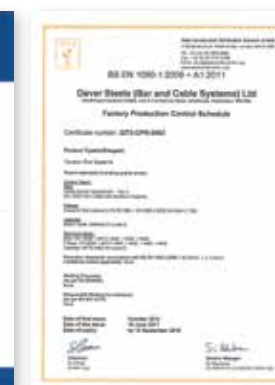
| Size | Lower stress<br>N/mm <sup>2</sup> | Upper stress<br>N/mm <sup>2</sup> | Stress range<br>N/mm <sup>2</sup> | Cycles                 | Proof test at 90% UTS | Crack test pass | Final number cycles    | Fatigue failure mode | Static break load kN |
|------|-----------------------------------|-----------------------------------|-----------------------------------|------------------------|-----------------------|-----------------|------------------------|----------------------|----------------------|
| M42S | 150                               | 250                               | 100                               | 2 x 10 <sup>6</sup>    | Yes                   | Yes             | 2 x 10 <sup>6</sup>    | No failure           | 653                  |
| M56  | 228                               | 314                               | 86                                | 3.53 x 10 <sup>6</sup> | Yes                   | Yes             | 3.53 x 10 <sup>6</sup> | No failure           | 1340                 |
| M56  | 199                               | 314                               | 114                               | 2.16 x 10 <sup>6</sup> | Yes                   | Yes             | 2.16 x 10 <sup>6</sup> | No failure           | 1334                 |
| M85  | 188                               | 292                               | 104                               | 2 x 10 <sup>6</sup>    | Yes                   | Yes             | 2 x 10 <sup>6</sup>    | No failure           | 3485                 |
| M90  | 188                               | 292                               | 104                               | 2 x 10 <sup>6</sup>    | Yes                   | Yes             | 2 x 10 <sup>6</sup>    | No failure           | 3869                 |

## Quality System

Daver Steels (Bar & Cable Systems) Ltd are CE marked to BS EN 1090-1 up to EXC 4 for structural tie bar systems and high tensile bar, in stainless or carbon steel.

Compression struts can be supplied up to EXC 3 using our CE marked structural fabricators, and our calculations which are checked by consultant structural engineers.

We maintain a high level of quality with ISO 9001:2015 management system to ensure we meet our customers' high expectations.



## Environment

The steel we use is produced from 90% recycled materials in an Electric Arc Furnace, with total carbon emissions 80% lower than the global average by investing in clean technologies and low fossil Nordic electricity. Green Clean Steel has less impurities, delivering a high quality steel with 2 tonnes less CO<sub>2</sub> per tonne of hot rolled steel. As with all steel, once our products reach their end of life they are 100% recyclable.





# Fittings

Shown below are the standard range of Daver Steels fittings. Special fittings can be made and supplied upon request.



Standard centre disc



Custom centre connector



Fork end arrangement



## Central Connectors

Centre discs are used to connect 3 or 4 tendons together at a central point. Bars and forks are generally threaded left hand/right hand for the central discs. Tendons are usually fork-fork type, but where longer adjustments or a pre-tension is required, fork-turnbuckle-fork arrangement can be used. Holes are drilled at an angle to suit your application whether for a braced bay or hanger rods.

- Standard centre discs are round with a central hole, but other shapes can be made on request



## Fork Ends

Threaded fork ends are used to terminate bars and transfer load to the structure. Fork ends are cast components from M12 - M100. The forks are threaded left-hand or right-hand depending on the tie rod arrangement and are generally tapped with a blind hole for corrosion detailing.



## Spade Ends

The spade design fits within the fork and matches the load criteria. Spades can be used in place of a fork but the effect of bending and single shear upon the pin must be taken into account. Spades are a special order item.



## Pins

Standard pins are supplied as a pin barrel with end caps. The end caps are secured with countersunk socket set screws to provide a flush finish. Other pin details can be machined to your specific project requirements. M12 pins are of a headed design with circlip.

- Custom load monitoring solutions can be designed to suit your project requirements.

## Lockcovers

The locking thread cover (lockcover) is a machined fitting which tapers the fork to the diameter of the bar. For the complete architectural look, they also hide exposed threads and when tightened against the fork and lock the tendon at the set length. Where thread covers are not required standard hexagonal nuts can be used.



## Turnbuckles

Turnbuckles are left hand and right hand threaded bar connectors which allow in-situ length adjustments. These are machined with a central chamber to give greater length adjustment than can be achieved with the left-hand/right-hand fork combination.

- Jacking turnbuckles must be specified if you intend to tension large bars
- Custom length turnbuckles can be manufactured for extra adjustment



## Cross Couplers

Cross couplers are available to provide a more cost-effective cross bracing solution than a centre disc, however the crossed bars limit the amount of adjustment available on site. Our standard cross couplers can accommodate a minimum of 40° between bars. Please contact our sales office for assistance with more acute angles.



Givatayim Bridge, Israel

# Product Data

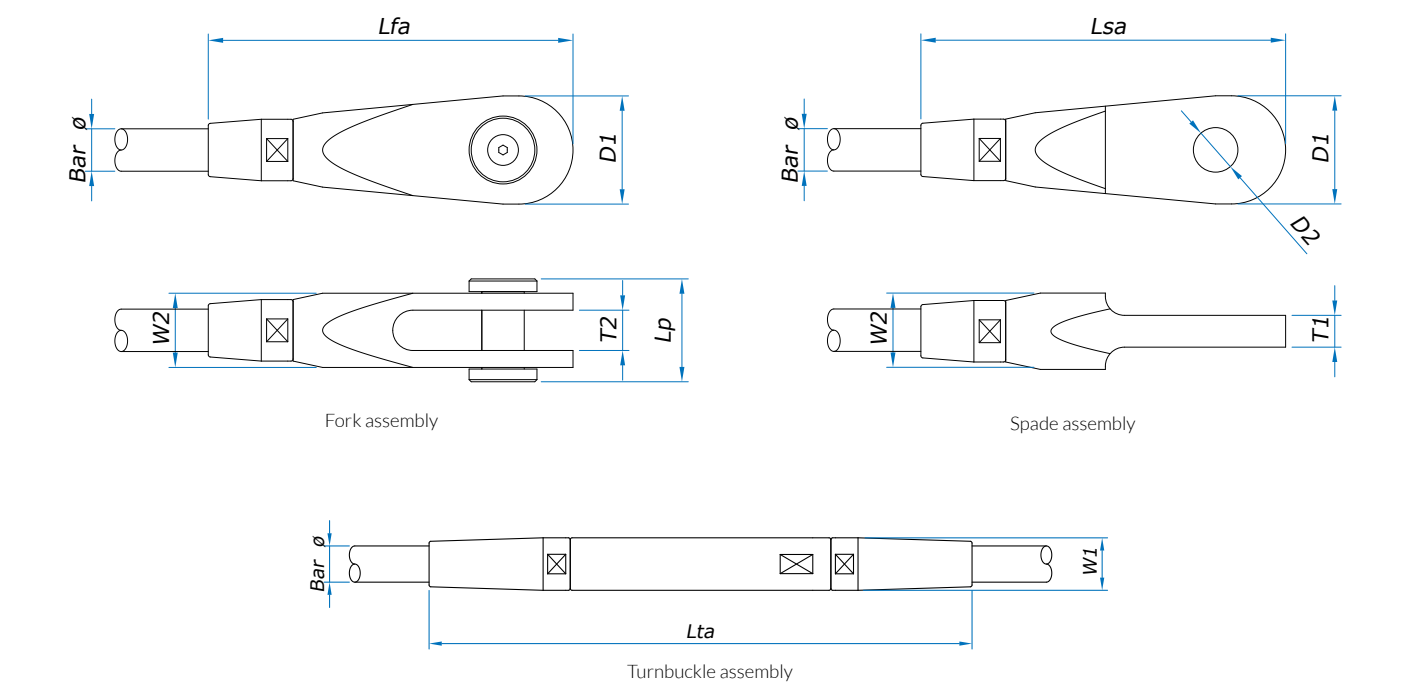
## Fittings Design Data

A variety of fittings can be supplied to match your requirements. All fittings are designed to the requirements of BS5950. All fittings exceed the capacity of the bar. Fittings are supplied self colour, painted, galvanised or in stainless steel (satin or bright polished).

### T2 Fork and Spade Assembly Dimensions

|                             |     | M12  | M16 | M20 | M24 | M30 | M36 | M42 | M48 | M56 | M64 | M76 | M90 | M100 |
|-----------------------------|-----|------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|
| Nominal bar diameter        |     | 12   | 16  | 19  | 22  | 28  | 34  | 39  | 45  | 52  | 60  | 72  | 85  | 97   |
| Fork assembly length        | Lfa | 115  | 138 | 172 | 200 | 239 | 272 | 303 | 326 | 388 | 433 | 511 | 624 | 709  |
| Spade assembly length       | Lsa | 115  | 138 | 172 | 200 | 239 | 272 | 303 | 326 | 388 | 458 | 536 | 649 | 734  |
| Thickness                   | W2  | 24   | 28  | 35  | 42  | 52  | 64  | 74  | 84  | 95  | 120 | 148 | 170 | 181  |
| Jaw gap (fork only) +0/-2mm | T2  | 14   | 16  | 19  | 24  | 30  | 36  | 39  | 44  | 49  | 59  | 76  | 86  | 91   |
| Spade thickness             | T1  | 10   | 12  | 15  | 20  | 25  | 30  | 35  | 40  | 45  | 55  | 70  | 80  | 85   |
| Width                       | D1  | 32   | 43  | 51  | 62  | 79  | 93  | 107 | 121 | 145 | 167 | 199 | 246 | 287  |
| Overall pin length          | Lp  | 34.5 | 38  | 48  | 55  | 73  | 85  | 99  | 110 | 120 | 149 | 183 | 213 | 223  |

All dimensions in mm. For full design details see pages 14 & 15



### T3 Turnbuckles

|                            |     | M12 | M16 | M20 | M24 | M30 | M36 | M42 | M48 | M56 | M64 | M76 | M90 | M100 |
|----------------------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|
| Nominal bar diameter       |     | 12  | 16  | 19  | 22  | 28  | 34  | 39  | 45  | 52  | 60  | 72  | 85  | 97   |
| Turnbuckle assembly length | Lta | 130 | 150 | 300 | 322 | 344 | 366 | 398 | 420 | 442 | 464 | 504 | 596 | 635  |
| Diameter                   | W1  | 18  | 24  | 29  | 35  | 43  | 52  | 60  | 68  | 80  | 91  | 108 | 129 | 143  |

| Tendon Adjustment |        | M12 | M16 | M20 | M24 | M30 | M36 | M42 | M48 | M56 | M64 | M76 | M90 | M100 |
|-------------------|--------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|
| Fork - fork       | +/- mm | 15  | 15  | 15  | 20  | 20  | 20  | 25  | 25  | -   | -   | -   | -   | -    |
| Per turnbuckle    | +/- mm | 25  | 25  | 50  | 50  | 50  | 50  | 50  | 50  | 50  | 50  | 50  | 50  | 50   |

All dimensions in mm. For full design details see pages 14 & 15

### T4 DST520 System Mechanical Properties

| Grade 520 Carbon Steel Bar |   | M12 | M16 | M20 | M24 | M30 | M36 | M42  | M48  | M56  | M64  | M76  | M90  | M100 |
|----------------------------|---|-----|-----|-----|-----|-----|-----|------|------|------|------|------|------|------|
| Yield load                 | kN  | 44  | 82  | 127 | 184 | 292 | 425 | 583  | 766  | 1056 | 1392 | 1999 | 2879 | 3605 |
| Ultimate load (break load) | kN  | 55  | 102 | 159 | 229 | 364 | 531 | 729  | 958  | 1320 | 1739 | 2528 | 3634 | 4547 |
| Nominal bar diameter       | mm  | 12  | 16  | 19  | 22  | 28  | 34  | 39   | 45   | 52   | 60   | 72   | 85   | 97   |
| Stress area                | mm <sup>2</sup>   | 84  | 157 | 245 | 353 | 561 | 817 | 1121 | 1473 | 2030 | 2676 | 3889 | 5591 | 6995 |
| Yield stress               | N/mm <sup>2</sup>   | 520 | 520 | 520 | 520 | 520 | 520 | 520  | 520  | 520  | 520  | 520  | 520  | 520  |
| Ultimate stress            | N/mm <sup>2</sup>   | 650 | 650 | 650 | 650 | 650 | 650 | 650  | 650  | 650  | 650  | 650  | 650  | 650  |
| Elongation                 | %   | 12  | 19  | 19  | 19  | 19  | 19  | 19   | 19   | 19   | 19   | 19   | 19   | 19   |
| Maximum single bar length  | m   | 6   | 12  | 12  | 12  | 12  | 12  | 12   | 12   | 12   | 12   | 12   | 12   | 12   |
| Bar specification          | Grade 520 bars, fine grained micro alloyed steel with enhanced mechanical properties. All carbon steel bar is fully weldable. |     |     |     |     |     |     |      |      |      |      |      |      |      |
| Thread specification       | Rolled metric threads to BS3643   |     |     |     |     |     |     |      |      |      |      |      |      |      |
| Length tolerance           | +/- 3mm for M12 to M100   |     |     |     |     |     |     |      |      |      |      |      |      |      |



| Grade 520 Stainless Steel Bar |  | M12 | M16 | M20 | M24 | M30 | M36 | M42  | M48  | M56  |
|-------------------------------|--|-----|-----|-----|-----|-----|-----|------|------|------|
| Yield load                    | kN   | 44  | 82  | 127 | 184 | 292 | 425 | 583  | 766  | 1056 |
| Ultimate load (break load)    | kN   | 55  | 104 | 162 | 233 | 370 | 539 | 740  | 958  | 1320 |
| Nominal bar diameter          | mm   | 12  | 16  | 19  | 22  | 28  | 34  | 39   | 45   | 52   |
| Stress area                   | mm <sup>2</sup>  | 84  | 157 | 245 | 353 | 561 | 817 | 1121 | 1473 | 2030 |
| Yield stress                  | N/mm <sup>2</sup>  | 520 | 520 | 520 | 520 | 520 | 520 | 520  | 520  | 520  |
| Ultimate stress               | N/mm <sup>2</sup>  | 660 | 660 | 660 | 660 | 660 | 660 | 660  | 660  | 660  |
| Maximum single bar length     | m  | 6+  | 6+  | 6+  | 6+  | 6+  | 6   | 6    | 6    | 6    |
| Bar specification             | Grade 316 stainless steel, cold drawn bar to BS970 or Duplex stainless steel |     |     |     |     |     |     |      |      |      |
| Thread specification          | Rolled metric threads to BS3643  |     |     |     |     |     |     |      |      |      |
| Length tolerance              | +/- 3mm for M12 to M56   |     |     |     |     |     |     |      |      |      |



### Download More

Additional data, 2D & 3D models are available to download from:  
[www.daverbarandcable.co.uk/information-resources/download](http://www.daverbarandcable.co.uk/information-resources/download)

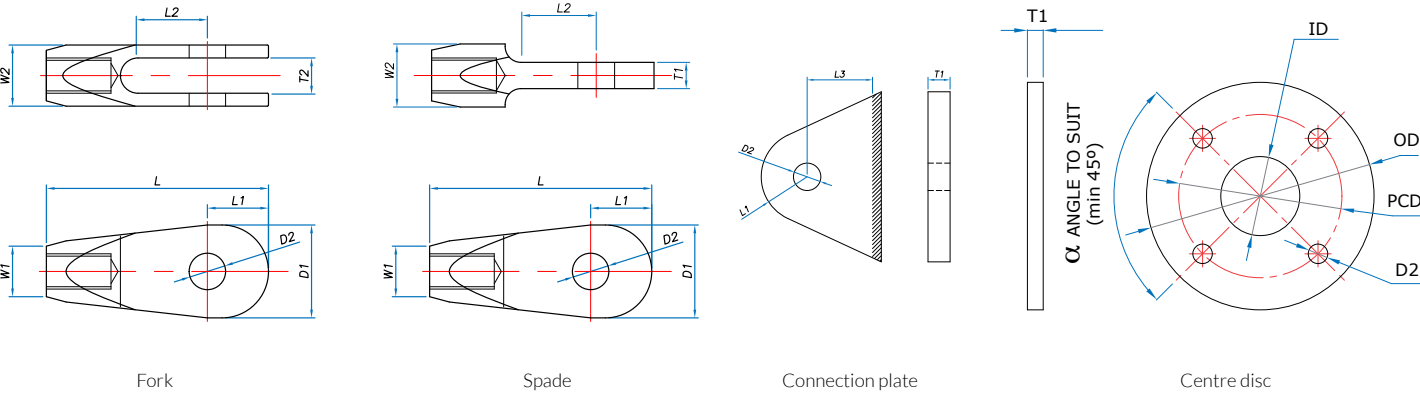


# Product Data

## T5 Fork and Spade Dimensions

|                             |    | M12 | M16 | M20 | M24 | M30 | M36 | M42 | M48 | M56 | M64 | M76 | M90 | M100 |
|-----------------------------|----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|
| Fork length                 | Lf | 90  | 112 | 132 | 155 | 189 | 217 | 243 | 266 | 313 | 348 | 420 | 498 | 575  |
| Spade length                | Ls | 90  | 112 | 132 | 155 | 189 | 217 | 243 | 266 | 313 | 373 | 445 | 523 | 600  |
| Diameter                    | W1 | 18  | 22  | 29  | 35  | 43  | 52  | 60  | 68  | 80  | 91  | 108 | 129 | 143  |
| Thickness                   | W2 | 24  | 28  | 35  | 42  | 52  | 64  | 74  | 84  | 95  | 120 | 148 | 170 | 181  |
| Jaw gap (fork only) +0/-2mm | T2 | 14  | 16  | 19  | 24  | 30  | 36  | 39  | 44  | 49  | 59  | 76  | 86  | 91   |
| Spade thickness             | T1 | 10  | 12  | 15  | 20  | 25  | 30  | 35  | 40  | 45  | 55  | 70  | 80  | 85   |
| Width                       | D1 | 32  | 43  | 51  | 62  | 79  | 93  | 107 | 121 | 145 | 167 | 199 | 246 | 287  |
| Pin hole diameter           | D2 | 13  | 17  | 21  | 25  | 31  | 37  | 43  | 50  | 58  | 66  | 78  | 96  | 111  |
| Projection                  | L1 | 21  | 27  | 33  | 41  | 52  | 61  | 69  | 78  | 96  | 110 | 131 | 161 | 188  |
| Jaw depth (fork only)       | L2 | 25  | 30  | 42  | 50  | 59  | 68  | 70  | 87  | 105 | 120 | 141 | 171 | 198  |

All dimensions in mm.



## T6 Accessories

| Connection Plates          |    | M12   | M16  | M20  | M24  | M30  | M36  | M42  | M48  | M56  | M64  | M76  | M90  | M100 |
|----------------------------|----|-------|------|------|------|------|------|------|------|------|------|------|------|------|
| Thickness                  | T1 | 10    | 12   | 15   | 20   | 25   | 30   | 35   | 40   | 45   | 55   | 70   | 80   | 85   |
| Pin hole diameter          | D2 | 13    | 17   | 21   | 25   | 31   | 37   | 43   | 50   | 58   | 66   | 78   | 96   | 111  |
| Projection                 | L1 | 21    | 27   | 33   | 41   | 52   | 61   | 69   | 78   | 96   | 110  | 131  | 161  | 188  |
| Clearance                  | L3 | 32    | 38   | 52   | 62   | 74   | 87   | 97   | 107  | 125  | 140  | 161  | 196  | 222  |
| Grade plate to BS EN 10025 |    | S 355 | S355 | S355 | S355 | S355 | S355 | S355 | S355 | S355 | S355 | S355 | S355 | S355 |

Ensure clearance for paint/galvanising

| Centre Discs               |     | M12  | M16  | M20  | M24  | M30  | M36  | M42  | M48  | M56  |
|----------------------------|-----|------|------|------|------|------|------|------|------|------|
| Thickness                  | T1  | 10   | 12   | 15   | 20   | 25   | 30   | 35   | 40   | 45   |
| Overall diameter           | OD  | 145  | 185  | 245  | 285  | 350  | 420  | 490  | 560  | 660  |
| Centre hole                | ID  | 50   | 60   | 70   | 90   | 100  | 120  | 140  | 160  | 200  |
| Pin hole diameter          | D2  | 13   | 17   | 21   | 25   | 31   | 37   | 43   | 49   | 57   |
| PCD                        | PCD | 110  | 140  | 180  | 210  | 260  | 310  | 360  | 410  | 480  |
| Grade plate to BS EN 10025 |     | S355 | S355 | S355 | S355 | S355 | S355 | S355 | S355 | S355 |

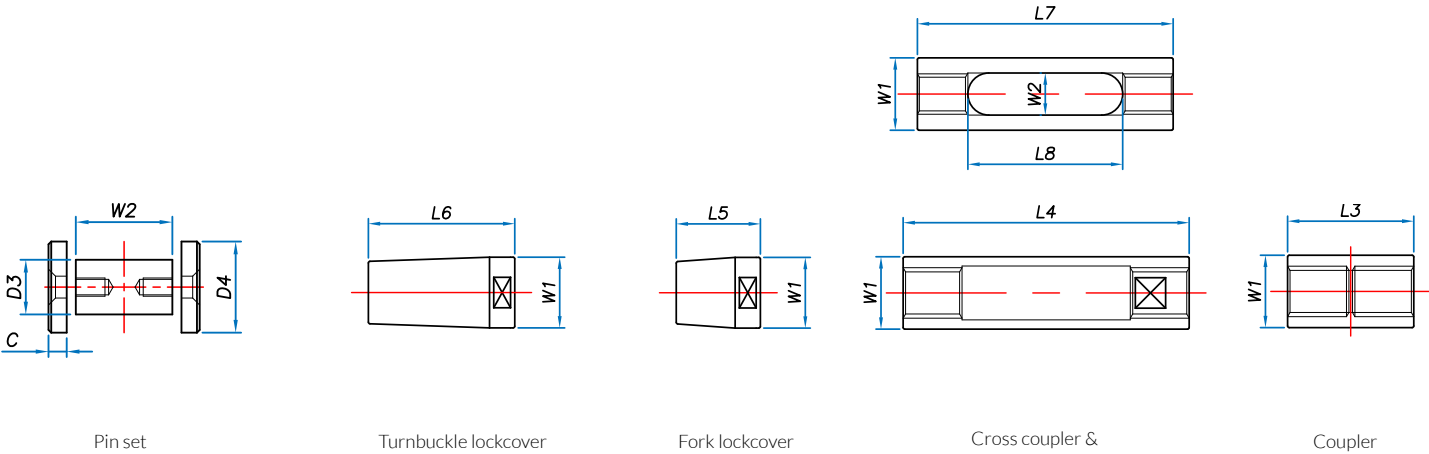
All dimensions in mm. Ensure clearance for paint/galvanising.

For stainless steel connection plates or centre discs, marine grade stainless with a minimum tensile strength of S355 must be used.

## T7 Accessories

| Pinsets           |    | M12 | M16 | M20 | M24 | M30 | M36 | M42 | M48 | M56 | M64 | M76 | M90 | M100 |
|-------------------|----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|
| Pin diameter      | D3 | 12  | 16  | 20  | 24  | 30  | 36  | 42  | 48  | 56  | 64  | 76  | 94  | 109  |
| Pin body length   | W2 | 24  | 28  | 36  | 43  | 53  | 65  | 75  | 86  | 96  | 121 | 153 | 173 | 183  |
| End cap diameter  | D4 | 20  | 25  | 32  | 35  | 50  | 55  | 60  | 60  | 70  | 86  | 100 | 120 | 140  |
| End cap thickness | C  | 3   | 5   | 6   | 6   | 10  | 10  | 12  | 12  | 12  | 14  | 15  | 20  | 20   |

| Lockcovers                  |    | M12 | M16 | M20 | M24 | M30 | M36 | M42 | M48 | M56 | M64 | M76 | M90 | M100 |
|-----------------------------|----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|
| Lockcover diameter          | W1 | 18  | 24  | 29  | 35  | 43  | 52  | 60  | 68  | 80  | 91  | 108 | 129 | 143  |
| Fork lockcover length       | L5 | 25  | 26  | 40  | 45  | 50  | 55  | 60  | 60  | 75  | 85  | 91  | 126 | 134  |
| Turnbuckle lockcover length | L6 | 30  | 33  | 78  | 84  | 87  | 93  | 102 | 105 | 106 | 112 | 118 | 153 | 160  |



| Turnbuckles/Couplers        |    | M12 | M16 | M20 | M24 | M30 | M36 | M42 | M48 | M56 | M64 | M76 | M90 | M100 |
|-----------------------------|----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|
| Coupler length              | L3 | 37  | 45  | 53  | 64  | 75  | 89  | 100 | 115 | 135 | 145 | 165 | 195 | 215  |
| Coupler/Turnbuckle diameter | W1 | 18  | 24  | 29  | 35  | 43  | 52  | 60  | 68  | 80  | 91  | 108 | 129 | 143  |
| Turnbuckle length           | L4 | 70  | 85  | 144 | 155 | 170 | 180 | 195 | 210 | 230 | 240 | 268 | 290 | 315  |

All dimensions in mm.

| Cross Coupler ( $\alpha$ min 40°) |    | M12 | M16 | M20 | M24 | M30 | M36 | M42 | M48 | M56 |
|-----------------------------------|----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| Length                            | L7 | 85  | 105 | 130 | 152 | 180 | 215 | 247 | 286 | 334 |
| Diameter                          | W1 | 25  | 29  | 36  | 43  | 53  | 63  | 75  | 85  | 99  |
| Slot Width                        | W2 | 14  | 18  | 22  | 26  | 32  | 38  | 44  | 50  | 58  |
| Long Length                       | L8 | 52  | 65  | 80  | 92  | 112 | 135 | 157 | 180 | 210 |
| Lockcover Length                  | L6 | 35  | 41  | 51  | 61  | 75  | 89  | 106 | 120 | 140 |
| Lockcover Diameter                | W1 | 25  | 29  | 36  | 43  | 23  | 63  | 75  | 85  | 99  |

All dimensions in mm



## Download More

Additional data, 2D & 3D models are available to download from:  
[www.daverbarandcable.co.uk/information-resources/download](http://www.daverbarandcable.co.uk/information-resources/download)





# Compression Struts



Daver Steels' compression struts at Terminal 2 Heathrow, London

To complement our existing tensile bar systems, Daver Steels have introduced a range of adjustable compression struts to EXC 3.

A compression strut comprises a central tubular section with a welded taper connection at each end.

The taper connection forms the shape of the compression strut and is threaded to take an end connection allowing an adjustable strut for applications experiencing compressive and tensile loads.

## Assembly

All compression struts are supplied fully assembled and set to the nominal pin-pin length. The installed strut can be adjusted to length by +/- 50 mm. Forks must be assembled in the same plane within 0.5° alignment.

## Alternative Arrangements

Alternative end details can be designed and manufactured to suit bespoke projects, without compromising the load characteristics.

Our standard configuration uses our standard forks, a thread cover for locking and aesthetic looks, and our design of tapered cone.

The strut system is designed in accordance with EN1993-1-1 and EN1993 -1-8 and their respective UK National Annexes. The ultimate capacities quoted take account of self-weight bending of the strut in accordance with equation 6.10, Table NAA1.2(B) UK National Annex to EN1990.

Our calculation methods have been validated by consultant structural design engineers.

## Fittings

For all of our data on forks, lockcovers and connection plates please view T5, T6 and T7 on pages 15 and 16.

## Surface Finishes

Compression struts are available in our standard surface finishes for both carbon and stainless steels.

Please see page 4 & 5 for more details.

## Critical Sections

- 1 CHS verification
  - Section capacity (combined bending & axial)
- 2 Interface between CHS & welded cone
  - Weld size required
- 3 Threaded bar
  - Combined bending & axial
  - Axial resistance of thread
- 4 Fork
  - Combined bending & axial
- 5 Pin
  - Combined bending & shear

NB: Reference to 'bending' above means the summation of strut buckling and self-weight bending effects.

## Partial Factors

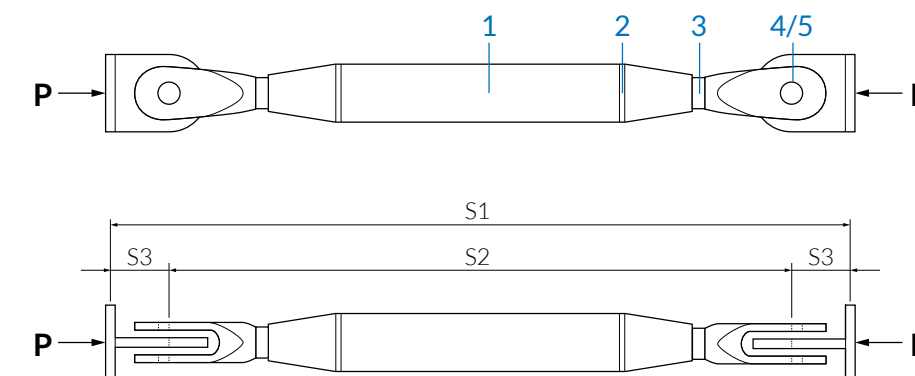
The allowable loads refer to the minimum design resistance in kN, calculated using the UK National Annex, material and Load Factors.

Partial factors for design of building members / sections EN1993-1-1

| $\gamma_{M0}$ | $\gamma_{M1}$ | $\gamma_{M2}$ | $\gamma_{M3}$ | $\gamma_{M4}$ | $\gamma_{M5}$ | $\gamma_{M6}$ | $\gamma_{M7}$ |
|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|
| 1.00          | 1.00          | 1.10          | 1.25          | 1.10          | 1.00          | 1.00          | 1.00          |

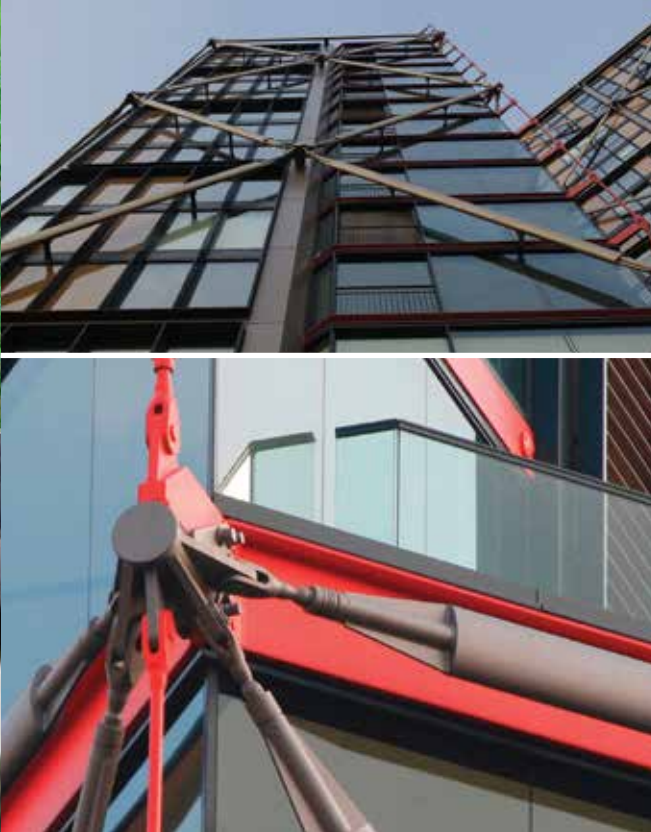
Partial factors for design of building connections/ joints EN1993-1-8

| $\gamma_{M0}$ | $\gamma_{M1}$ | $\gamma_{M2}$ | $\gamma_{M3}$ | $\gamma_{M4}$ | $\gamma_{M5}$ | $\gamma_{M6}$ | $\gamma_{M6,ser}$ | $\gamma_{M7}$ |
|---------------|---------------|---------------|---------------|---------------|---------------|---------------|-------------------|---------------|
| 1.00          | 1.00          | 1.25          | 1.25          | 1.10          | 1.00          | 1.00          | 1.00              | 1.10          |



S1 = Effective length  
 S2 = Pin to pin length  
 S3 = Pin to point of resistance  
 P = Load in kN





NEO Bankside, London

# Load Capacity Data

## Carbon Steel

Each compression strut is custom made, so alternative designs and end connections can be accommodated. Below are examples of typical loads which can be expected at the tabulated lengths.

T8 Carbon steel tubes: BS EN10210-1 Grade S355JR

| Fork/Bar Sizes             | M12                          | M16      | M20      | M24      | M30      | M36      | M42         | M48        | M56        | M64        | M76        | M90      | M100       |
|----------------------------|------------------------------|----------|----------|----------|----------|----------|-------------|------------|------------|------------|------------|----------|------------|
| CHS Size (diameter x t mm) | 33.7 x 4                     | 42.4 x 4 | 48.3 x 5 | 60.3 x 5 | 76.1 x 5 | 88.9 x 5 | 114.3 x 6.3 | 139.7 x 10 | 168.3 x 10 | 193.7 x 10 | 244.5 x 16 | 273 x 16 | 323.9 x 16 |
| S1 m                       | P -- Design Resistance in kN |          |          |          |          |          |             |            |            |            |            |          |            |
| 1.5                        | 8                            | 25       | 45       | 74       | 127      | 216      | 306         | 426        | 600        | 837        | 1207       | 1807     | 2376       |
| 2                          |                              | 17       | 29       | 56       | 127      | 216      | 306         | 426        | 600        | 837        | 1207       | 1807     | 2376       |
| 2.5                        |                              | 13       | 22       | 40       | 98       | 202      | 306         | 426        | 600        | 837        | 1207       | 1807     | 2376       |
| 3                          |                              | 10       | 18       | 31       | 74       | 153      | 306         | 426        | 600        | 837        | 1207       | 1807     | 2376       |
| 3.5                        |                              |          | 15       | 26       | 60       | 122      | 306         | 426        | 600        | 837        | 1207       | 1807     | 2376       |
| 4                          |                              |          | 13       | 22       | 51       | 102      | 199         | 359        | 600        | 837        | 1207       | 1807     | 2376       |
| 4.5                        |                              |          | 12       | 20       | 44       | 88       | 168         | 300        | 560        | 837        | 1207       | 1807     | 2376       |
| 5                          |                              |          | 10       | 17       | 39       | 78       | 146         | 258        | 480        | 781        | 1207       | 1807     | 2376       |
| 5.5                        |                              |          |          | 16       | 35       | 66       | 129         | 226        | 416        | 683        | 1207       | 1807     | 2376       |
| 6                          |                              |          |          | 14       | 32       | 55       | 116         | 201        | 367        | 600        | 1194       | 1807     | 2376       |
| 6.5                        |                              |          |          | 13       | 29       | 47       | 106         | 182        | 328        | 532        | 1074       | 1783     | 2376       |
| 7                          |                              |          |          | 11       | 24       | 40       | 97          | 166        | 297        | 478        | 965        | 1624     | 2376       |
| 7.5                        |                              |          |          | 10       | 21       | 35       | 90          | 154        | 272        | 434        | 872        | 1475     | 2376       |
| 8                          |                              |          |          |          | 18       | 30       | 82          | 143        | 251        | 398        | 793        | 1342     | 2226       |
| 8.5                        |                              |          |          |          | 16       | 27       | 72          | 133        | 233        | 368        | 727        | 1226     | 2062       |
| 9                          |                              |          |          |          | 14       | 23       | 64          | 125        | 218        | 342        | 670        | 1126     | 1908       |
| 9.5                        |                              |          |          |          | 12       | 21       | 57          | 118        | 205        | 320        | 623        | 1041     | 1767       |
| 10                         |                              |          |          |          | 11       | 18       | 51          | 112        | 194        | 301        | 582        | 968      | 1640       |
| 11                         |                              |          |          |          | 9        | 15       | 41          | 101        | 175        | 270        | 515        | 849      | 1429       |
| 12                         |                              |          |          |          |          | 12       | 34          | 93         | 159        | 245        | 464        | 759      | 1265       |
| S3 mm max                  | 50                           | 50       | 50       | 75       | 100      | 100      | 100         | 125        | 125        | 175        | 200        | 225      | 250        |

Tubes with a higher minimum yield can be acquired on a longer lead time for specific projects. We can provide our calculations to ensure your design meets the building requirements.

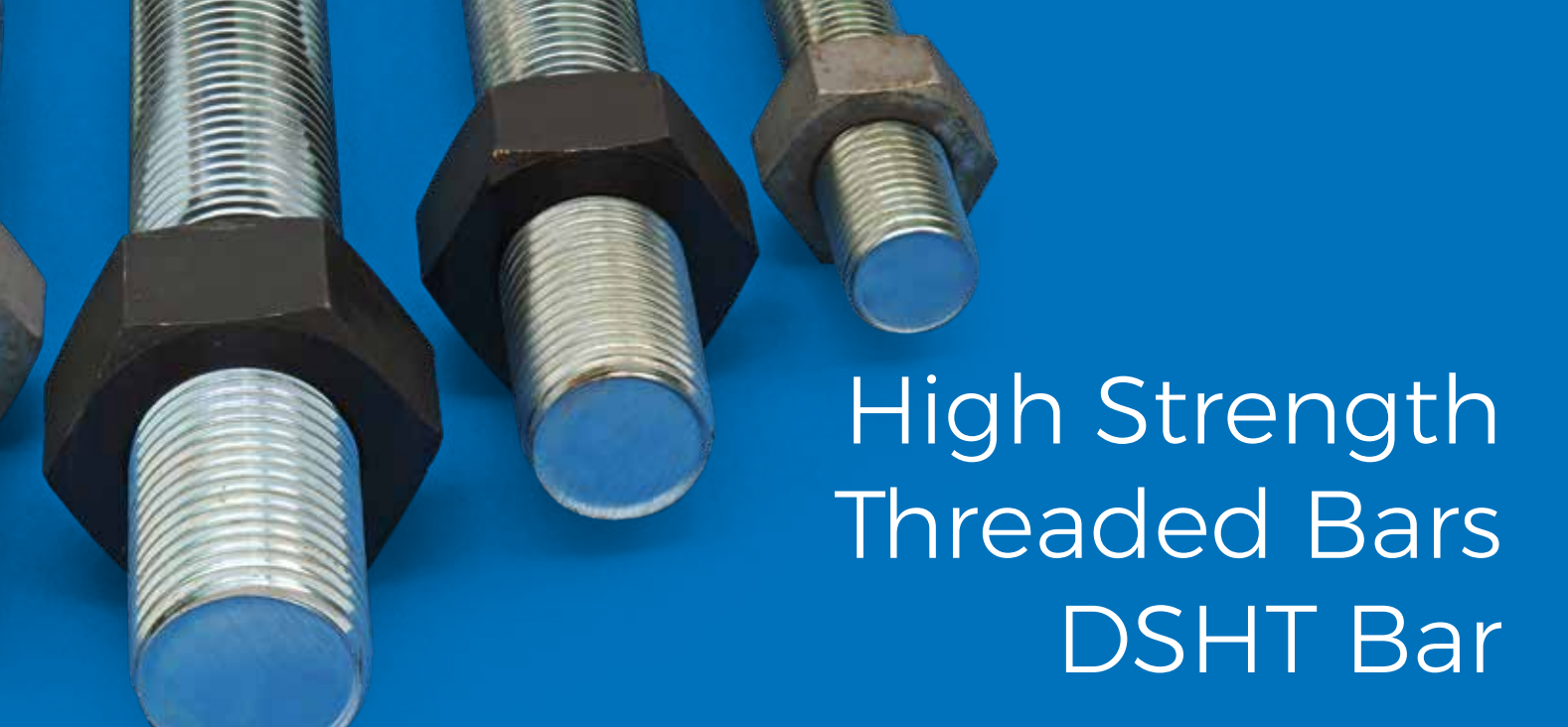
## Stainless Steel

T9 Stainless steel tubes in grade 316 to BS EN10296 - min. Yield Stress of 230 N/mm<sup>2</sup>

| Fork/Bar Sizes             | M12                         | M16      | M20      | M24      | M30      | M36      | M42         | M48        | M56        |
|----------------------------|-----------------------------|----------|----------|----------|----------|----------|-------------|------------|------------|
| CHS Size (diameter x t mm) | 33.7 x 4                    | 42.4 x 4 | 48.3 x 5 | 60.3 x 5 | 76.1 x 5 | 88.9 x 5 | 114.3 x 6.3 | 139.7 x 10 | 168.3 x 10 |
| S1 m                       | P --Design Resistance in kN |          |          |          |          |          |             |            |            |
| 1.5                        | 6                           | 18       | 39       | 78       | 159      | 270      | 382         | 426        | 772        |
| 2                          |                             | 12       | 26       | 48       | 123      | 261      | 382         | 426        | 772        |
| 2.5                        |                             | 10       | 19       | 35       | 84       | 178      | 382         | 426        | 772        |
| 3                          |                             |          | 16       | 27       | 65       | 133      | 287         | 400        | 772        |
| 3.5                        |                             |          | 13       | 23       | 53       | 107      | 222         | 388        | 600        |
| 4                          |                             |          | 12       | 20       | 45       | 90       | 181         | 327        | 636        |
| 4.5                        |                             |          | 10       | 17       | 39       | 78       | 154         | 275        | 523        |
| 5                          |                             |          |          | 16       | 35       | 67       | 134         | 237        | 441        |
| 5.5                        |                             |          |          | 14       | 32       | 55       | 119         | 208        | 381        |
| 6                          |                             |          |          | 12       | 27       | 45       | 108         | 187        | 336        |
| S3 mm max                  | 50                          | 50       | 50       | 75       | 100      | 100      | 100         | 125        | 125        |

Tubes with a higher minimum yield can be acquired on a longer lead time for specific projects. We can provide our calculations to ensure your design meets the building requirements.





# High Strength Threaded Bars DSHT Bar



High strength threaded bar in wind turbine construction

## Applications

High strength bar is used widely throughout the Civil & Structural Engineering industry. Typical uses include:

- Holding down bolts
- Temporary works
- Tie bars
- Masonry tensioning

## Daver Steels HT Bar

Daver Steels offer high strength threaded bar equivalent to Grade 10.9 and conforming to the requirements of BS EN ISO 898-1. DSHT bar has a high yield stress (typically 900N/mm<sup>2</sup>) but unlike some other HT bars also has a good V-notch toughness (min 45J @ 20°C and 27J @ -20°C).

Standard diameters available are M30 to M56 and lengths of 6m. Larger diameters and lengths are available at special request but may be subject to increased lead time.

Threads are standard metric coarse pitch to BS 3643 class 8g and allow a variety of standard and special fittings to be used. Left hand threads can also be supplied, by request.

## Alloy Steels & Stainless Materials

Carbon bars are made from a heat treated alloy and threads are rolled to provide greater fatigue resistance. All material is independently tested for mechanical properties. An equivalent stainless steel high strength threaded bar is also available.

## Stressing

Daver Steels can offer stressing equipment for hire or sales and advise on site stressing procedures. Our standard metric threads make stressing easier and the equipment readily available

## Fittings Available

- Hex nuts
- End plates
- Couplers
- Washers

Please contact our sales department for more information

## Finishes (Corrosion Protection)

- Grease
- Greenkote™
- Denso Tape
- Zinga
- Paint
- Heat shrink tube

## Site Precautions

DSHT bar is a heat treated steel and must not be welded or be subjected to heat (e.g. welding / cutting / grinding / sparks).

DSHT bar can easily be cut on site using discs or blades but heat must be kept to a minimum (flame cutting must not be used).

## Manufacture

ISO 9001, 3.1 Certification, CE marked. Third party tensile tests available. European made and sourced.

## T12 Hydraulic Jacks

The table below gives the main dimensions of hydraulic jacks available from Daver Steels.

| Bar Dia | Weight | Type | Max load | Min Bar | B   | D   | L1  | L2  | L3  |
|---------|--------|------|----------|---------|-----|-----|-----|-----|-----|
| mm      | kg     |      | kN       | Centres | mm  | mm  | mm  | mm  | mm  |
| 30      | 3.5    | DJ2  | 457      | 80      | 102 | 90  | 60  | 128 | 236 |
| 36      | 6.5    | DJ3  | 822      | 100     | 133 | 117 | 75  | 155 | 277 |
| 42      | 11     | DJ4  | 1264     | 110     | 163 | 155 | 85  | 165 | 305 |
| 48      | 11     | DJ4  | 1264     | 115     | 163 | 155 | 100 | 165 | 342 |
| 56      | 16     | DJ5  | 1833     | 135     | 193 | 181 | 110 | 187 | 342 |

## T13 Mechanical Properties

|              | Code                          |                   | DSHT30 | DSHT36 | DSHT42 | DSHT48 | DSHT56 |
|--------------|-------------------------------|-------------------|--------|--------|--------|--------|--------|
|              | Thread Diameter               |                   | 30     | 36     | 42     | 48     | 56     |
| Bars         | 0.2% Proof (yield) load (min) | kN                | 505    | 735    | 1009   | 1326   | 1827   |
|              | Failure (break) load (min)    | kN                | 617    | 899    | 1233   | 1620   | 2233   |
|              | Design load according EC3     | kN                | 480    | 699    | 959    | 1167   | 1608   |
|              | 0.2% Proof stress (min)       | N/mm <sup>2</sup> | 900    | 900    | 900    | 900    | 900    |
|              | Ultimate stress (min)         | N/mm <sup>2</sup> | 1100   | 1100   | 1100   | 1100   | 1100   |
|              | Thread stress area            | mm <sup>2</sup>   | 561    | 817    | 1121   | 1473   | 2030   |
|              | Thread pitch                  | mm                | 3.5    | 4      | 4.5    | 5      | 5.5    |
|              | Standard end thread length    | mm                | 200    | 250    | 250    | 250    | 300    |
|              | Nominal bar diameter          | mm                | 28     | 34     | 39     | 45     | 52     |
|              | Mass per metre                | kg                | 4.8    | 6.8    | 9.3    | 12.2   | 16.8   |
|              | Max length without coupling   | m                 | 12     | 12     | 12     | 12     | 12     |
| Hex Nuts     | Width across flats            | mm                | 46     | 55     | 65     | 75     | 85     |
|              | Width across corners          | mm                | 53.1   | 63.5   | 75.1   | 85.6   | 98.1   |
|              | Length                        | mm                | 24     | 29     | 34     | 38     | 46     |
| Flat Washers | Outside diameter              | mm                | 90     | 108    | 126    | 144    | 168    |
|              | Thickness                     | mm                | 8      | 10     | 12     | 12     | 15     |
| Couplers     | Outside diameter              | mm                | 48     | 53     | 63     | 73     | 83     |
|              | Length                        | mm                | 75     | 89     | 100    | 115    | 135    |

Min Elongation (A5) : 10%

Min Charpy (V Notch) : 45 J @ 20°C, 27 J @ -20°C.

Typical Brinell Hardness : 300 - 350 HBW

