

## TENN HLB High Load Anchors

Torque-Controlled Expansion Anchors



### ADVANTAGES

- High clamping loads
- In-situ fastening is possible, i.e. the anchor hole may be drilled through the clearance hole in the attachment
- Alignment problems eliminated
- Attachments may be removed and re-installed
- Anchor may be re-expanded
- Hardened washers resist inversion

*Made from top grade steel for strength and durability, the Tenn HLB High Load Anchor is designed to achieve the highest clamping loads and secure load bearing anchorage in hard concrete.*

Tenn HLB Anchors feature a compressible plastic collar, the purpose of which is to prevent the bolt from being prestressed before the attachment or fixture is securely tightened against the concrete surface.

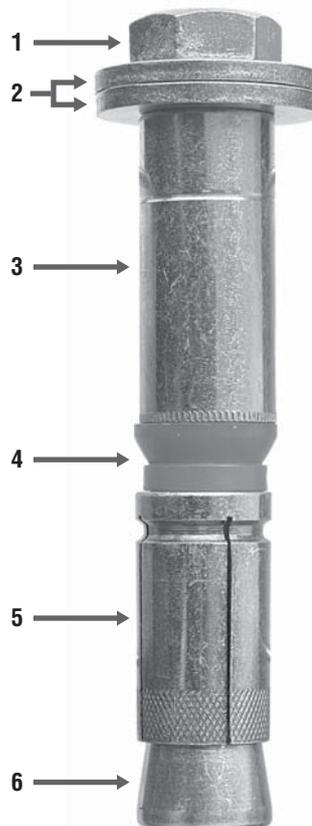
The anchor is set by tightening the bolt head, which draws the cone nut up through the expansion sleeve, expanding it against the sides of the drill-hole.

HLB anchor develops its tensile capacity by means of a combination of high frictional resistance generated by the anchor's expansion forces and a keying grip developed between the expanded anchor and the surrounding concrete mass. The spacer sleeve aids in increasing the shear capacity. The anchor's tensile capacity depends on the depth of embedment and the strength of the concrete.

### Typical Applications

- Tunnel fixtures
- Safety railings
- Space frame base plates
- Curtainwall brackets
- Pipework supports
- Roof trusses

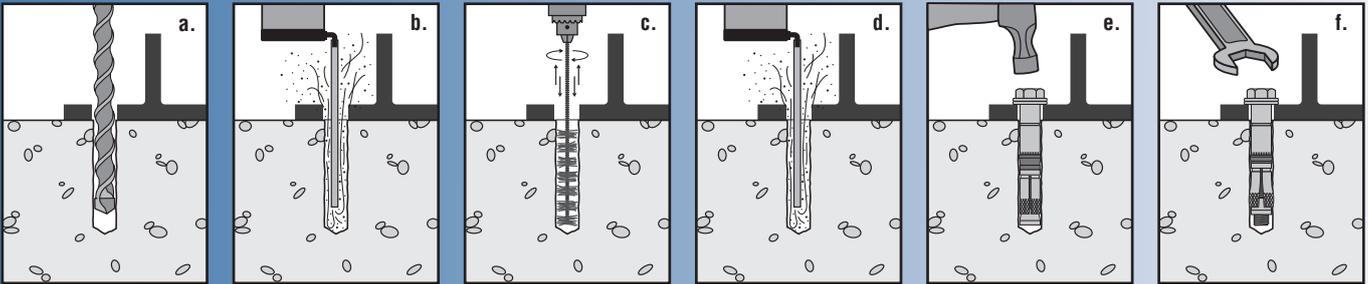
### TENN HLB MATERIAL SPECIFICATIONS



| Description |   | Mechanical Properties     |                           |
|-------------|---|---------------------------|---------------------------|
|             |   | Minimum Tensile Strength  | Minimum Yield Stress      |
|             |   | $f_t$ , N/mm <sup>2</sup> | $f_y$ , N/mm <sup>2</sup> |
| 1           | Hex Head Bolt, DIN 931 Carbon Steel, Property Class 8.8 | 800                       | 640                       |
| 2           | Washer (2 pcs), DIN 1544 Carbon Steel, Grade ST37       | 650                       | -                         |
| 3           | Spacer Sleeve, Precision Steel Tube DIN 2394/2393       | 370                       | -                         |
| 4           | Compression Collar, Acetal Resin Plastic                | -                         | -                         |
| 5           | Expansion Sleeve, DIN 1654 Carbon Steel, Grade ST52     | 800-900                   | -                         |
| 6           | Cone Nut, Carbon Steel, Heat-treated                    | 1300-1500                 | -                         |

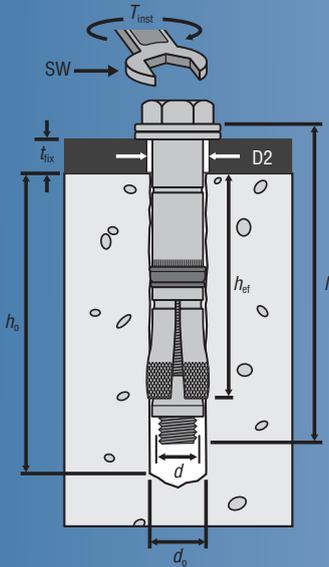


**INSTALLATION PROCEDURE**



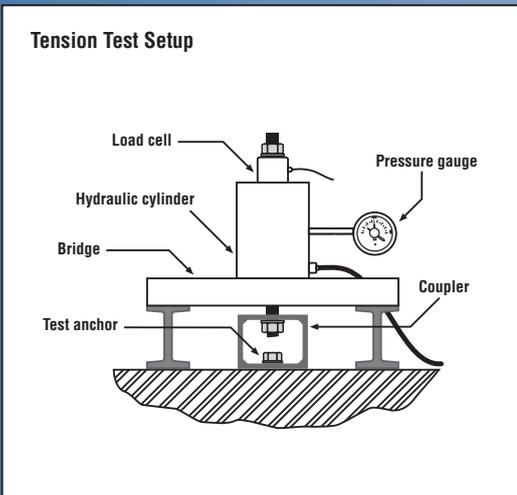
- a. Drill hole to correct diameter and depth.
- b. Blow out dust.
- c. Brush sides of hole to loosen dust.
- d. Blow out remaining dust.
- e. Tap in Tenn HLB Anchor.
- f. Apply tightening torque.

**INSTALLATION DIMENSIONS**



| Type         | Anchor Size <i>d</i> | Bolt Length <i>l</i> , mm | Maximum Attachment Thickness <i>t<sub>fix</sub></i> , mm | Drill-Hole Diameter <i>d<sub>0</sub></i> , mm | Minimum Drill-Hole Depth <i>h<sub>0</sub></i> , mm | Tightening Torque            |                                  | Wrench Size SW, mm | Clearance Hole Diameter D2, mm |
|--------------|----------------------|---------------------------|--|---|--|------------------------------|----------------------------------|--------------------|--------------------------------|
|              |                      |                           |  |   |  | <i>T<sub>inst</sub></i> , Nm | <i>T<sub>inst</sub></i> , ft.lb. |                    |                                |
| HLB.M10.1415 | M10                  | 90                        | 15   | 14  | 90   | 50                           | 36.8                             | 17                 | 16                             |
| HLB.M10.1425 | M10                  | 100                       | 25   | 14  | 90   | 50                           | 36.8                             | 17                 | 16                             |
| HLB.M10.1450 | M10                  | 120                       | 50   | 14  | 90   | 50                           | 36.8                             | 17                 | 16                             |
| HLB.M12.1825 | M12                  | 115                       | 25   | 18  | 105  | 80                           | 59.0                             | 19                 | 20                             |
| HLB.M12.1840 | M12                  | 130                       | 40   | 18  | 105  | 80                           | 59.0                             | 19                 | 20                             |
| HLB.M16.2425 | M16                  | 140                       | 25   | 24  | 125  | 180                          | 132.6                            | 24                 | 26                             |
| HLB.M16.2450 | M16                  | 160                       | 50   | 24  | 125  | 180                          | 132.6                            | 24                 | 26                             |
| HLB.M20.2830 | M20                  | 155                       | 30   | 28  | 155  | 275                          | 202.7                            | 30                 | 30                             |
| HLB.M20.2860 | M20                  | 200                       | 60   | 28  | 155  | 275                          | 202.7                            | 30                 | 30                             |

**TEST DATA**



All tests were conducted in accordance with ASTM E-488-96 "Standard Test Methods for Strength of Anchors in Concrete and Masonry Elements" in 30 N/mm<sup>2</sup> unreinforced concrete. Edge effect, concrete strength and rebar location, if any, will affect anchorage performance.

| HLB Anchor Size <i>d</i> | Drill-Hole Diameter <i>d<sub>0</sub></i> , mm | Average Ultimate Pull-out Loads, <i>N<sub>u</sub></i> (kN) |       |       |        |        |
|--------------------------|---|--|-------|-------|--------|--------|
|                          |   | Embedment Depth, <i>h<sub>ef</sub></i>                     |       |       |        |        |
|                          |   | 65 mm  | 80 mm | 95 mm | 110 mm | 125 mm |
| M10                      | 14  | 33.6*  | 37.1* | -     | -      | -      |
| M12                      | 18  | -  | 44.9* | 49.2* | 58.2*  | -      |
| M16                      | 24  | -  | -     | 60.3* | 66.3*  | 69.5*  |
| M20                      | 28  | -  | -     | -     | 80.7*  | 93.6*  |

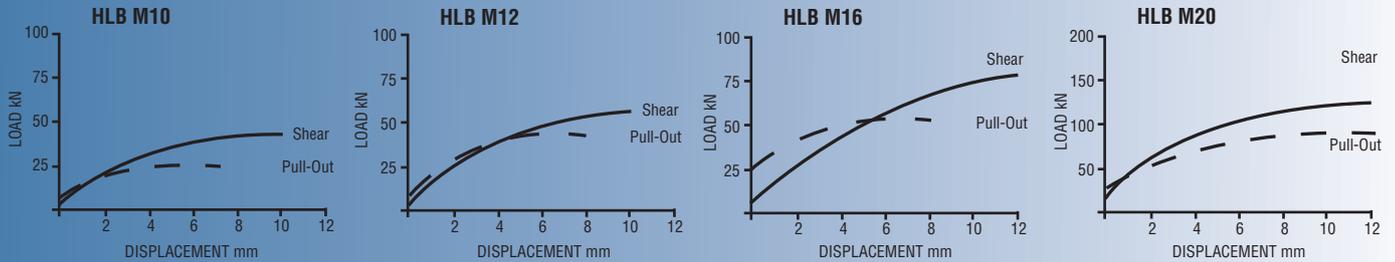
| HLB Anchor Size <i>d</i> | Drill-Hole Diameter <i>d<sub>0</sub></i> , mm | Average Ultimate Shear Loads, <i>V<sub>u</sub></i> (kN) |        |        |        |         |
|--------------------------|---|---|--------|--------|--------|---------|
|                          |   | Embedment Depth, <i>h<sub>ef</sub></i>                  |        |        |        |         |
|                          |   | 65 mm   | 80 mm  | 95 mm  | 110 mm | 125 mm  |
| M10                      | 14  | 48.3**  | -      | -      | -      | -       |
| M12                      | 18  | -   | 66.0** | -      | -      | -       |
| M16                      | 24  | -   | -      | 89.1** | -      | -       |
| M20                      | 28  | -   | -      | -      | -      | 137.6** |

**Failure modes**

- \*Concrete-cone failure
- \*\*Lateral concrete-cone failure



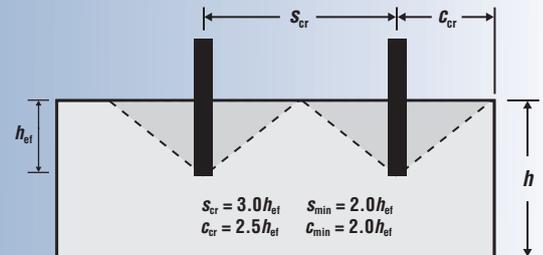
**Typical Load – Displacement Graphs for Tenn HLB Anchors in 30 N/mm<sup>2</sup> Concrete**



**SAFE WORKING LOADS**

**Table 1. Safe Working Loads in C20/25 Concrete**

| Anchor Size <i>d</i> | Drill-Hole Diameter <i>d</i> <sub>01</sub> , mm | Effective Embedment Depth <i>h</i> <sub>ef</sub> , mm | Minimum Concrete Thickness <i>h</i> , mm | Critical Spacing <i>s</i> <sub>cr</sub> , mm | Critical Edge Distance <i>c</i> <sub>cr</sub> , mm | Safe Working Loads                   |                                    |
|----------------------|---|---|--|--|--|--------------------------------------|------------------------------------|
|                      |   |   |  |  |  | Tension <i>N</i> <sub>red</sub> , kN | Shear <i>V</i> <sub>red</sub> , kN |
| HLB.M10              | 14  | 65  | 150                                      | 195  | 165  | 8.4                                  | 12.1                               |
| HLB.M12              | 18  | 80  | 160                                      | 240  | 200  | 11.2                                 | 16.5                               |
| HLB.M16              | 24  | 95  | 180                                      | 285  | 240  | 15.1                                 | 22.3                               |
| HLB.M20              | 28  | 125   | 220                                      | 375  | 315  | 20.1                                 | 34.4                               |



**Table 2. LOAD REDUCTION FACTORS FOR REDUCED CENTRE-TO-CENTRE SPACING – TENSION AND SHEAR LOADING**

| HLB Anchor Size <i>d</i>                     | M10   | M12  | M16  | M20  |
|--|---|------|------|------|
| Critical Spacing <i>s</i> <sub>cr</sub> , mm | 195   | 240  | 285  | 375  |
| Min. Spacing <i>s</i> <sub>min</sub> , mm    | 130   | 160  | 190  | 250  |
| Actual Spacing <i>s</i> , mm                 | Reduction Factors $\psi_s$ for reduced centre-to-centre spacing |      |      |      |
| 130  | 0.70  |      |      |      |
| 150  | 0.79  |      |      |      |
| 160  | 0.84  | 0.70 |      |      |
| 190  | 0.98  | 0.81 | 0.70 |      |
| 195  | 1.00  | 0.83 | 0.72 |      |
| 240  |   | 1.00 | 0.86 |      |
| 250  |   |      | 0.89 | 0.70 |
| 285  |   |      | 1.00 | 0.78 |
| 325  |   |      |      | 0.88 |
| 340  |   |      |      | 0.92 |
| 350  |   |      |      | 0.94 |
| 375  |   |      |      | 1.00 |

**LOAD REDUCTION FACTORS**

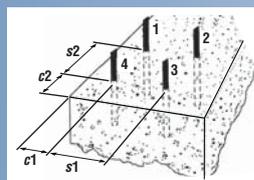
- **Critical spacing *s*<sub>cr</sub>**  
The least centre-to-centre spacing at which the loads listed in Table 1 are applicable. If the spacing is less than *s*<sub>cr</sub> the anchor's safe working load must be adjusted downwards. Refer to Table 2 for appropriate reduction factors.
- **Minimum spacing *s*<sub>min</sub>**  
The minimum centre-to-centre spacing allowed.
- **Critical edge distance *c*<sub>cr</sub>**  
The least anchor-to-edge distance at which the loads listed in Table 1 are applicable. If the edge distance is less than *c*<sub>cr</sub>, the anchor's safe working load must be adjusted downwards. Refer to Table 3 for appropriate reduction factors.

**Table 3. LOAD REDUCTION FACTORS FOR REDUCED EDGE DISTANCE – TENSION AND SHEAR LOADING**

| HLB Anchor Size <i>d</i>                        | M10  | M12  | M16  | M20  |
|---|--|------|------|------|
| Critical Edge Dist. <i>c</i> <sub>cr</sub> , mm | 165  | 200  | 240  | 315  |
| Min. Edge Dist. <i>c</i> <sub>min</sub> , mm    | 130  | 160  | 190  | 250  |
| Actual Edge Dist. <i>c</i> , mm                 | Reduction Factors $\psi_c$ for reduced edge distance |      |      |      |
| 130   | 0.70   |      |      |      |
| 150   | 0.87   |      |      |      |
| 160   | 0.96   | 0.70 |      |      |
| 165   | 1.00   | 0.74 |      |      |
| 190   |  | 0.93 | 0.70 |      |
| 200   |  | 1.00 | 0.76 |      |
| 220   |  |      | 0.88 |      |
| 240   |  |      | 1.00 |      |
| 250   |  |      |      | 0.70 |
| 270   |  |      |      | 0.79 |
| 285   |  |      |      | 0.86 |
| 315   |  |      |      | 1.00 |

- **Minimum edge distance *c*<sub>min</sub>**  
The minimum anchor-to-edge distance allowed.

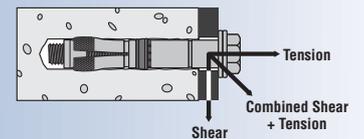
- **Group effect**  
In this drawing, Anchor #4 is the most unfavourably placed anchor in the group because it is close to two edges and two other anchors. If the spacing and edge distance criteria are not met, the safe working load for Anchor #4 must be multiplied by two spacing and two edge reduction factors.



**Group capacity.** The capacity of a group of anchors – in tension and shear – shall be the capacity of

the most unfavourably placed anchor in the group multiplied by the number of anchors in the group.

**• Combined Tension-Shear Loading**



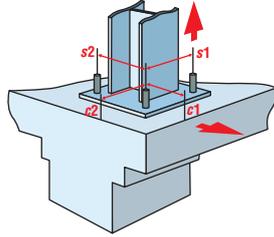
If the anchor is loaded in both tension and shear, the resulting combined load must satisfy the following equation:

$$\frac{\text{Actual tension load}}{\text{Safe working tension load}} + \frac{\text{Actual shear load}}{\text{Safe working shear load}} \leq 1.4$$



## CALCULATION EXAMPLE

Calculate the capacity of an anchor group consisting of 4 nos. M12 Tenn HLB Anchors installed in 25 N/mm<sup>2</sup> concrete. The anchor group is loaded simultaneously in tension and shear.



### Basic Principles

1. The safe working tension and shear capacity of an anchor is obtained by considering each load reducing effect due to close spacing and edge distance and then applying a reduction factor to the pre-adjusted safe working load.
2. The safe working tension capacity of a group of anchors is equal to the safe working tension load of the most unfavourably placed anchor within the group, multiplied by the number of anchors in the group.
3. The safe working shear capacity of a group of anchors is equal to the safe working shear capacity of the most unfavourably positioned anchor within the group, multiplied by the number of anchors in the group.

### Installation Geometry

- Embedment depth  $h_{ef}$ : 85 mm
- Concrete thickness  $h$ : 200 mm
- Anchor spacing:  $s_1 = 160$  mm,  $s_2 = 200$  mm (**Critical spacing is 240 mm**)
- Edge distances:  $c_1 = c_2 = 200$  mm (**Critical edge distance is 200 mm**)

### CALCULATION

Anchor #4 is the most unfavourably positioned anchor due to two spacing and two edge distances.

**Pre-adjusted safe working tension load: 11.2 kN**

**Pre-adjusted safe working shear load: 16.5 kN**

The load reduction factors  $\psi_s$  for Tenn M12 HLB Anchors installed at 160 mm and 200 mm spacing:

#### Tension - Reduced Spacing:

$s_1 = 160$  mm,  $\psi_{s1} = 0.70$

$s_2 = 200$  mm,  $\psi_{s2} = 0.83$

#### Shear - Reduced Spacing:

$s_1 = 160$  mm,  $\psi_{s1} = 0.70$

$s_2 = 200$  mm,  $\psi_{s2} = 0.83$

The load reduction factors  $\psi_c$  for Tenn M12 HLB Anchors installed 200 mm from a free edge:

#### Tension - Reduced Edge Distance:

$c_1 = 200$  mm,  $\psi_{c1} = 1.00$

$c_2 = 200$  mm,  $\psi_{c2} = 1.00$

#### Shear - Reduced Edge Distance:

$c_1 = 200$  mm,  $\psi_{c1} = 1.00$

$c_2 = 200$  mm,  $\psi_{c2} = 1.00$

Calculation for adjusted safe working tension and shear loads:

$$\begin{aligned} \text{Tension} &= SWL * \psi_{s1} * \psi_{s2} * \psi_{c1} * \psi_{c2} \\ &= 11.2 * 0.70 * 0.83 * 1.00 * 1.00 = 6.5 \text{ kN} \end{aligned}$$

$$\begin{aligned} \text{Shear} &= SWL * \psi_{s1} * \psi_{s2} * \psi_{c1} * \psi_{c2} \\ &= 16.5 * 0.70 * 0.83 * 1.00 * 1.00 = 9.6 \text{ kN} \end{aligned}$$

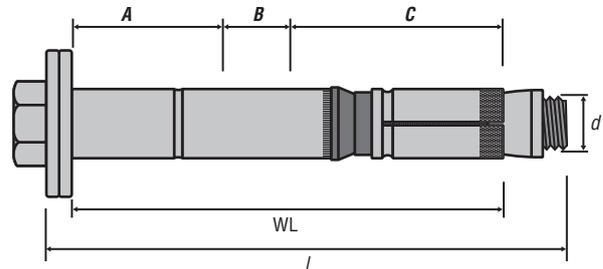
For said group of anchors, the safe working tension capacity is:  
(4 anchors) \* (6.5 kN per anchor) = 26.0 kN

For said group of anchors, the safe working shear capacity is:  
(4 anchors) \* (9.6 kN per anchor) = 38.4 kN

### CHECK COMBINED TENSION AND SHEAR LOADING INTERACTION:

$$\frac{\text{Actual tension load}}{\text{Safe working tension load}} + \frac{\text{Actual shear load}}{\text{Safe working shear load}} \leq 1.4$$

## LENGTH SELECTION



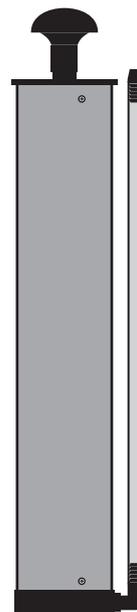
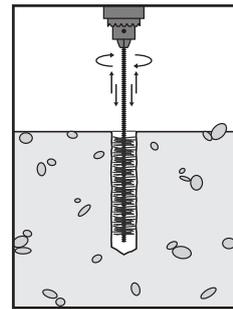
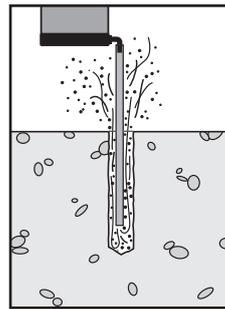
Select an anchor with sufficient working length WL to accommodate A+B+C (mm)

A. Thickness of attachment

B. Depth of any air space or non-structural layer

C. Embedment depth (minimum  $4*d$ )

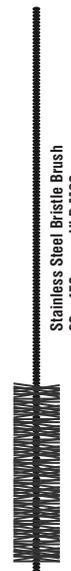
## HOLE CLEANING EQUIPMENT



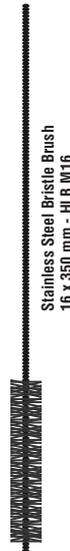
Blow-out Pump



Stainless Steel Bristle Brush  
26 x 550 mm - HLB M22



Stainless Steel Bristle Brush  
22 x 450 mm - HLB M20



Stainless Steel Bristle Brush  
16 x 350 mm - HLB M16



Stainless Steel Bristle Brush  
13 x 300 mm - HLB M12