

Crane Specification Document



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IMCA M 171 Rev. 1

This document supersedes IMCA M 171 (issued in July 2003) which has now been withdrawn.

This document includes new sections on man-riding and personnel lifting; and certification and documentation of multi-layer winches.

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Crane Specification Document

IMCA M 171 Rev. 1 – May 2013

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I Introduction

This document was originally published in July 2003. It has recently been reviewed and now contains updated sections on man-riding and personnel lifting (section 3.7) and the certification and documentation of multi-layer winches (section 7.3).

I.1 Summary

- I.1.1 The document discusses the various aspects of crane design and performance in general terms only and intends to make the customer aware of the various options available for consideration. The intention is that the customer will approach the crane provider with a functional specification that contains the minimum of technical requirements. The crane provider can then respond describing how it intends to meet the functional requirements. This response will contain a detailed technical specification. The final design of the crane can then be agreed at further clarification meetings. Offshore crane design is unique in that almost every new build crane will be a one-off in some respect in order to meet the customer's specific requirements. It is recognised that many customers have extensive experience of crane purchase and it would be expected that the customer and manufacturer would interact early in the design stage to ensure that the best crane for the job is designed, purchased and installed. It is hoped that, by involving both customers and providers in the drafting of this document, a useful tool is developed which will ensure that all aspects of the crane's design and performance are understood and discussed at the earliest possible stage in the process. It is intended that this document can equally be used by customers either purchasing a new crane for installation on their vessel or chartering a vessel in order to carry out a lifting operation using that vessel's crane. Where the term 'manufacturer' or 'provider' is used, it should be understood that these terms are interchangeable depending upon whether the purchase or charter of a crane is being discussed. This document can also be used for the specification of other lifting appliances used for lifting in an offshore environment.

I.2 Layout of This Document

- I.2.1 This document is in three parts. The first part contains the explanatory notes designed to aid the user in application of the questionnaire which forms the second part (Appendix 1).
- I.2.2 The questionnaire forming the second part is in the format of a table intended for use in an enquiry or request for quotation or contract to provide a crane. It is clearly referenced to the relevant parts of the explanatory notes.
- I.2.3 The third part consists of a brief checklist (Appendix 2) which can be used as an information exchange when chartering a crane vessel.

The crane specification is naturally quite detailed, as it is meant to assist in the provision of cranes required for a range of purposes. It is intended to be tailored to suit individual companies' needs as required in the various stages of developing the crane specification.

2 Functional and Technical Specification

2.1 Crane's Functional Purpose

- 2.1.1 The customer should give as much information as possible regarding the crane's intended purpose. This may seem obvious but good information at this stage will greatly assist the provider in supplying the best crane for the job. Using a crane for tasks outside its design intent significantly increases safety risks, crane failures and downtime. Most of the detail of the crane's intended use is contained in subsequent sections but at this stage the customer should detail:
- General description of the type and size of the vessel (including flag and classification society) and the intended use of the crane, e.g. internal lifts, subsea construction, retrieval of loads from subsea, remotely operated vehicle (ROV) support, supply vessel operations, vessel to vessel lifts, vessel to platform lifts and personnel lifting, i.e. is it to be a marine crane or an offshore crane?
 - Where will the crane be used – in port, at sea, subsea or surface only?
 - Will the crane be required to perform personnel transfer operations?
 - An indication of the design loads, life and estimated average running time.
 - A visit to the vessel by a representative of the crane provider may be beneficial if it can be arranged.

2.2 Crane Arrangement

- 2.2.1 Where does the customer intend to place the crane? Forward, aft or amidships? Does it need to be on the centreline to serve both sides of the vessel or towards one side to favour the vessel's usual operations? Vessel motions are greater towards the bow and stern of the vessel and therefore, in this respect, the ideal location for a crane which is to be used for offshore work will be nearer the midship section of the hull. A crane placed towards the port or starboard sides of the vessel will be able to take advantage of the greater strength which generally exists in the hull at these points.

Does it need to reach the quayside or the sea surface on both sides of the vessel? Is it desirable to place the crane outside of the hull, i.e. on a box section? Is the crane to be located adjacent to a helideck? What space is available for mounting the crane? If space is extremely tight then certain types of crane with a smaller footprint may need to be considered.

What degree of rotation is required? In most cases this will be 360° but occasionally this may be reduced if the crane is to be located flush against an accommodation block for example ('bulkhead' cranes). There may be cost savings to be made by utilising cable chains instead of slip rings or hydraulic joints in cranes which are restricted to less than full rotational freedom. Mast cranes which have the winches mounted in or near the base of the crane can achieve approximately 400° of rotation (i.e. one full rotation plus 40° before having to reverse direction). The operator has to be aware of where the 0° point lies, as this cannot be crossed. For handling of items on deck this can be limiting.

If the crane is required to operate in hazardous areas then it will need to be built to, or be suitable for, the applicable electrical standards. However, careful consideration of the actual extent of the hazardous area can reduce the amount of upgrading of the crane required and still achieve hook coverage into the hazardous area. This can be achieved by only having the boom or part of the boom rated for hazardous areas or by raising the crane machinery room, cab and jib above the hazardous area.

- 2.2.2 Consideration should be given to the location of the boom and hook rest. On larger cranes this may be a substantial structure in itself and will take up a sizable deck area. The customer may require the crane provider to design and supply the boom rest but typically the crane provider will supply information concerning the dimensions and weights involved and leave the actual design and construction to the customer's subcontractor.

2.3 Vessel Motions

- 2.3.1 Information regarding the vessel's motions is vital in assisting the crane manufacturer in designing, or the provider in specifying, a crane which will fulfil the customer's expectations. Crane manufacturers differ with regards to the format in which the information is to be presented. Some manufacturers

ask for basic pitch, roll and heave information in order that they can calculate the accelerations of the boom tip in various positions. Some manufacturers require these accelerations to be provided by the customer. This information is needed for various wave heights up to say 6m and for the worst case wave angle (normally from the vessel's beam). In the case of a vessel new build, this information initially may not be available but it is important that as much information on this subject is given to the crane manufacturer at the earliest stage possible. If the information is not forthcoming then the crane manufacturer will most likely make assumptions erring on the safe side. This may result in unnecessary de-rating of the crane.

- 2.3.2 Vessel motions will be used to define off and side lead angle limits, strength of structural components, weather limitations and requirements for the design of heave compensation systems.

2.4 Crane Type

- 2.4.1 Mast crane: As the name implies, a mast crane consists mainly of a steel mast welded to the deck. Only the jib and mast head rotate. Around the mast there are two rotatable rings – the slew platform which has the jib and its pivots, the control cabin and tigger winches if required – and the masthead with the connection for the luffing tackles and the main hoists. The masthead is fitted on a slew bearing and is free to rotate to follow the direction of the luffing tackles.

The advantages/disadvantages of a mast crane are:

- a) The load moment is transferred through the mast construction rather than the slew bearing, which makes the slew bearing less critical;
- b) A mast crane will be slightly heavier than a similar sized pedestal crane;
- c) Smaller installation area for larger cranes because a large diameter slew bearing is not needed but more headroom is needed;
- d) Vertical lashing of jib may be possible;
- e) Possible limited tail swing;
- f) The additional costs of a mast crane due to the extra steelwork in the mast mean that the savings to be made in the slew bearing may only become apparent as the size of the crane increases.

- 2.4.2 Pedestal crane: The most common type of crane consists of a steel crane house bolted to the pedestal via a slew bearing. The winches, hydraulic equipment, electrical cabinets, jib pivots, luffing tackles, hydraulic rams and control cabin are all attached either inside or outside the crane house. The slew bearing is a critical part of the pedestal crane and there are various measures that the customer can take in order to reduce the likelihood of having to routinely replace the bearing, an expensive and time consuming task. These include fitting of internal crack monitoring equipment, routine grease sampling and analysis and the fitting of load data recording equipment which will maintain a history of lift cycles, total loading and any overload conditions. Use of these measures can mean that it is possible for classification societies to allow the original slew bearing to last for the design life of a crane.

The advantages/disadvantages of a pedestal crane are:

- a) Equipment can be housed inside the crane house. No equipment within the hull or on deck;
- b) Generally lighter than a similar sized mast crane;
- c) Simple interface with vessels structure;
- d) Can be mounted on the side of the hull due to simple interface;
- e) Generally less headroom is needed than with a mast crane.

2.5 Boom Type

- 2.5.1 There are four main types of boom or jib to consider – box section (which may be a single box or A-frame construction), lattice construction, knuckle boom and telescopic. The type of boom supplied may be influenced by other characteristics of the crane such as safe working load (SWL) and reach but the following should be borne in mind by the customer:

- 2.5.2 Box section booms come in all sizes from a simple one tonne (1t) stores crane to heavy lift applications in excess of one thousand tonnes (1000t). As the size increases then the design is likely to change from a single box to an A-frame style consisting of a framework of box girders.

The advantages/disadvantages of box booms include:

- a) Lower construction and installation costs than other types of boom;
- b) Less maintenance than other boom types;
- c) More flexible than a lattice boom – better spring constant characteristics – which leads to better de-rating curves, i.e. can be used safely in worse environmental conditions with less weather downtime;
- d) Because a box boom is likely to be a ‘ram luffing’ boom there is less uncontrolled boom motion in rough weather (changes in load on a wire luffed boom could allow movement of the boom);
- e) Short working radius where ram luffing is used;
- f) Lower centre of gravity where ram luffing is used;
- g) Boom is more resistant to damage from swinging loads;
- h) Ability to place sheaves along boom, giving the option of heavy lift rigging at shorter radius;
- i) No wire is needed for luffing – saving in purchase and maintenance cost.

2.5.3 Lattice booms are commonly used on platforms and occasionally on vessels for mid range lifting capacity or long outreach applications.

Some of the advantages/disadvantages of lattice booms are:

- a) The boom length (if so designed) may be easily changed by adding or removing modular sections;
- b) Lattice booms of 40m or longer will be lighter than equivalent box booms;
- c) Because the lattice boom design is not capable of withstanding great bending moments or shear forces, this type of boom will require a wire luffing system;
- d) Nearly all lifts should be from the boom tip because alternative lifting points of any size cannot be placed along the boom because of the reasons stated in c).

2.5.4 Knuckle boom (or articulated boom) cranes are becoming increasingly popular on vessels and other floating structures such as floating production storage and offloading units (FPSOs) and semi-submersibles despite the greater cost when compared to a fixed box boom.

The advantages/disadvantages of knuckle booms are:

- a) The pendulum effects which can be induced on a suspended load due to vessel motions can be substantially reduced because the boom tip can often be positioned very close to the lifting point of the load thereby keeping the wire length to a minimum;
- b) Less space is needed for the stowage of the ‘folded’ crane;
- c) Special tools can be fitted to the boom tip, e.g. for pipe handling;
- d) Because the knuckle can generally only open approximately 110° there may be some limitations when attempting to lift very tall items or loads located at high levels at a short radius.

2.5.5 Telescopic booms also have the advantage of being able to operate with the boom tip closer to the load, thereby reducing the pendulum effect. They also require less space for stowage than a fixed length boom. The disadvantages include the increased complexity and weight of the boom due to the telescoping equipment. Most telescopic booms can only be telescoped in/out without load; the boom is then locked into position before the load is lifted. This should be considered for the final operation.

2.5.6 Fly-jibs are lighter structures which are occasionally fitted to the tips of large crane booms. Their purpose is to provide an extended reach for a special purpose but at a reduced lifting capacity.

2.5.7 A trolley can be fitted to run on rails along the length of a boom. This can be utilised to provide a light lifting capacity in lieu of a conventional whip line at the boom tip. The advantage of this is that there is no need to top the main boom up for small radius lifts, a saving in time and also a reduction in the pendulum effect.

2.6 Lifting Capacity and Working Radius

2.6.1 Possibly the most important feature of the crane and, on the face of it, the easiest to specify. However, there are aspects which should be carefully considered. Undoubtedly, the customer will have a good idea what loads the crane will need to safely lift. However, time spent considering the full range and frequency of the operations that the crane is expected to perform over the foreseeable life

of the vessel or crane will help ensure that the most suitable crane is installed. Considerations will include:

- a) The required lifting capacity should be stated for each aspect of the crane's work, i.e. alongside, internal lifts at sea, supply vessel work, subsea work and personnel lifting. This is because different dynamic factors need to be considered at the design stage in order to achieve the required SWL;
- b) In addition, the working radius should be stated for the capacities detailed in a) above, as well as the absolute maximum boom length;
- c) For offshore lifts, the maximum sea state and vessel motions at which the required lifting capacity is wanted should be stated. When multiple hoists are present, these limits can be different;
- d) For subsea operations, the depth and therefore the weight of the wire will become a factor and therefore needs to be allowed for. A load chart to take into account weight of wire should be provided;
- e) If the type of subsea lift for which the crane is to be designed or used is known, then the difference between the weight of the load in air and in water should be stated;
- f) Are multiple hoists required, i.e. two or three hooks with differing capacities, or is a single line sufficient which may be able to be reeved through multiple sheaves to give higher lifting capacities? This will depend on the anticipated work of the crane, i.e. will the crane be required to carry out smaller lifts while rigged for its capacity lift or is it acceptable to spend time re-rigging for occasional heavy lifts;
- g) Does the customer wish to design in extra lifting capacity to take into account possible future client requirements or a change in the vessel's role? If this is the case then it is possible at the design and construction stage to include increased strength in the crane's structural aspects. Items such as winches, wires and power packs can be upgraded at a later stage but it is much more difficult and expensive to uprate the basic structural aspects of the crane including the slew bearing and gearboxes.

From the above information, the crane provider can begin to design/specify the crane based on the worst case situations. The crane's total capabilities can then be calculated and tabulated.

2.7 Working Height

- 2.7.1 Are there any obstructions that the load is expected to clear? This may range between the ship's side rail to a large process plant or pipelay spread. Full details and drawings should be provided for consideration.

2.8 Lift Height/Depth

- 2.8.1 The greatest distance between the boom tip when at full elevation and the lowest point at which the load is required to be handled should be calculated. It should be stated whether the crane is expected to be used only on the surface (i.e. deck, quayside or sea level) or subsea in support of diving and/or construction activities. In the case of multi-fall arrangements, it is especially important to state the expected operational depth of the hook for each configuration in order to calculate the total length of wire required. For subsea work it is generally advisable to avoid multi-fall arrangements which can spin and foul once underwater. Some manufacturers recommend a single fall for depths greater than 250m although others have supplied 1200m depth on a double fall arrangement and claim no reported operational problems. Ultra deep water depths may require consideration of an external wire storage reel coupled with a traction winch. A line out meter is strongly recommended for safe and accurate subsea work.

2.9 Hook, Luff and Slew Speed

- 2.9.1 The required hook speeds are stated in the various classification society rules. These will vary depending on the operational mode of the crane; higher hook speeds are required for supply vessel operations for example and will also vary with sea state. If it is considered necessary that speeds in excess of those required by the rules are desirable then this should be conveyed to the crane provider. This will involve an examination of the power balance of the crane, i.e. if maximum speeds were required on all functions simultaneously at full load, then an uprated power pack would be needed. It is more common to request that two functions (always including hoist) are available

simultaneously at full speed and full load. An example where extra speed may be necessary is in deep water work where the time taken to deploy and recover the hook may be considerable. Due consideration should also be made for multiple fall arrangements which will naturally be proportionally slower than the single fall configuration – is the resulting speed too slow for safe and effective operations? Luff and slew speeds are important for supply vessel operations, i.e. the crane should be capable of following reasonable vessel motions safely. Slew speeds may also be proportional to outreach to avoid excessive jib head speed.

2.10 Off Lead/Side Lead

- 2.10.1 Off lead and side lead angles are stipulated in class rules for different modes of operation. The crane provider will use these angles to calculate the required strength and functional design of the jib head and other components based on the required SWL.

2.11 Environmental Operating Conditions

- 2.11.1 The majority of cranes offered will be capable of withstanding the normal range of environmental conditions encountered at sea world-wide. This is generally a temperature range of -10°C to +35°C. However, if the customer knows that the crane will be expected to operate for any length of time in extremes of temperature, say down to -20°C or up to +45°C, then this can be covered at the design/specification stage. Lower temperatures may require higher grade steel, heating systems for hydraulics/electric motors, jacket water heating for diesels and better heating and insulation for control cabs if fitted. High temperatures may require uprated cooling for electronic components and hydraulics, uprated cooling for diesels, also climate control for control cabs.
- 2.11.2 Where a large cooling plant is required then consideration may be given to fitting a water cooled system as opposed to air cooled because of possible high noise levels. It should be noted that water cooled systems require additional maintenance.
- 2.11.3 Wind speed limitations are another factor to consider. On smaller vessels, then the vessel motion is likely to halt crane operations before any wind speed limits of the actual crane are reached. The manufacturer will state the wind speed limitations for operational use.

2.12 Constant Tension/Heave Compensation

- 2.12.1 Most crane manufacturers offer various options to achieve heave compensation. The aim of these systems is to keep the load stable in relation to the sea floor regardless of the motion at the boom tip due to heave, pitch and roll. Different manufacturers may use different terms to describe similar systems and it is important that the customer fully understands the function and capabilities of the system being offered.
- a) Constant tension: This system aims to achieve a constant tension in the crane wire in order to keep it vertical. This is achieved by creating a pre-set tension in the wire which is less than the weight of the load. Although useful for loading/unloading of supply vessels, great care should be taken by the operator when setting the tension so that unintentional lifting of the load does not occur resulting in a dangerous situation. This system is useful for maintaining a vertical wire once a load has been set down on the seabed during subsea construction activities.
 - b) Passive heave compensation: This can be likened to a shock absorbing system which uses the mass and/or drag of the load to reduce the motion of the load in relation to the seabed. There is no part of the system acting directly on the winch. Load balance is achieved usually by a compensation cylinder which uses the motion of the load to charge accumulators which in turn recycle this stored energy to adjust the compensation cylinder stroke and therefore dampen the motion of the load.
 - c) Active heave compensation: This involves real time automatic control of the winch or a compensating cylinder in order to counteract the heave motion of the jib head. Information on the jib head motion comes from a motion reference unit (MRU). These systems often make use of energy stored in nitrogen accumulators. An active system which does not take advantage of stored energy in accumulators would require additional energy to drive the winch or compensation cylinder. Therefore, this type of active system would generally only be fitted to cranes of lower capacity.

- d) Combination passive/active heave compensation: This combines the two systems described in b) and c) above.

The capabilities of the system under varying loads and environmental conditions should be fully discussed between the manufacturer and customer. As previously mentioned (2.3), an accurate measurement or estimation of vessel motions is critical in ensuring that heave compensation systems meet the expectations of the customer.

2.13 Wire Construction

- 2.13.1 Crane wires will generally be supplied in either carbon steel or galvanised form. Some construction standards will stipulate galvanised (which is preferred). Common wire strengths in use in the industry are 1960 or 2160 N/mm². The grease used during the construction of the wire should be fit for purpose and for the expected operational temperatures. Furthermore, the grease used for the re-lubrication of the wire must be compatible with the original grease.
- 2.13.2 The construction of the wire rope will depend on its use. Ordinary lay or Langs lay is used where both ends of the wire are secured, e.g. luffing wires. This is because when a wire is subjected to load, then the strands will tend to straighten or unravel thereby causing the wire to rotate. For single fall applications, then non-rotating wire rope must be used. This is constructed with an inner core of ordinary or Langs lay which may be left or right handed, covered by an outer core of similar construction but 'handed' in the opposite direction to the inner core.

3 Supply Requirements

3.1 Choice of Drive System

3.1.1 Although electro-hydraulic and electric are the most common type of drive system, there are several options available.

- a) Electric: Direct electric drive is likely to be fitted to small cranes (e.g. lifesaving appliance davits or small stores cranes).

Medium or high voltage direct electric drive may be considered for large cranes. Electric drives offer reliability, low maintenance and low noise levels. The initial cost will be comparatively higher but a customer may wish to look at the total lifetime costs.

- b) Electro-hydraulic: The most common drive on medium and large installations. Consists of electric motors driving one or more hydraulic power units.

Electric installations are the normal choice on vessels with a reliable and sufficient generating plant.

- c) Diesel: Consisting of an independent diesel engine driving the crane's winches and slewing gear via a torque converter and clutch arrangement. Not so common on new installations.

- d) Diesel hydraulic: Consisting of an independent diesel engine driving one or more hydraulic power units.

Diesel installations may be considered for situations where there is a limited, non redundant or unreliable electrical generating capability (e.g. barges, platforms). It has been reported by at least one manufacturer that environmental concerns and restrictions have started to influence customers in certain regions against diesel installations where there is already spare electrical capacity.

- e) Hydraulic ring-line: Some vessels may have a central hydraulic system driving several applications. If the system is of sufficient capacity and power then a hydraulic crane can be added to the system. Problems in integrating multiple applications with differing pressure and flow requirements make this an uncommon option.

3.2 Supply Voltage

3.2.1 The customer should specify the available voltage and frequency and also if the power supply can be back fed. Normally, supply voltage will be in the range 380-690V. Higher voltage supplies offer some advantages in that they enable smaller motors to be utilised and reduce losses due to higher currents which in turn reduces fault current protection levels. This can be considered a major advantage when using system discrimination fault monitoring. Indeed, there are some installations on vessels which utilise voltages of 6-11kV. However, these tend to be on very heavy lift, specialised vessels which justify the production of these high voltage (and high cost) motors whereas motors in the 440V range are readily available and utilised by hydraulic equipment manufacturers. The supply voltage frequency should also be stated. The existing expertise within the customer's organisation may also be a factor in this decision.

3.3 Starting and Operating Current

3.3.1 Invariably, the customer will specify that a starter box is supplied with the crane. These range in complexity (and cost) from:

- a) A simple direct online starter which instantly connects the motor to the ship's supply switchboard with the consequent sudden increase in load. This would only be used for smaller motors.
- b) An autotransformer or 'easy start' system which builds up motor supply voltage over a period of up to 20 seconds. This gradually increases the load on the ship's supply switchboard. This is a relatively expensive option and therefore not as common as options a) and c).
- c) Star-delta starter. For Star-delta starter both ends of the motor winding are brought out to the starter cabinet. Switching between the two configurations is done through contactors and timed relays. The motor is initially started on star resulting in reduced current and thereby starting torque as the supply voltage is across two windings. The change over timer relay is set to allow sufficient time for the motor to approach running speed before changing to delta configuration. This is the most common type of starter for medium or large installations.

- 3.3.2 Methods b) and c) are preferable for most crane installations as they avoid sudden large loads being placed on the ship's supply switchboard with the consequent risk of disruption to the electrical network.
- 3.3.3 The manufacturer should state what the expected maximum starting and operating current will be for the installation. The customer will then have to ensure that a breaker of suitable size is available on the ship's supply switchboard.
- 3.3.4 The manufacturer should clearly state the type, size and location of the starter boxes and associated cabling which will be supplied. The interface between manufacturer supplied equipment and customer supplied must be clearly understood. For cranes designed for critical operations, for example emergency diving bell recovery, an independent secondary power supply will be required that should be supplied from a separate switchboard.

3.4 Power Requirements

- 3.4.1 The power consumption range of the crane should be stated by the manufacturer. This can range from 10kW for a small stores crane to 2.5MW for a 500t construction crane found on some vessels. The power consumption of the crane has massive implications when considering the power balance on a vessel, particularly diesel electric dynamically positioned (DP) vessels, and can influence the design of safety features such as discrimination and preferential tripping or may require additional or separate power generation capability to be added retroactively or at the design stage.

3.5 Hydraulic System Requirements

- 3.5.1 Power pack capacity: The type and capacity of each power pack should be stated.
- 3.5.2 Power pack redundancy: In multiple power pack installations, the capability of the system following failure of one unit should be clearly stated and understood. For example, is each power pack capable of driving each function of the crane (hoist, luff, slew) or are the functions split between power packs. The customer may require that redundancy is built into the design to allow full range of operation (perhaps at reduced speeds) in the event of failure of a unit. This redundancy may extend to the power supplies for each power pack. Provision of total redundancy is possible but is expensive and takes up a lot of space. Total redundancy is an uncommon option.
- 3.5.3 Pipes and fittings: The type and quality of fittings should be agreed. Carbon steel is significantly cheaper than stainless steel but care needs to be taken to protect it. This may involve the placing of pipework inside the crane structure to protect it from the elements, wrapping the pipes and fittings with 'Denso' tape and the application of specialist coatings. The proper securing of pipework is very important to ensure that pipe connections are not stressed due to pressure induced shock loading and/or crane vibration.
- 3.5.4 For hydraulic oil cooling the adequate provision of filters and coolers should be agreed. The available flow of cooling and the type (fresh/seawater/air) in addition to the maximum incoming temperature should be specified by customer.
- 3.5.5 Local instrumentation: A useful aid to troubleshooting is local instrumentation such as pressure and/or flow gauges placed at suitable locations throughout the hydraulic system. Where gauges are not fitted, provision may be made for easy attachment of portable measuring equipment at critical points. The manufacturer should state what standard fittings are supplied. Any upgrading or additional requirements of the customer should be stated.
- 3.5.6 Cleanliness standards: The manufacturer should state to what cleanliness standards it assembles hydraulic systems. One industry standard, for example, which gives guidelines for achieving, evaluating and controlling the cleanliness of hydraulic fluid power components from time of manufacture through to installation in a hydraulic power system is ISO/TR 10949:2002. Some manufacturers fit filtering and flushing systems to their cranes which will constantly keep the hydraulic system at this standard. It is also an option to have the connection points for such filtering equipment fitted in order to facilitate easy fitting of the equipment if necessary. There is a potential benefit to be gained by the installation of real time condition monitoring equipment for oil quality which is relatively cheap. This equipment can detect oil contamination and show oil quality trends.

3.6 Cable Requirements

- 3.6.1 Agreement needs to be reached between the customer and manufacturer regarding the provision and installation of the cabling between the ship's supply switchboard, the starter box and the crane location. Cable installation will of course need to be in accordance with the vessel's classification society's rules for electrical installations. Detail on cable requirements should be stated by the manufacturer along with the power and current requirements.

3.7 Man-riding and Personnel Lifting

- 3.7.1 Most design standards have specific requirements in order to allow personnel to be lifted with the crane; some standards require an additional safety factor, means of emergency power, emergency lowering, additional brakes, etc. It is important to specify if personnel are to be lifted by the crane and if so which hoisting gear should be used and what SWL should be lifted.

4 Control/Instrumentation System Requirements

4.1 Operator's Cabin

- 4.1.1 The customer should specify the location of the cabin, i.e. left, right or central. This may depend on the location of the crane and its anticipated operational mode. Smaller cranes may only require an open operator's platform.
- 4.1.2 Fittings for the operator's comfort and safety should be specified in addition to maximum noise and vibration levels. This may include motorised window wipers, demisters, heating, ventilation and air conditioning (HVAC) system to maintain the temperature within specified limits under all anticipated external conditions, ergonomic seating, tinted or glare reducing glass, sound insulation, internal lighting (including emergency), portable fire extinguishers, life jacket, smoke hood or emergency escape breathing set. Some cabin installations have been designed with space for an additional seat to allow for training of new operators.

4.2 Cabin Controls and Instruments

- 4.2.1 The manufacturer will specify the standard controls and instruments which are fitted as standard to each cabin or platform. This may include control levers or pedals for hoist, slew and luffing, levers or pedals for telescoping or knuckle control, levers or pedals for brake operation. Some or all of these functions may alternatively be combined in one or more joystick control. Links to the vessel's internal communications systems may be fitted including telephones, talkbacks, UHF/VHF, public address (PA) system. There may be advantages in providing the crane operator with a feed from the vessel's closed circuit television (CCTV) system.
- 4.2.2 A safe load indicator should be fitted where gross overload protection has not been installed. This will generally give the operator an indication of the load on the hook as an absolute value and also as a proportion of the SWL. The system will also, as a rule, give the operator visual and audible alarms as the limits of the crane are approached and/or exceeded. As the SWL of the crane may vary with radius and rigging configuration then the load indicator needs to be able to recognise these variables. This may be accomplished either automatically or via operator input or by a combination of these methods. A system should be chosen which reflects the complexity of the crane. This equipment may also incorporate a data logging facility which can be used for maintenance planning or failure investigation. The safe load indicator may also incorporate a line-out meter. A line-out meter is strongly recommended for accurate subsea work. Class requirements should also be checked in this matter.
- 4.2.3 Controls and indicators for any constant tension or heave compensation system will need to be available in the control cabin.

4.3 Remote Control

- 4.3.1 Various remote control options may be considered which could include a neck slung remote operator panel for smaller cranes such as stores cranes or the control of some or all functions of bigger cranes from a remote location, e.g. control of a subsea crane from the dive or ROV control room.

4.4 Safety and Emergency Devices

- 4.4.1 Safety devices will normally be fitted in accordance with the applicable class society's rules but the following options may also be considered:
 - a) Gross overload protection: This can be a regulatory requirement (e.g. in the UK and Norway) on platform cranes and is intended to prevent a snagged load on a supply vessel from pulling the crane over with disastrous consequences. The system ensures that the hoist or luffing winch will pay out wire regardless of winch command at a preset level to prevent overload and failure of the structure. This is not so common on vessels. Whenever safety systems are used, it is wise to investigate how they operate and ensure that they 'fail safe'. For instance, a system that pays out wire regardless of winch control could constitute a free-falling load.
 - b) Overload alarms: These are usually set to 95% or 100% of SWL.

- c) Anti two block: A system which will prevent the lower block from physically touching the head of the crane jib. Two blocking can lead to physical damage to and/or failure of the block, the jib and the wire. Such a system can operate either on physical limit switches or can be triggered by a rope counter recognising when the two block situation is about to occur. The latter system relies on the accuracy of the rope counter.
- d) Over-hoist: Similar to the two block system. May give a warning or a cut-out when the hook is approaching the boom head.
- e) Over-lower: Prevents too much wire being paid out. For safety reasons generally at least four turns of wire must be left on the drum at all times.
- f) Emergency stop.
- g) Boom camera: Useful to give the operator a good view of the top of the load and can assist with hook positioning.

4.4.2 The customer will usually specify that there is a capability to return the crane (and load) to a safe condition following a major system failure. This will require facilities and procedures for lowering the hook and boom and slewing the crane. On smaller cranes there may be an emergency hand pump, while on larger cranes a small emergency power pack may be provided. Detailed procedures should be provided by the manufacturer which should be tested during customer acceptance trials.

5 Maintenance and Repair Requirements

5.1 Recommended Spares

- 5.1.1 It has been estimated by one manufacturer that the majority of downtime on a crane can be prevented by keeping approximately 20% of spare parts immediately available. The critical part of this solution is of course ensuring that it is the correct 20% that is maintained on board. The crane manufacturer should provide the customer with a detailed essential spares list which should include items required for routine maintenance. The list should contain equipment whose function, mode of operation or availability makes such equipment critical for safe operation. The customer should consider additional requirements based on the need for continuous operations especially where there may be problems with the delivery of spares, long lead times, potential of obsolete parts and the ability of the vessel's crew to adequately maintain or repair may be a factor. Allowance should be made for any additional spares which may be needed during the first year of operation. The customer should carefully consider the provider's advice before making a decision on a parts policy. It should be remembered that the list of spares can only be finalised once the design is completed.
- 5.1.2 Additional spares may be needed for the installation and commissioning process. The manufacturer should ensure that these are available so that the process is not delayed. Such spares will normally be included in the supply and installation cost but this should be clearly agreed.

5.2 Maintenance Programme

- 5.2.1 It is expected that all vessel operators will have some form of planned maintenance system as part of their vessel management system in order to maintain the vessel in accordance with all applicable rules and regulations. These systems vary enormously in their sophistication but every operator should ensure that a comprehensive programme of testing and maintenance is put in place for any crane and which is commensurate to the criticality of operations, requirements for availability and complexity of installed equipment. Such maintenance planning should be sympathetic to the ability of the vessel crew to comply and where necessary identify requirements for external resources to assist. This will contribute towards reducing downtime. Again as with the spare parts policy, full consultation between the manufacturer and the customer should take place and reference should be made to the manufacturer's recommended maintenance programme before the final maintenance schedule is drawn up and implemented. It may be advantageous to make use of data logging and condition assessment facilities which will enable maintenance to be targeted and scheduled more effectively. The customer should satisfy himself that the manufacturer is able to provide the relevant information prior to contract.
- 5.2.2 Some manufacturers may offer a complete life cycle maintenance programme whereby their engineers visit the vessel at pre-determined intervals to carry out routine maintenance and health checks.

5.3 Maintenance Access and Aids

- 5.3.1 Access to the major items on the crane for repair or maintenance should be considered and discussed with the provider at an early stage. An example might be the accessibility of grease sampling points to determine the operational condition of the slew bearing. The manufacturer should describe how access to all parts of the crane for routine and non-routine inspection, repair and maintenance is achieved. This may be via boom and crane house walkways and platforms, machinery rooms within the crane house or boom, or even access lifts in some cases. If machinery is located within the crane house or boom then there should be suitable and sufficient access for routine maintenance and/or removal. Lifting pad eyes of suitable size should be permanently fitted as appropriate to facilitate the removal of heavier items.
- 5.3.2 It may be inevitable that there are some large components of the upper part of the crane that need external lifting facilities to remove them from the crane in the case of major breakdown. The customer may even wish to consider the location of other vessel cranes at the design stage in order to achieve lifting coverage. In any case, the customer should be satisfied that all major components can be removed in a dockside situation with the minimum of dismantling. The manufacturer should ensure that detailed procedures are supplied for the removal of all major items for repair or replacement.

- 5.3.3 It has been mentioned previously that in order to facilitate ultra deep water work, the crane's winches may be placed on or under deck because of their size. This option also has the advantage that access to these components for maintenance or removal may be much easier. This option may be considered in cases where on deck or under deck space is available.
- 5.3.4 Some manufacturers offer remote access to the crane's control system. This might be beneficial for downloading the logged data for analysis and maintenance planning, as well as for access to the control system, which can be used for technical support and problem solving. The company should have in place suitable procedures to ensure that any changes to software or hardware that may result in changes to the safety logic or operational parameters have gone through a management of change process before implementation.

If the crane control remote access system is connected to the vessel's network and/or to the internet, adequate provisions are to be taken to ensure system security, i.e. against viruses, malware, unauthorised access, etc.

6 Testing, Installation, Trials and Training

6.1 Testing

- 6.1.1 Manufacturers of new cranes are likely to carry out a full set of factory acceptance tests (FAT) prior to shipping and/or installation. This may include bench testing of individual components followed by a full function and load test upon completion. All hydraulic components should be completely flushed and clean before final assembly. The customer may wish to have a representative attend some or all of these tests. Alternatively, the customer may accept documented reports on the outcome of these tests. The requirements for any certifying body's representative to attend any or all of the various FAT should be ascertained.

The programme for the FAT should be provided to the customer in good time in order for it to be studied and any queries answered or amendments made.

6.2 Failure Modes and Effects Analysis (FMEA)

- 6.2.1 A crane by its nature will inevitably have single point failures which will lead to inability to complete any given lifting operation. Short of major structural failure of the crane or hoist wire, any crane which is built to recognised standards should not have any single failures which would lead to an uncontrolled dropping of the load or boom. For cranes fitted with active or passive heave compensation, consideration should be given to failure modes which result in loss of heave compensation with the load attached. However, the customer may wish to consider the benefits of conducting a failure modes and effects analysis in order to identify critical failures which may have a serious effect on crane availability or an inability to release or recover a subsea load for example. The manufacturer should state whether FMEAs are produced as standard or can be produced on request.

6.3 Installation and Commissioning

- 6.3.1 Some crane manufacturers have their own quayside facilities adjacent to the factory for installation of their products. If this is not convenient for the customer then it is possible to ship the crane either broken down to components or as a complete unit to repair or building yards world-wide. Manufacturers will normally quote prices ex-works which will not include any delivery expense. Delivery will normally be arranged by the customer. Arrangements and costs for delivery should be clearly agreed between manufacturer and customer.
- 6.3.2 Installation of the crane obviously needs careful planning and co-ordination between the customer, the manufacturer and the shipyard, if applicable. The manufacturer should provide full installation requirements in the form of drawings and instructions. Special consideration should be given to the interface between the crane and the vessel's structure. The customer may require that the crane is delivered with one half of a bolted flange, a bolted flange plus an interface for welding to the vessel's structure or simply a section of crane pedestal below the slew ring suitable for welding to the vessel's structure (a section equal in height to the diameter of the slew ring is one manufacturer's standard). The necessity for the manufacturer's representatives to be present during the installation of the crane will vary.
- 6.3.3 The time and resources needed for commissioning the crane should be agreed well in advance so that suitable arrangements can be made. Every effort should be made to arrive at a realistic estimate based on experience and all available information. It is important that the commissioning team is not brought on site prematurely before the installation is complete. Power should be available, the hydraulic system should be charged and suitable test weights should be on site. Commissioning of heave compensation systems has historically caused difficulties as realistic vessel motions are beneficial in achieving a good initial calibration. The customer and manufacturer may need to come to an arrangement whereby a commissioning engineer is carried on the first voyage or is available to travel offshore in order to take advantage of suitable weather conditions.

6.4 Trials

- 6.4.1 The trials are required to give reassurance (and perhaps satisfy inspectors/class so they issue a certificate) to the owner that what has been ordered, has been delivered. If the owner requires a crane that can only lower a 500t load and only retrieve a 300t load, then the costs will be reflected and the trials will demonstrate that.

Upon completion of installation, a full set of acceptance trials should be carried out to a pre-arranged programme to prove functionality. The manufacturer should provide a test programme and will likely have a representative present at the trials. As part of the trials, a full load and overload test should be carried out that may include a retrieval test from maximum designed water depth with maximum design load. In section 2.1.1(a) above 'retrieval of loads' is only an option. Therefore it may not be required to be included on every trials programme. If the crane is to come under a class society then the class surveyor will also have to be present during the acceptance trials and load test. All testing should be carried out in as dynamic a fashion as possible to prove the crane's operational capability is as designed.

6.5 Training

- 6.5.1 Much downtime and many incidents are attributed to incorrect operation. Even with smaller or basic cranes, having a competent operator is imperative. The customer may well have its own training programme or competency assurance scheme for crane operators but it may be advantageous to utilise the manufacturer's training options when these are available. This is especially important with more complex installations which may include multiple hoists, sophisticated heave compensation mechanisms or advanced computerised control and monitoring systems. The manufacturer should state what training it can give and what is included in the standard contract. Training of the crane operator's maintenance personnel is also well worthwhile and the ability of the crane manufacturer to provide such training should be stated.

7 Certification and Documentation

7.1 Certification

- 7.1.1 The customer may wish to have the crane designed, built and installed to a classification society's rules. This may be the vessel's class society or any other. The customer's requirements in this matter should be clearly stated at the earliest stage. Most crane manufacturers will be familiar with and able to design and build to any of the major classification societies' rules.

Apart from the knowledge that the crane has been built to established international standards, the advantage of having the crane built to these rules is that it will be more easily accepted by clients and flag state authorities in areas where the vessel may be working.

Even if the crane is built to class rules, the manufacturer is also likely to build the crane to other applicable standards such as American Petroleum Institute (API) 2C, European Committee for Standardisation (CEN), British Standards Institute (BSI) or European Federation Standard (FEM).

The manufacturer should state which standards the crane is built to and provide documentary evidence to support this.

If the customer requires the crane to meet any other recognised standard then this should be clearly stated and agreed.

The following are different types of certification offered by classification societies that may benefit the customer:

- ◆ Design appraisal -> Certificate of Design Appraisal -> usually only structural
- ◆ Manufacturing review -> Manufacturing Survey Report
- ◆ Overload testing -> Witness of test (this is not a SWL certificate)

Cranes can be built to classification society rules, which may include all the above and additionally the verification and check of machinery and control systems, both for design, fabrication and testing.

7.2 Documentation

- 7.2.1 If the crane is built to class rules then there will be a specific requirement for a document package. In any case, the manufacturer should provide a documentation package which may include the following:

- a) operations manual;
- b) general arrangement (GA) drawings of the crane;
- c) power system drawings;
- d) electrical drawings;
- e) hydraulic schematic;
- f) list of standards used to design and build the crane;
- g) spare parts manual;
- h) list of recommended spares;
- i) documented report of FAT including non-destructive testing (NDT) or other testing of individual components;
- j) maintenance procedures;
- k) details of world-wide service centres and contact details;
- l) class society documentation as applicable; this should clearly identify and describe each type of certification and/or verification that is applicable;
- m) a strength verification report of the crane, including which load factors have been used for the crane. For example, which design factors for the winches have been used;
- n) report of testing after installation including load and, if required, retrieval testing;

- o) load/radius curves for differing sea states. These curves should list all the factors which have been used, and indicate the capacity at hook block, i.e. the weight of the wire and the hook block have been taken into account in the curves;
- p) retrieval curves, if required, which give the maximum allowable retrieval loads from all depths, from maximum depths to zero. This should be carried out for all possible reeving configurations and for intermediate depths.

7.3 Multi-layer Winches

7.3.1 When specifying an offshore crane for subsea use it should be recognised that there are information gaps in the available standards when requesting multi-layer winch systems for retrieval purposes. The most specific guidance is currently provided by Det Norske Veritas (DNV)'s Standard for Certification of Lifting Appliances 2.22 (2011).

Member companies have experienced failures on this type of equipment and it is recommended that the following points are considered when specifying a multi-layer winch:

- a) Design: If a multi-layer winch, in excess of seven (7) layers, is being used for subsea retrieval operations the customer should review the suitability of the design factors by utilising a design appraisal process. As these processes are usually only structural, an additional detailed check of the winch, drum, flange and connection should be specified to ensure that they are adequate for the intended purpose of the winch. The supplier should state which factors have been used in the design of the crane and which design factor (e.g. DNV 'C' factor) or design method has been used.
- b) The supplier should issue a clear specification of the retrieval capability, together with retrieval curves if appropriate. These retrieval curves should state the maximum retrieval capacity from maximum water depth up to zero, including intermediate depths and for all possible reeving configurations. Curves should provide capacities at hook block, i.e. the weight of the wire and the block should be taken into account in the curves.
- c) Testing: It is recommended to carry out a full offshore function and load testing of the winch with normal full SWL test weight applied from full depth and back to the surface (retrieval). Equivalent testing can be carried out ashore after test procedure approval by the owner and/or relevant inspector.

Crane Bid Information Questionnaire

Instructions for Completion of the Crane Bid Information Questionnaire

Column 1	Reference – this refers the reader back to the appropriate section of the text which covers the relevant item.
Column 2	Section heading.
Column 3	Refers back to the text sub-heading number and identifies further questions or requirements as applicable.
Column 4	The customer is to enter its requirements and/or existing conditions as appropriate. This should include as much detail as possible. Reference may be made to other documents, standards or drawings as necessary. In some cases, a simple tick may be all that is necessary to indicate that an option is required.
Column 5	The provider should detail the specification which is being offered. This may match the customer's requirements exactly, may differ slightly or differ to a large extent. In this case the provider should explain why they are offering or recommending a specification which differs from the customer's requirement. Reference may be made to other documents, standards or drawings as appropriate.

Crane Bid Information Questionnaire				
1 Ref	2 Heading	3 Item/Subject	4 Customer Requirement/Comment	5 Provider Comment
2.1	Crane's Functional Purpose	2.1.1 Full description of the vessel and the intended uses of the crane		
2.2	Crane Arrangement	2.2.1 Description of intended crane position		
		2.2.1 Degree of rotational freedom required		
		2.2.1 Is crane to be located in or near a hazardous area?		
		2.2.2 Is supply of boom/hook rest required?		
2.3	Vessel Motions	2.3.1 Customer to supply vessel motion information in the manufacturer's preferred format		
2.4	Crane Type	2.4.1 Mast crane		
		2.4.2 Pedestal crane		
		Manufacturer to suggest options		
2.5	Boom Type	2.5.2 Box		
		2.5.3 Lattice		
		2.5.4 Knuckle (articulated)		
		2.5.5 Telescopic		
		Manufacturer to suggest options		
2.6	Lifting Capacity and Working Radius	2.6.1 Customer to tabulate the SWL required for each type of lift (in port, deck internal, offshore), the maximum radius for each SWL and the maximum sea state for each combination		
		2.6.1 f) Main block plus whip line for smaller loads		
		2.6.1 f) Single line which needs re-rigging for heavy lifts		
		2.6.1 Minimum working radius		
		2.6.1 g) Is additional strength to be designed in to the crane to allow for future uprating?		
2.7	Working Height	2.7.1 What height is needed to clear other vessel fittings and equipment or to lift large items of equipment?		

Crane Bid Information Questionnaire				
1 Ref	2 Heading	3 Item/Subject	4 Customer Requirement/Comment	5 Provider Comment
2.8	Lift Height/Depth	2.8.1 What is the maximum distance required from the crane hook to the boom tip?		
		2.8.1 Is a deck or below deck storage winch to be considered for ultra deep water work?		
2.9	Hook, Luff and Slew Speed	2.9.1 Does the customer require speeds in excess of class society minimums? Manufacturer to state standard speeds?		
2.10	Off Lead/Side Lead	2.10.1 To meet class rules		
2.11	Environmental Operating Conditions	2.11.1 Temperature range		
		2.11.2 Water or air cooled hydraulics		
		2.11.3 Wind speed		
2.12	Constant Tension/Heave Compensation	2.12.1 a) Constant tension		
		2.12.1 b) Passive heave compensation		
		2.12.1 c) Active heave compensation		
		2.12.1 d) Combined active and passive heave compensation		
		Manufacture to suggest available options. NB Full details of the capabilities of the system offered under all load and sea state conditions are to be detailed		
2.13	Wire Construction	Material, size, strength and construction of all wires to be detailed		
3.1	Choice of Drive System	3.1.1 a) Direct electric		
		3.1.1 b) Electric-hydraulic		
		3.1.1 c) Direct diesel		
		3.1.1 d) Diesel hydraulic		
		3.1.1 e) Hydraulic ring-line		
		Manufacturer to suggest available options		
3.2	Supply Voltage	3.2.1 Voltage		
		3.2.1 Frequency		
		3.2.1 Phase		

Crane Bid Information Questionnaire				
1 Ref	2 Heading	3 Item/Subject	4 Customer Requirement/Comment	5 Provider Comment
3.3	Starting and Operating Current	3.3.1 a) Direct online starter		
		3.3.1 b) Auto transformer (Easy start)		
		3.3.1 c) Star Delta		
		3.3.3 Starting current		
		3.3.3 Max operating current		
		3.3.4 Description of type, size and location of proposed starter boxes (manufacturer/customer interface)		
3.4	Power Requirements	3.4.1 Min kW		
		3.4.1 Max kW		
3.5	Hydraulic System Requirements	3.5.1 Power pack capacity		
		3.5.2 Power pack redundancy		
		3.5.3 Pipes and fittings		
		3.5.4 Filters		
		3.5.4 Cooling system		
		3.5.5 Local instrumentation		
		3.5.6 Cleanliness standards		
3.6	Cable Requirements	Responsibility for cabling between switchboard and starter box to be agreed (customer/manufacturer interface)		
3.7	Man-riding and Personnel Lifting	3.7.1 Are personnel to be lifted with the crane?		
		3.7.1 If so, which hoisting gear is to be used?		
		3.7.1 What is the SWL?		
4.1	Operator's Cabin	4.1.1 Location of cab or platform		
		4.1.2 Windscreen wipers		
		4.1.2 Demister		
		4.1.2 HVAC		
		4.1.2 Ergonomic seating		
		4.1.2 Tinted glass		

Crane Bid Information Questionnaire				
1 Ref	2 Heading	3 Item/Subject	4 Customer Requirement/Comment	5 Provider Comment
		4.1.2 Sound insulation to relevant standards		
		4.1.2 Life jacket		
		4.1.2 Smoke hood or escape set		
		4.1.2 Internal lighting (including emergency)		
		4.1.2 Fire extinguisher		
4.2	Cabin Controls and Instruments	4.2.1 Manufacturer to list standard levers, pedals, joysticks		
		4.2.1 CCTV		
		4.2.1 Telephone		
		4.2.1 Talkback		
		4.2.1 UHF/VHF		
		4.2.2 Safe load indicator/line-out meter		
		4.2.3 CT and heave compensation		
4.3	Remote Control	4.3.1 Customer to detail remote control requirements		
4.4	Safety and Emergency Devices	4.4.1 a) Gross overload protection		
		4.4.1 c) Anti two block		
		4.4.1 d) Over-hoist		
		4.4.1 e) Over-lower		
		4.4.1 f) Emergency stop		
		4.4.2 Requirements to manoeuvre the crane following major failure		
		Emergency manoeuvring facility and procedures provided by manufacturer		
5.1	Recommended Spares	5.1.1 Manufacturer to supply list of recommended spares		
		5.1.2 Manufacturer to provide estimates of spares needed for the installation and commissioning phase		

Crane Bid Information Questionnaire				
1 Ref	2 Heading	3 Item/Subject	4 Customer Requirement/Comment	5 Provider Comment
5.2	Maintenance Programme	5.2.1	Manufacturer to provide maintenance instructions and intervals	
		5.2.2	Does manufacturer offer life cycle maintenance package?	
5.3	Maintenance Access and Aids	5.3.1	Manufacturer to detail standard fittings and options for access	
		5.3.1	Manufacturer to detail which machinery items are located within the crane house or box boom and confirm that access and/or removal is possible through existing doors, hatches or removable plates	
		5.3.1	Manufacturer to confirm that suitable permanent pad eyes are fitted to facilitate removal of machinery items	
		5.3.2	Manufacturer to confirm that all major items of equipment can be removed in a dockside operation without major dismantling Procedures to be provided for removal of major items	
		5.3.3	Customer to confirm interest in locating winches or other machinery items on deck or under deck to facilitate maintenance and/or removal	
6.1	Testing	6.1.1	Manufacturer to detail the level of factory testing prior to delivery	
		6.1.1	Is a fully documented FAT carried out?	
		6.1.1	Does the customer wish to witness FAT?	
6.2	Failure Modes and Effects Analysis (FMEA)	6.2.1	Does the manufacturer conduct an FMEA for each crane?	
		6.2.1	Can the manufacturer provide an FMEA?	
		6.2.1	Does the customer require the manufacturer to produce FMEA?	

Crane Bid Information Questionnaire				
1 Ref	2 Heading	3 Item/Subject	4 Customer Requirement/Comment	5 Provider Comment
6.3	Installation and Commissioning	6.3.1	Does the manufacturer have quayside facilities for crane installation?	
		6.3.1	Where is installation planned to take place?	
		6.3.1	Responsibility for transit to be agreed	
		6.3.2	Manufacturer to provide full installation drawings and instructions	
		6.3.2	Interface between crane and vessel structure: manufacturer and customer to agree on arrangements	
		6.3.2	Is manufacturer required to provide specialised personnel for installation?	
		6.3.3	Estimated time for commissioning?	
		6.3.3	If a heave compensation system is fitted, then the customer and client may agree that it is necessary to wait for suitable weather conditions before commissioning is accepted	
6.4	Trials	6.4.1	Does manufacturer provide a detailed acceptance trial programme?	
		6.4.1	Does acceptance trial include a full dynamic load test?	
		6.4.1	Is a retrieval test from full water depth with maximum load planned?	
		6.4.1	Does manufacturer's representative attend acceptance trial?	
		6.4.1	Is attendance of class society surveyor required?	
6.5	Training	6.5.1	Manufacturer to detail what training (operating and maintenance personnel) it is able to provide	
		6.5.1	What training is provided as part of standard contract?	

Crane Bid Information Questionnaire				
1 Ref	2 Heading	3 Item/Subject	4 Customer Requirement/Comment	5 Provider Comment
7.1	Certification	7.1.1 Is the crane to be designed, built and installed to a class society's rules? If yes, then customer to state which		
		7.1.1 Does the customer require the crane to be designed, built and installed to any other recognised standard?		
		7.1.1 It should be clarified what the certification/verification entails?		
		7.1.1 Manufacturer to state to which other standards the crane will be designed, built and installed		
7.2	Documentation	7.2.1 Documentation package to include:		
		7.2.1 a) Operations manual		
		7.2.1 b) As-built GA drawings of crane		
		7.2.1 c) Power system drawings		
		7.2.1 d) Electrical drawings		
		7.2.1 e) Hydraulic schematics		
		7.2.1 f) List of standards used to design and build the crane		
		7.2.1 g) Spare parts manual		
		7.2.1 h) List of recommended spares		
		7.2.1 i) Documented report of FAT including NDT or other testing of individual components		
		7.2.1 j) Maintenance procedures		
		7.2.1 k) List of world-wide service centres including contact details		
		7.2.1 l) Class society documentation as applicable		
		7.2.1 n) Report of testing after installation including load tests		
7.2.1 o) Load/radius curves that clearly specify which factors have been used				

Crane Bid Information Questionnaire				
1 Ref	2 Heading	3 Item/Subject	4 Customer Requirement/Comment	5 Provider Comment
		7.2.1 If required by the owner: Retrieval curves, from intermediate water depths and for the different reeving configurations. Clear specification of retrieval capability. The curves should provide capacity at hook block		
7.3	Multi-layer Winches	7.3.1 a) Is the winch multi-layer in excess of seven (7) layers?		
		7.3.1 a) Is it used for subsea retrieval?		
		7.3.1 a) Carry out additional detailed check of winch, drum, flange and connection. All factors used in the design of winch should be specified		
		7.3.1 Full design documentation should be issued		
		7.3.1 c) Carry out full offshore function testing of the winch with normal full SWL test weight applied		
		7.3.1 c) Carry out retrieval test from full water depth and back to surface with maximum designed load (retrieval)		
		7.3.1 c) Equivalent retrieval testing can be carried out ashore after test procedure approval by the owner and/or relevant inspector		

Crane Vessel Selection Criteria

Note: If the lift(s) have been fully engineered, the job pack(s) should be passed to the prospective vessel owners so they can ascertain which of their vessels, if any, are suitable. In addition, the following information should be supplied if not contained in the job packs.

Item	Information required to facilitate crane vessel selection	Insert information as required and/or circle 'yes' or 'no'
Regarding Weight of Load		
1	Dry weight of heaviest load to be lifted (inc. rigging, lifting frames, spreaders, etc.)	
2	Wet weight if load being deployed subsea	
3	Dimensions of heaviest load (inc. rigging, lifting frames, spreaders etc.) LxWxH	
4	Orientation of load in relation to crane (i.e. long face or wide face towards crane)	
5	Distance from this face to centre of gravity of load	
6	Dimension from base of load to sling (s) 'pick point' (i.e. effective load height)	
7	Height to be lifted from sea level (to landing level plus suitable clearance) or	
8	Depth to be lowered to sea level	
9	Minimum distance vessel can be from installation (if applicable)	
10	Dimension of C of G of load from edge of installation when load in final installed position	
11	Lateral clearance at landing site (will affect maximum allowable sea state) N, S, E, W	
12	Is dynamic position required for accurate placing of load?	Yes/No
13	What DP class shall the barge or vessel require DP I, DP II or DP III?	
14	Is load to be lifted on to another floating vessel (additional dynamics)?	Yes/No
15	Is load to be transported on crane vessel?	Yes/No
16	Is load to be lifted from lay barge?	Yes/No
17	Is an auxiliary hoist required for handling rigging	Yes/No
Regarding Size of Load		
18	Dry weight of largest load to be lifted (inc. rigging, lifting frames, spreaders, etc.)	
19	Wet weight if load being deployed subsea	
20	Dimensions of largest load (inc. rigging, lifting frames, spreaders etc.) LxWxH	
21	Orientation of load in relation to crane (i.e. long face or wide face towards crane)	
22	Distance from this face to centre of gravity of load	
23	Dimension from base of load to sling (s) 'pick point' (i.e. effective load height)	
24	Height to be lifted from sea level (to landing level plus suitable clearance) or	
25	Depth to be lowered to sea level	
26	Minimum distance vessel can be from installation (if applicable)	
27	Dimension of C of G of load from edge of installation when load in final installed position	
28	Lateral clearance at landing site (will affect maximum allowable sea state) N, S, E, W	
29	Is dynamic position required for accurate placing of load?	Yes/No
30	What DP class shall the barge or vessel require DP I, DP II or DP III?	
31	Is load to be lifted on to another floating vessel (additional dynamics)?	Yes/No
32	Is load to be transported on crane vessel?	Yes/No
33	Is load to be lifted from lay barge?	Yes/No
34	Is an auxiliary hoist required for handling rigging?	Yes/No
All Loads		
35	Location of lift, with relevant information on tides	
36	Time of year lift is planned to take place (weather windows, etc.)	
37	Desires sea state/wind speed for lift, e.g. Up to 1.5m Hsig and 15kts	
38	Other special requirements	