

TRINITY HOUSE

MOORING CHAIN SPECIFICATION

NAVIGATION BUOY MOORINGS

(excluding clenching shackles)

Trinity House Specification No. S015

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SPECIFICATION S015			TH Mooring Chain Specification Navigation Buoy Moorings	
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1 Scope

This Specification covers the manufacture, inspection, testing and finishing of steel chains, shackles, bridle assemblies and swivels used for GLA Navigation Buoy Moorings.

The General Lighthouse Authorities comprise Trinity House Lighthouse Service (THLS), Northern Lighthouse Board (NLB) and Commissioners of Irish Lights (CIL).

Details of clenching shackles, which may be used with NLB and CIL moorings, are included in Trinity House Specification No. S008: Major Floating Aid Moorings.

2 Reference Drawings and Standards

The chain, bridle and shackles shall be sized and formed in accordance with the relevant TH Drawing(s) listed below:

Mooring Bridles	Drg. No. YBB/1
Open Link Chain	Drg. No. YBD/1
Chain Link Component Details	Drg. No. YBD/1
Triangular Links and Swivels	Drg. No. YBD/3
Shackles	Drg. No. YBD/2

Mooring Bridles for CIL buoys shall be sized and formed in accordance with CIL requirements included on TH drg No. YBB/1

Where called for all chain and shackles shall conform to the recommendations of the following international and British Standards:

- BS EN 10083-1: Steels for quenching and tempering
- BS ISO 1834: Short link chain for lifting purposes
- ISO 2415, (Grade M4), Forged shackles for general lifting purposes
- BS EN 13889: Forged steel shackles for general lifting purposes Grade 6 - Safety
- BS 3416 Bitumen-based coatings for cold application
- BS EN ISO 6506-1: Metallic materials. Brinell hardness test.
- BS EN ISO 6892-1: Metallic materials. Tensile testing.

3 Material Specification

Steel: 28Mn6 + QT to BS EN 10083-1 or
U3 to Lloyds Rules

Heat treatment is described in Section 7.

Material shall be identifiable throughout the manufacturing process.

4 Chain Form, Dimensions and Manufacture

The standard length of chain is 100 metres. Lengths of 25m and 50m may also be ordered.

The size of chain specified refers to the basic diameter of the material forming the common links of the chain. All finished dimensions are to comply with THLS Drg. No. YBD/1.

The chains are to be of the open link type with pitched links well formed, butt welded with all surplus weld material removed, to allow each link to bed properly and have free movement.

26mm size chains are to have one intermediate link and one end link at each end of the common links.

5 Bridle Assemblies and Swivels: Form, Dimensions and Manufacture

Complete bridle assemblies are to be supplied as shown on the Schedule and THLS Drg. No. YBB/1, including swivels complying to THLS Drg. No. YBD/3 and chain complying to THLS Drg. No. YBD/1.

All swivels are to be accurately formed so that the bow can be freely rotated on the swivel eye pin without excess clearance.

The transition from the threaded part to the eye shall be smooth with rounded thread undercut to avoid stress concentration.

The retaining cap shall be secure on the eye by both screw thread and welding, the locking pin being securely welded in position.

6 Shackle Form, Dimensions and Manufacture

Shackles shall be of special form as detailed on THLS Drg. No. YBD/2. The size of shackle specified refers to the body section diameter.

All shackles are to have properly rounded bodies and neatly shaped eyes, where the fit between the pin and bow shall be as laid down in THLS Drg. No. YBD/2. The latter may be achieved with greater consistency if grinding of the bolts is carried out after heat treatment.

Shackles are to be fitted with split forelock cotters which are to be a snug fit in accurately slotted holes provided in the ends of the pins. THLS Drg. No. YBD/2 refers.

The cotter pin may be manufactured from S275N or S275NL, to BS EN 10025 part 3, or equivalent.

7 Heat Treatment

After forging and welding, and before being proof loaded all items are to be heat treated as prescribed in BS 10083 or Lloyd's Rules.

A Thermal history report shall be produced for each batch.

Test pieces from finished items are to have a Brinell hardness number in the range 179 – 255.

8 Certification

All items shall be inspected, and the proof tests witnessed by a GLA Engineer or inspection authority approved by a GLA Engineer. The Inspector is to be given, where possible, two weeks notice prior to the commencement of any testing.

A non-destructive examination shall be carried out on assemblies that require proof testing. This should be by either 100% Magnetic Particle or Liquid Penetrant Examination.

Any item showing signs of burning, folds, laps or other defects shall be rejected.

All chains, bridles and shackles are to be kept clean and free from any coating until after they have been inspected, tested and approved by the Inspector.

Certificates shall be provided:

- material certificates of all original material used including identification of the steel mill; chemical analysis; results of Charpy impact tests preferably at 0°C, the test temperature being quoted
- certification of heat treatment of all finished items, mechanical properties including surface Brinell Hardness and Core Brinell Hardness of samples
- proof test and examination certificates
- break load test certificates
- certificates of conformity including
 - Manufacturers name
 - Drawing/specification numbers and issues
 - Reference to material and test certificates, all certificates being traceable to the material used and the product
 - Identification of test houses used
 - Identification of inspectors
 - Identifying marks on items
 - Confirmation that the material, form, dimensions and test results comply with the Specification.

Full certification must be available at the time of inspection. Items should not be despatched until the TH Engineer or representative has approved all certification.

9 Chain Inspection

The dimensions of chain links over the length of the chain shall be measured to check compliance with THLS Drg. No. YBD/1, including the material diameter around the entire link, outside length, and outside width.

10 Bridle Assemblies and Swivel Inspection

Chain links within bridle assemblies shall be inspected as Section 9 above.

Swivels shall be inspected by a TH Engineer to check dimensional compliance against THLS Drg. No. YBD/3 including the material diameters around the triangular link, eye, and bow. The welding of the retaining cap and locking pin shall be visually inspected for weld quality, form and size.

The TH Inspector, prior to assembly, may also inspect the swivel eyes, bows, retaining caps and locking pins. The Supplier is to advise the Inspector when these components are available for inspection.

11 Shackle Inspection

Shackles shall be inspected by a TH Engineer to check form and dimensional compliance with THLS Drg. No. YBD/2 and this specification.

A non-destructive examination shall be carried out on assemblies that require proof testing. This should be by either 100% Magnetic Particle or Liquid Penetrant Examination.

Any item showing signs of burning, folds, laps or other defects shall be rejected.

12 Chain

Size (mm)	Proof Load (Tonnes)	Min. Break Load (Tonnes)	Min. Energy Absorption for a 1 metre Test Length (Joules)
26	16.9	42.25	92600
32	25.6	64.00	140300
38	36.1	90.25	197800
42	44.1	110.30	241700

Table 1 Chain Test Loads

The measured extension shall also not be less than 0.167 x original test length. The extension measured shall be taken as a combination of the extension due to both the elastic behaviour and plastic deformation taking place in the material. As such the Supplier must provide a facility to record the ultimate extension just prior to the fracture of a link.

Corresponding minimum extensions of a 3 link test sample can be obtained by referencing Graph 1, Appendix D.

13 Bridle Proof Testing and Break Test

Bridle assemblies and swivels are to be proof tested to the loads given in Table 1 for the bridle chain size. Each leg of the bridle including the swivel and chain links attached to the bow is to be tested in turn. Separate swivels are to be tested including the chain links attached to the bow, and both sets of links attached to the triangular link in turn.

The form and free movement of the chain and swivel, including free rotation of the bow on the eye pin shall be checked after the proof test and the chain and swivel visually inspected for defects.

Sufficient additional links of bridle chain shall be produced to enable break load tests to be undertaken on test lengths from one leg of every 10 bridles, the tests being undertaken as Section 12 above.

Sufficient bridle assemblies or separate swivels shall be made to allow for break load testing of one swivel from every 25 bridle assemblies and separate swivels. For these purposes, batches of less than 25 shall be treated as being of 25 items. The swivel

or bridle assembly shall be randomly selected by the Inspector for test to the minimum break load specified in Table 1 for the chain/swivel size. The loaded part shall include the swivel, chain links attached to the bow, and one set of chain links attached to the triangular link.

The Inspector may request that the swivel is sectioned through the retaining cap and the transition where the eye is enclosed by the bow. If the swivel is found to have cracks; acute angles at the transition or thread undercut; poor thread form; or the retaining cap and locking pin are insecurely welded, which arise from poor manufacture, the whole batch of swivels may be rejected.

14 Shackle Proof Testing and Break Test

All shackles are to be proof tested to the appropriate loads given in Table 2, the proof load being applied at the centre of the pin.

Size (mm)	Working Load Limit (Tonnes)	Proof Load (Tonnes)	Minimum Break Load (Tonnes)
35	9.1	18.2	36.4
46	16.4	32.8	65.6

Table 2 Shackle Test Loads

Working Load Limit (WLL) shall be calculated in accordance with BS6994 Appendix D. The form of the shackle, fit of the pin and cotter pin, and withdrawal of the pin shall be checked after the proof test, and all items visually inspected for defects.

Sufficient shackles shall be made to allow the minimum break loads given in Table 2 to be applied to one shackle out of every 25 of the same size. If a batch consists of less than 25 shackles one shall be made to allow for the break load test.

15 Identification

Items approved by the Inspector shall be stamped and certified (see Appendices A-C) on site. They shall then be recommended to the GLA Engineers as acceptable and thence the ordering departments within the GLAs for acceptance subject to final treatment (see 16) being satisfactorily carried out.

All lengths of chain are to have their end links stamped with the following information:

- Manufacturer's ID
- Manufacturer's serial number
- Month and year of manufacture
- Proof load applied

Shackles are to be stamped with identical information.

All non-conforming material and product shall be identified and segregated from the conforming product.

Non-conforming product where rework or concession is not approved by the Inspector and GLA Engineer(s) should be scrapped, including all items which have been subjected to break load tests.

16 Finish

The entire order of chains, shackles etc., are to be thoroughly wire brushed and painted with a good quality bitumen coating to BS Specification 3416 Type 1 all surfaces.