



TABLE OF EFFICIENCY FACTORS

TERMINATION EFFICIENCY - NORMALLY TAKEN AS 0.75										
BENDING EFFICIENCY:										
PIN DIAMETER	<0.8	0.8	0.9	1.0	1.5	2.0	3.0	4.0	5.0	6.0
ROPE DIAMETER										
EFFICIENCY	NOT ADVISED	0.44	0.47	0.50	0.59	0.65	0.71	0.75	0.78	0.80



## 6 THE CRANE AND CRANE VESSEL

### 6.1 Hook load

6.1.1 The hook load shall be shown not to exceed the allowable crane capacity as taken from the load-radius curves.

6.1.2 The allowable curves as presented may sometimes include dynamic effects. If a suitable statement is received to this effect, the hook load may, for comparison with the load-radius curves, be derived from the gross weight, rather than the lift weight.

6.1.3 Some crane curves specify different allowable load curves for different seastates. These may similarly be taken to include dynamic effects. A seastate representing the probable limits for the operation should be chosen, and the gross weight used.

### 6.2 Documentation

Where Approval is required, the documentation as stated in Section 15 shall be submitted.

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## 7 STRUCTURAL CALCULATIONS

### 7.1 Load cases and structural modelling

7.1.1 Structural calculations, based on the load factors discussed above, shall include adequate loadcases to justify the structure. For example, for an indeterminate, 4-point lift the following loadcases should normally be considered;

- a. Base case, using lift weight, resolved to the lift points, but with no skew load factor.
- b. Lift weight, with skew load factor applied to one diagonal.
- c. Lift weight, with skew load factor applied to the other diagonal.

7.1.2 In all cases the correct sling angle and point of action, and any offset or torsional loading imposed by the slings shall be considered.

### 7.2 Structure

7.2.1 The overall structure shall be analysed for the loadings shown in Section 7.1.

7.2.2 The primary supporting members shall be analysed using the most severe loading resulting from Section 7.1, with a consequence factor of 1.15 applied (see Section 5.15).

### 7.3 Lift points

7.3.1 An analysis of the lift points and attachments to the structure shall be performed, using most severe load resulting from Section 7.1, and a consequence factor of 1.35 (see Section 5.15). The 5% side load (Section 5.7) should also be applied, as should any torsional load resulting from the 45:55 2-part sling loading (Section 5.10), if applicable.

7.3.2 Where the lift point forms a structural node, then the calculations shall also include the loads imposed by the members framing into it.

### 7.4 Spreader bars or frames

Spreader bars or frames, if used, should be similarly treated, with loadcases as above. A consequence factor of 1.35 shall be applied to lift points, and 1.15 applied to members directly supporting the lift points, in accordance with Section 5.15.

### 7.5 Allowable stresses

7.5.1 Stress levels shall be within those permitted by the latest edition of a recognised and applicable offshore structures code. The loading shall be treated as a normal serviceability level functional load with associated load/resistance or safety factors (in a Working Stress code, the one third increase for environmental loadings shall not be allowed; similarly for an LRFD/partial factor code the load factor would be greater than that used for ultimate conditions).



a. The total load factor shall not be less than the product of all the factors required by Section 5, multiplied by a further factor of 1.30.

b. The material reduction factor shall be not less than;

Elastic design of steel structures; - 1.15

Plastic design of steel structures;	1.30
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[illegible]



## 8 LIFT POINT DESIGN

In addition to the structural requirements shown in Sections 5 and 7, the following should be taken in to account in the lift point design;

### 8.1 Sling ovalisation

Adequate clearance is required between cheek plates, or inside trunnion keeper plates, to allow for ovalisation under load. In general, the width available for the sling shall be not less than  $(1.25D + 25\text{mm})$ , where D is nominal sling diameter. However, the practical aspects of the rigging and de-rigging operations may demand a greater clearance than this.

### 8.2 Plate rolling and loading direction

8.2.1 In general, for fabricated lift points, the direction of loading should be in line with the plate rolling direction. Lift point drawings should show the rolling direction.

8.2.2 Through thickness loading of lift points and their attachments to the structure should be avoided if possible. If such loading cannot be avoided, the material used shall be documented to be free of laminations, with a recognised through-thickness designation.

### 8.3 Pin Holes

Pin-holes should be bored/reamed, and should be designed to suit the shackle proposed. Adequate spacer plates should be provided to centralise shackles.

### 8.4 Cast Padears

Cast padears shall be designed taking into account the following aspects;

- The geometrical considerations as indicated in Section 8.1
- The stress analysis process
- The manufacturing process and quality control.

### 8.5 Non-Destructive Testing

8.5.1 The extent of non-destructive testing shall be submitted for review.

8.5.2 Where repeated use is to be made of a lift point, a procedure should be presented for re-inspection after each lift.

**9 CLEARANCES**

The required clearances will depend on the nature of the lift, the proposed limiting weather conditions, the arrangement of bumpers and guides and the size and motion characteristics of the crane vessel and the transport barge.

Subject to the above, for offshore lifts, the following clearances should normally be maintained at each stage of the operation. Smaller clearances may be acceptable for inshore or onshore lifts.

**9.1 Clearances around lifted object**

- 9.1.1 3m between any part of the lifted object (including spreaders and lift points) and crane boom.
- 9.1.2 3m vertical clearance between the underside of the lifted object and any other previously installed structure, except in the immediate vicinity of the proposed landing area.
- 9.1.3 3m between the lifted object and other structures on the same transport barge.
- 9.1.4 3m horizontal clearance between the lifted object and any other previously installed structure, unless purpose-built guides or bumpers are fitted.
- 9.1.5 3m remaining travel between travelling block and fixed block at maximum load elevation.

**9.2 Clearances around crane vessel**

- 9.2.1 Where the crane vessel is moored adjacent to an existing platform, 3m between any part of the crane vessel and the platform and 10 m between any anchor line and the platform.
- 9.2.2 Where the crane vessel is dynamically positioned, 5m nominal between any part of the crane vessel and the platform.
- 9.2.3 3m between crane vessel and seabed, after taking account of tidal conditions, vessel motions, increased draft and changed heel or trim during the lift.

**9.3 Clearances around mooring lines and anchors**

- 9.3.1 The clearances stated below are given as guidelines to good practice. The specific requirements and clearances should be defined for each project and operation, taking into account particular circumstances such as;

- water depth
- proximity of subsea assets
- survey accuracy
- the control ability of the anchor handling vessel
- seabed conditions
- estimated anchor drag during embedment
- the probable weather conditions during anchor installation.

Operators and contractors may have their own requirements which may differ from those stated below, and should govern if more conservative.

- 9.3.2 Clearances should take into account the possible working and stand-off positions of the crane vessel.
- 9.3.3 Moorings should never be laid in such a way that they could be in contact with any subsea asset. This may be relaxed when the subsea asset is a trenched pipeline, provided it can be demonstrated that the mooring will not cause frictional damage or abrasion.
- 9.3.4 Moorings shall never be run over the top of a subsea completion or wellhead.
- 9.3.5 Whenever an anchor is run out over a pipeline, flowline or umbilical, the anchor shall be securely stowed on the deck of the anchor handling vessel. In circumstances where either gravity anchors or closed stern tugs are used, and anchors cannot be stowed on deck, the anchors shall be double secured through the additional use of a safety strap or similar.
- 9.3.6 The vertical clearance between any anchor line and any subsea asset should be not less than 20 metres in water depths exceeding 40 metres, and 50% of water depth in depths of less than 40 metres.
- 9.3.7 Clearance between any mooring line and any structure other than a subsea asset should be not less than 10 metres.
- 9.3.8 When an anchor is placed on the same side of a subsea asset as the crane vessel, it should not be placed closer to the subsea asset than 100 metres.
- 9.3.9 When the subsea asset lies between the anchor and the crane vessel, the final anchor position should be not less than 200 metres from the subsea asset.
- 9.3.10 During lifting operations, crossed mooring situations should be avoided wherever practical. Where crossed moorings cannot be avoided, the separation between active catenaries should be not less than 30 metres in water depths exceeding 100 metres, and 30% of water depth in water depths less than 100 metres.
- 9.3.11 If any of the clearances specified in Sections 9.3.6 through 9.3.10 are impractical because of the mooring configuration or seabed layout, a risk assessment shall be carried out and special precautions taken as necessary.



## 10 BUMPERS AND GUIDES

For module installation the arrangement and design philosophy for bumpers and guides shall be submitted, where applicable. In general, bumpers and guides should be designed in accordance with the following;

### 10.1 Module movement

The maximum module movement during installation should be defined. In general the module motions should be limited to;

- Vertical movement;  $\pm 0.75$  m
- Horizontal movement;  $\pm 1.50$  m
- Longitudinal tilt; 2 degrees
- Transverse tilt; 2 degrees
- Plan rotation; 3 degrees

The plan rotation limit is only applicable when the module is close to its final position.

### 10.2 Position of bumpers and guides

The position of bumpers and guides shall be determined taking into account acceptable support points on the module.

### 10.3 Bumper and guide forces

Bumpers and guides should be designed to the following forces (where W = lift weight);

#### a) Vertical sliding bumpers

Horizontal for in plane of bumper;  $0.10 \times W$

Horizontal (friction) force, out of plane of bumper;  $0.05 \times W$

Vertical (friction) force;  $0.01 \times W$

Forces in all 3 directions will be combined to establish the worst design case.

#### b) Pin/bucket guides

Horizontal force on cone/end of pin;  $0.05 \times W$

Vertical force on cone/end of pin;  $0.10 \times W$

Horizontal force in any direction will be combined with the vertical force to establish the worst design.

#### c) Horizontal "cow-horn" type bumpers with vertical guide

Horizontal force in any direction;  $0.10 \times W$

Vertical (friction) force;  $0.01 \times W$

Horizontal force in any direction will be combined with vertical force to establish the worst design case.





d) Vertical "cow-horn" type guide with horizontal bumper

Horizontal force in any direction;  $0.05 \times W$

Vertical force on inclined guide-face;  $0.10 \times W$

Horizontal force in any direction will be combined with vertical force to establish the worst design case.

10.4 Design considerations

10.4.1 The connection into the module, and the members framing the bumper or guide location, should be at least as strong as the bumper or guide.

10.4.2 The stiffness of bumper and guide members should be as low as possible, in order that they may deflect appreciably without yielding.

10.4.3 Design of bumpers and guides should cater for easy sliding motion of bumper in contact with guide. Sloping members should be at an acute angle to the vertical. Ledges and sharp corners should be avoided on areas of possible contact, and weld beads should be ground flush.



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**UNDERWATER LIFTING**

If any part of the lift operation includes lifting or lowering through water, information shall be submitted, which either;

- shows how the total in-water lifting loads are derived, taking into account the weight, buoyancy, entrained mass, boom-tip velocities and accelerations, inertia and drag forces, or
- Demonstrates that the in-water case is not critical.