



Restraining Chains for Hydraulically Operated Shoring Equipment

Restraining chains, historically referred to as “hanging chains”, are used to support the weight of hydraulically operated equipment against accidental movement from site equipment or from small ground movements. Restraining chains should never be used for lifting and therefore the Lifting Operations and Lifting Equipment Regulations 1998 (LOLER) do not apply.

LOLER defines lifting equipment as “work equipment for lifting or lowering loads”. Restraining chains are not (and must not be) used for lifting or lowering a load and therefore fall outside the scope of LOLER. Consequently the regime specified by LOLER for thorough examination is therefore NOT applicable to these chains.

The Provision and Use of Work Equipment Regulations 1998 (PUWER) however, require that all work equipment is maintained (Regulation 5) and inspected (Regulation 6) at suitable intervals and it is standard practice to inspect each restraining chain assembly before it is sent out on hire. This forms part of the supplier’s equipment maintenance procedures.

These chains are fitted with inspection tags prior to delivery. The tags confirm that an inspection procedure has been carried out.

The supplier will provide the user with a “Usage Guide” giving the instructions necessary for the correct use of the chains.

Two options are possible for the manner in which the chains are connected from the frame to the sheeting:-

1. The top frame is supported from the sheeting, with subsequent frames supported from the frame above;
2. All the frames are connected directly to the sheeting.

The Factor of Safety on the chain and its components shall not be less than 4. All restraining chain assemblies will have a stated rated capacity.

Users should note:-

- The user **MUST** use all the chains specified by the supplier;
- Only the chains supplied shall be used and shall be positioned as recommended;
- The user must ensure that the hook detail fitted to the top restraining chain is to be compatible with the type of sheet pile used;
- The attachment of the chain to the shoring equipment is to be as indicated by the supplier in the user guide.

Restraining chains are fitted with a shortening detail and the chains shall be adjusted so that the frame is maintained at its correct level. There shall be no more than one link slack in any chain. The maximum angle between the chain and the frame shall not be greater than 30° from the vertical in any plane.

Equipment Available

The range of hydraulically operated equipment available has increased in the last decade with much larger and heavier equipment being developed.

Examples of Restraining Chains in Use



Sheet Damage by Chain Hook



Poor Installation – Angle Greater than 30°

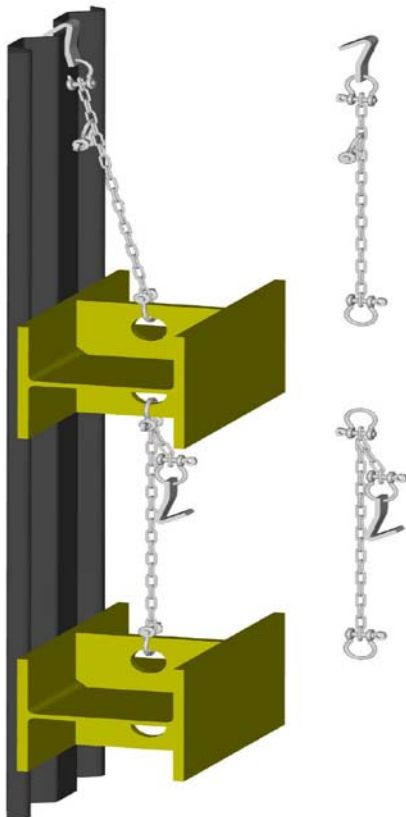


Illustration of Correct Installation



Example of Correct Installation with Class B Chains



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The Use of Restraining Chains to Support Shoring Equipment

Equipment Weight Class

Hydraulically operated equipment can be easily divided by weight into two groups:-

Class	Typical Equipment	Restraining Chain Requirements
Class A	<ul style="list-style-type: none"> • Waler frames in aluminium and steel • Manhole braces up to 5.0metre leg length • Vertical shores 	For these frames the load per chain does not exceed 1.0 Tonne. Class A chains shall not be used where more than two frames are suspended.
Class B	All frames where the load per chain exceeds 1.0 tonne.	The design loading for Class B Restraining Chains is defined by EN 14653-1 clause 7.10. (See pages 5 & 6). All STIG members supply chains that conform to this standard.

The Choice of Chain for Class A

These systems are light in weight and commercial chains and associated components can be used. The specification of these chains and their components shall define the breaking load and the working load.

The number of chains necessary and their location shall be defined. These chains do not require any numbering or traceability records.

The Choice of Chain for Class B

These are heavy systems and the chain and its components shall be as a minimum Grade 8 conforming to EN 818. High yield long link chains may also be used, subject to documentation being available to prove an equivalent tensile load capacity.

It is the nature of these chains that the top level is required to 'hook' over the top edge of the sheet and that the hook is designed so that damage to the sheet is minimised. The hook type must relate to the sheet piles used. The number, location and spacing of the chains shall be defined.

Maintenance of Restraining Chains

All restraining chains and their components shall be visually inspected by a competent person after every hire. The visual inspection shall reject any chain for the following reasons :-

- Obvious damage;
- Chain stretch that exceeds a maximum of 10%;
- Hook deformation;
- Missing components.



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Do's and Don'ts

Do	Do Not
<ol style="list-style-type: none"> 1. Ensure that personnel who are to use the equipment have received the appropriate instruction and training. 2. Check all components are correct before use. 3. Position the chains as per the job site drawing of the instruction data issued with the equipment. 4. With the frame positioned by the excavator or crane adjust any excess slack in the chain. 5. Ensure that all shackle pins are fully screwed home. 6. Inspect the chains regularly for signs of excessive overloading. 7. Ensure that the inspection tag is in place before use. 8. Ensure that the supplier's user guide instructions have been read. 	<ol style="list-style-type: none"> 1. Use the chains for lifting or lowering operations. 2. Twist or knot the chain. 3. Load the chain significantly. 4. Use non-standard components. 5. Use damaged or non-conforming components. 6. Wrap chains unless approved by the supplier.

Extract from EN 14653-1:2003 - *Manually operated hydraulic shoring systems for groundwork support.*

7.10 Restraining chain

7.10.1 General

The minimum characteristic resistance of a restraining chain is R_{KT} .

A restraining chain may include hooks, shackles and shortening clutches. The strength requirements shall apply in the weakest configuration of use.

Allowance shall also be made for any mal-distribution of load that may occur due to non-symmetrical arrangements of the assembly.

The restraining chain shall be secured to the top of the sheet piling (see Figure 13).

NOTE 1 Proprietary suppliers normally specify the characteristic tensile resistance of a restraining chain assembly R_{KT} and reference should be made to either EN 818 or commercial manufacturers of long link chains.

The minimum theoretical number of restraining chain assemblies supporting shall be obtained from expression (2). For practical application, this shall be rounded up to the nearest whole number.

$$N_b = \frac{(W_F + W_A) \times N_F \times \gamma_{NB}}{R_{KT}} \tag{2}$$

where

N_F is the number of frames;

N_b is the minimum number of chains supporting one frame;

W_F is the total mass of a frame.

W_A is maximum mass of any ancillary equipment. e.g. intermediate struts;

γ_{NB} is a partial safety factor applied to the chain with a recommended value of 4 (see Annex A).

For Class A frames the minimum value of R_{KT} shall be 20 kN.

For Class B frames the minimum value of R_{KT} shall be 40 kN.

NOTE 2 The value of γ_{NB} represents a partial safety factor to cover the maltreatment of chains.

NOTE 3 Restraining chains are not defined as lifting equipment.

Extract from EN 14653-1:2003 - continued

NOTE 4 The number of chains used should allow for the maximum load applied including allowances for additional loads from supplementary equipment, for example bracing struts and knee braces, where these are to be used with this equipment.

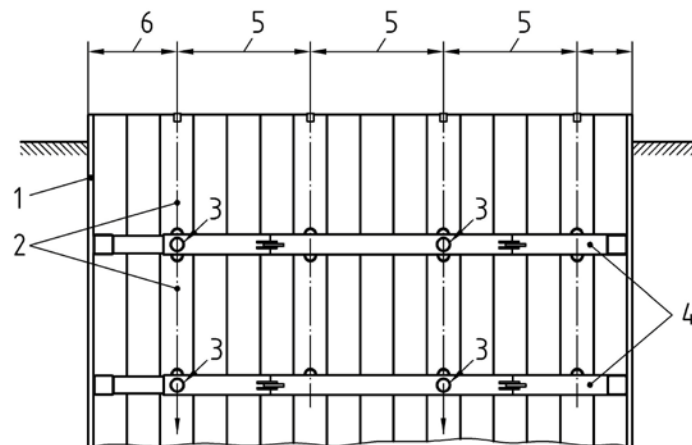
7.10.2 The maximum spacing in metres (s) between adjacent restraining points on a hydraulic bracing frame leg or a waler rail shall be given by the following Equation (3):

$$s = \frac{R_{KT}}{N_F \times \gamma_{NE} \times m} - \frac{W_A}{m} \tag{3}$$

where

m is the maximum mass per metre of the rail. Definitions of other symbols are given in 7.9.

Figure 18 shows the basis of the equation.



Key

- | | |
|--|---------------------------------|
| 1 Sheet pile | 4 Hydraulic bracing frame leg |
| 2 Restraining chain | 5 Spacing of hanging chains |
| 3 Waler loading from ancillary equipment | 6 End spacing of hanging chains |

NOTE 1 It is assumed that the load (*W_A*) acts coincident with the restraining chain.

NOTE 2 The end spacing (6) of hanging chains is usually half the general spacing (5).

Figure 18 — Spacing and loading of restraining points

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