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7 LIFTING EQUIPMENT

7.1 GENERAL

7.1.1 Scope

1 This Part specifies the requirements for the design, manufacture, construction, installation, testing and commissioning of hoists, monorails, bridge cranes trolley assemblies, davits and 'A' frames.

2 Related Sections and Parts are as follows:

Section 1, General
Section 8, Drainage Works
Section 10, Instrumentation, Control and Automation
Section 21, Electrical Works

7.1.2 References

1 The following standards or revised/updated versions are referred to in this Part:

ASME B30.9..... Slings (Synthetic round sling endless)

ASME B30.10..... Hooks (Cranes, hooks)

BS 302 (ISO 2408) Stranded steel wire ropes -; (EN 12385 Steel wire ropes. Safety -)

BS 449,..... The use of structural steel in building (EN 1993- Eurocode 3: Design of steel structures)

BS 729 (ISO 1459, 1460, 1461) Specification for hot dip galvanized coatings on iron and steel articles (ISO 1460 -Metallic coatings — Hot dip galvanized coatings on ferrous materials — Gravimetric determination of the mass per unit area ; ISO 1461 - Hot dip galvanized coatings on fabricated iron and steel articles — Specifications and test methods)

BS 2573-1 (ISO 4301-1) Rules for the design of cranes - Specification for classification, stress calculations and design criteria for structures;(EN 13001-1 Cranes. General design - General principles and requirements; EN 13001-2 Crane safety. General design - Load actions; EN 13001-3-1 Cranes. General Design - Limit States and proof competence of steel structure; EN 13001-3-2 Cranes. General design - Limit states and proof of competence of wire ropes in reeving systems; EN 13001-3-3 Cranes. General design - Limit states and proof of competence of wheel/rail contacts; EN 13001-3-5 Cranes. General design - Limit states and proof of competence of forged and cast hooks) (ISO 4301-1 Cranes and lifting appliances — Classification — Part 1: General)

BS 2853..... Specification for the testing of steel overhead runway beams for hoist blocks

BS 2902..... Specification. Higher tensile steel chain slings and rings, links alternative to rings, egg links and intermediate links

BS 3032..... Specification for higher tensile steel shackles; (ISO 2415 - Forged shackles for general lifting purposes — Dee shackles and bow shackles)

BS 3243..... Specification for hand-operated chain blocks; (EN 13157 Cranes. Safety. Hand powered cranes)

BS 3481-2 ..... Flat lifting slings - Specification for flat woven webbing slings made of man-made fibre for general service

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BS 3551..... Specification for alloy steel shackles

BS 4941 (IEC 292) .... Specification for motor starters for voltages up to and including 1000 V a.c. and 1200 V d.c. - ; (EN 60947-3 Low-voltage switchgear and controlgear - Switches, disconnectors, switch-disconnectors and fuse-combination units); (IEC-292 Low-voltage motor starters; (IEC 60947-4-1 Low-voltage switchgear and controlgear - Part 4-1: Contactors and motor-starters - Electromechanical contactors and motor-starters))

BS 4942,..... Short link chain for lifting purposes : Short link chain grade (T) 8; (BS 4942-6 Short link chain for lifting purposes - Specification for grade T (8) calibrated chain; (ISO 3077))

BS 5304..... Code of practice for the safety of machinery (BSI PD 5304 -Guidance on safe use of machinery)

BS 5714,..... Method of measurement of resistivity of metallic materials

BS 5744,..... Code of practice for safe use of cranes (overhead/underhung travelling and goliath cranes, high pedestal and portal jib dockside cranes, manually-operated and light cranes, container handling cranes and rail-mounted low carriage cranes)

BS 6231,..... Electric cables. Single core PVC insulated flexible cables of rated voltage 600/1000 V for switchgear and controlgear wiring

BS 6346,..... Electric cables. PVC insulated, armoured cables for voltages of 600/1000 V and 1900/3300 V

BS 6405,..... Specification for non-calibrated short link steel chain (grade 30) for general engineering purposes: class 1 and 2: Non-calibrated short link chain (grade 30) for general engineering purposes

BS 6994..... Specification for steel shackles for lifting and general engineering purposes: grade M(4); (ISO 2415 - Forged shackles for general lifting purposes — Dee shackles and bow shackles)

BS 7121..... Code of practice for safe use of cranes -

BS 7613,..... Specification for hot rolled quenched and tempered weldable structural steel plates; (EN 10025-1 Hot rolled products of structural steels - Part 1: General technical delivery conditions; EN 10025-6 Hot rolled products of structural steels - Part 6: Technical delivery conditions for flat products of high yield strength structural steels in the quenched and tempered condition)

BS 7668,..... Weldable structural steels. Hot finished structural hollow sections in weather resistant steels. Specification

BS 7671,..... Requirements for Electrical Installations. IET Wiring Regulations

BS 4942 (ISO 1834, 1835, 3075-3077) Short link chain for lifting purposes – (ISO 1834 Short link chain for lifting purposes — General conditions of acceptance; ISO 1835 Round steel short link chains for lifting purposes — Medium tolerance sling chains — Grade 4, stainless steel; ISO 3075 Short link chain for lifting purposes — Grade S (6) non calibrated, for chain slings etc.; ISO 3076 Round steel short link chains for general lifting purposes — Medium tolerance sling chains for chain slings — Grade 8; ISO 3077 Short-link chain for lifting purposes — Grade T, (types T, DAT and DT), fine-tolerance hoist chain)

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EN 287 ..... Qualification test of welders - Fusion welding; (EN 287-1 test of welders - Fusion welding - Part 1: Steels: ISO 9606-1Qualification testing of welders - Fusion welding - Part 1: Steels; ISO/AWI 9606.2 Qualification testing of welders — Fusion welding; EN 287-2 Approval testing of welders - Fusion welding - Part 2: Aluminium and aluminium alloys: ISO 9606-2 Qualification test of welders - Fusion welding - Part 2: Aluminium and aluminium alloys)

EN 288..... Specification and approval of welding procedures for metallic materials; (ISO 15607 Specification and qualification of welding procedures for metallic materials — General rules; ISO 15609-1 Specification and qualification of welding procedures for metallic materials — Welding procedure specification — Part 1: Arc welding; ISO 15614-1 Specification and qualification of welding procedures for metallic materials — Welding procedure test — Part 1: Arc and gas welding of steels and arc welding of nickel and nickel alloys; ISO 15614-2 Specification and qualification of welding procedures for metallic materials — Welding procedure test — Part 2: Arc welding of aluminium and its alloys; ISO 15610 Specification and qualification of welding procedures for metallic materials — Qualification based on tested welding consumables; ISO 15611 Specification and qualification of welding procedures for metallic materials — Qualification based on previous welding experience; ISO 15612 Specification and qualification of welding procedures for metallic materials — Qualification by adoption of a standard welding procedure specification; ISO 15613 Specification and qualification of welding procedures for metallic materials — Qualification based on pre-production welding test)

EN 818-7 and ISO 3077, Short link chain for lifting purposes - Safety - Part 7: Fine tolerance hoist chain, Grade T (Types T, DAT and DT) : stainless steel chain, grade 80. Polished short link calibrated load chain for pulley blocks; (ISO 3077 Short-link chain for lifting purposes — Grade T, (types T, DAT and DT), fine-tolerance hoist chain)

EN 1492-1 ..... Textile slings - Safety - Part 1: Flat woven webbing slings made of man-made fibres for general purpose use

EN 1677..... Components for slings - Safety -

EN 10113 ..... Hot-rolled products in weldable fine grain structural steels; (EN 10025-1 Hot rolled products of structural steels - Part 1: General technical delivery conditions; EN 10025-3 Hot rolled products of structural steels - Part 3: Technical delivery conditions for normalized/normalized rolled weldable fine grain structural steels; EN 10025-4 Hot rolled products of structural steels - Part 4: Technical delivery conditions for thermomechanical rolled weldable fine grain structural steels)

EN 10155 ..... Structural steels with improved atmospheric corrosion resistance. Technical delivery conditions; (EN 10025-1 Hot rolled products of structural steels - General technical delivery conditions; EN 10025-5 Hot rolled products of structural steels - Technical delivery conditions for structural steels with improved atmospheric corrosion resistance)

EN 10204 ..... Metallic products - Types of inspection documents

EN 10210 ..... Hot finished steel structural hollow sections

EN 12385 ..... Steel wire ropes. Safety -

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EN 13001 (ISO 4301, 8306) -- Power driven overhead travelling cranes, semi-Goliath and Goliath chain for general use; (EN 13001 Cranes - General design; ISO 4301 Cranes — Classification- ; ISO 12488-1 Cranes — Tolerances for wheels and travel and traversing tracks — Part 1: General

EN 13414-1 ..... Steel wire rope slings. Safety - Slings for general lifting service

EN 13414-2 ..... Steel wire rope slings. Safety - Specification for information for use and maintenance to be provided by the manufacturer

EN 60947 ..... Low-voltage switchgear and controlgear - ; (IEC 60947 Low-voltage switchgear and controlgear -)

ISO 2415 ..... Forged shackles for general lifting purposes — Dee shackles and bow shackles

ISO 2903 ..... ISO metric trapezoidal screw threads — Tolerances

ISO 3077 ..... Short-link chain for lifting purposes — Grade T, (types T, DAT and DT), fine-tolerance hoist chain

ISO 4301-1 ..... Cranes and lifting appliances — Classification — Part 1: General

ISO 4309 ..... Cranes — Wire ropes — Care and maintenance, inspection and discard

ISO 7592 ..... Calibrated round steel link lifting chains — Guidelines to proper use and maintenance

7.1.3 System Description

1 General. Lifting equipment shall be provided as required to remove equipment for replacement and/or maintenance purposes. The design shall ensure safe access is provided for the operation of the lifting equipment. Overhead cranes may also be required to grant access for maintenance of roof mounted equipment such as light fittings, fans, and shall be designed to facilitate this. Davits shall only be used to lift submersible pumpsets and other equipment from wells. Lifting equipment shall be supplied with all the necessary spacers, clamps, harnesses, slings, D links and eye bolts to lift any of the installed plant. Guards shall be provided in accordance with Part 1.

7.1.4 Submittals

1 In addition to the requirements of Part 1 of this Section the Contractor shall provide data and information as described in the following paragraphs.

2 Design data. Complete structural calculations of crane and monorail member and component sizing and design, classification of crane and mechanism shall be submitted, as required by BS 2573 (ISO 4301-1), BS 2853 and the application / building requirements.

3 Shop Drawings. These shall be submitted as required by Part 1. Lay-out drawings shall clearly show the lifting height of the equipment and clearances in relation to other equipment and structures where the largest items are lifted.

4 Test certificates shall be submitted as required under factory inspection and testing.

5 Operation and maintenance manuals and instructions. The Contractor shall include all the documentation required by Section 1 on the lifting equipment in the operation and maintenance manuals. A copy of the design data, factory and site tests shall be included in the manuals.

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7.2 PRODUCTS

7.2.1 General

1 Hoist monorails, bridge cranes, davits and 'A' frames shall include all equipment, appurtenances and auxiliaries to make the lifting equipment fully operational and capable of performing under the specified load conditions.

2 Lifting systems, including hoists, as far as feasible, shall use the standard components of one manufacturer to simplify maintenance.

3 Nameplates shall be permanently attached to the monorail hoist and bridge crane hoist assemblies. The lifting capacity shall be stencilled on in tonnes in both Arabic and English on each side and shall be clearly legible from the working level.

4 Warning signs in the Arabic and English languages shall be provided to the approval of the Engineer and affixed to the bottom lift blocks or pendant controllers.

7.2.2 Design Conditions

1 Cranes and lifting equipment shall be suitable for indoor or outdoor installation, as designated.

2 The high ambient temperature of 55^0C in which outdoor lifting equipment and particularly outdoor cranes may be required to operate shall be taken into consideration, particularly with respect to the electrical load ratings of motors, switchgear, resistors, cables and wiring, as well as mechanical heat sources such as brakes, bearings and gearing. Due allowance shall be made for possibly higher temperatures than the maximum recorded shade temperature near the roofs of buildings, if the lifting equipment is mounted in a building, or for the effect of direct sunlight if mounted externally.

3 Design of travelling monorail hoist and bridge crane hoists and incidental accessories shall be based upon the use of a factor of safety of 5, structural beams shall have a factor of safety of 2 with capacity load on all mechanical parts of the system. The factors of safety shall be based upon the ultimate strength of the material used. The equipment shall be of ratings and sizes designated in the Project Specification.

4 Lifting equipment shall be rated for the load of the heaviest installed item of plant, and designed such that one man can operate it without difficulty.

5 Hooks and load chains shall reach to the floor of the lowest level.

6 Lifting equipment installations shall comply with BS 5744 and BS 7121.

7 Unless otherwise specified in the particular project specification, hoist speed – low (creep speed) shall be within the range of 0.63 m/minute ± 30%

8 The hoist speed, high shall be as fast as possible without impairing safety in working according to particular applications and requirements.

9 All the components of crane shall be of at least M5 group classification and mechanism in accordance with ISO 4301-1.

7.2.3 Davits

1 Davits and sockets shall be fabricated from fully welded mild steel, to BS 7668, BS 7613, EN 10155, EN 10013, galvanised and protected in accordance with BS 729 and Section 8.

2 Davits too heavy to manhandle shall consist of a davit arm, with removable pillar, and rotating removable jib arm.

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3 Davits shall have a roller thrust bearing swivel for the upright pillar, with a locking mechanism.

4 Sockets shall be cast-in, unless bolted sockets are specified, or it is not possible to fix cast-in sockets. A rubber socket plug with a stainless steel chain shall be provided to prevent sand ingress when the davit is not in use.

7.2.4 Monorail Travelling Hoists

1 Each hoist shall comprise a manually operated geared travelling pulley block complete with steel runway beams, “A” frame supports where specified and all accessories including slings and spreaders.

2 Pulley blocks shall be manually operated up to a height of 6 to 8 m. Above 8 m electric hoists shall be provided.

3 The runway beams shall be designed, tested and certified in accordance with BS 2853.

4 The blocks shall run on the lower flange of the runway beam and shall be of the spur geared close haul type.

5 The blocks shall be complete with a geared travelling trolley and shall be capable of being easily removed from the trolley without the necessity for dismantling. The operating chain for the longitudinal motion of the trolley shall extend to within 600 mm of the floor.

6 Load chain collection boxes shall be provided.

7 Monorail systems shall not be used for loads exceeding 2000 kg.

7.2.5 Cranes

1 Cranes shall comprise end carriages and bridge units to be bolted together on site, during erection.

2 Cranes shall be single girder or double girder as designated.

3 All exposed moving parts of the drive mechanisms shall be fitted with safety guards wherever possible, in accordance with Part 1.

4 The bridge girders, end carriages and crab structures of the crane shall be designed and constructed in accordance with all the relevant requirements of EN 13001. With the crane operating under maximum service load, the stress in any operating component shall not exceed the permissible values stipulated in Part 1 of BS 2573 (ISO 4301). The crane manufacturer shall supply all the information required EN 13001.

5 The main bridge girders shall be plate or box girder designed as compound beams with the rails for the crab track secured on the top flange.

6 Jacking points and tie downs shall be provided for both bridge and crab.

7.2.6 Manually Operated Chain Blocks

1 The hoisting wheel shall be grooved and pocketed to receive the load chain. The load chain shall be stainless steel chain Grade 80 according to EN 818-7 and ISO 3077.

2 Hand chains shall be to Grade 30 BS 6405 or better.

3 Chain guides shall be provided to ensure effective guidance of the load chain into the load chain wheel pockets. A stripper shall be provided to ensure effective disengagement of the load chain from the load chain wheel.

4 The idler wheel scores shall be so shaped as to avoid twisting the chain as it passes round. The pitch diameter of the idler wheels shall not be less than 16 times the size of the chain, unless they are so shaped as to avoid a bending action on the link.

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5 The load chain anchorage, associated fittings and framework at the slack end shall be rated at 2.5 times the maximum tension in the load chain when the working load limit is being lifted. Any link used for connecting the load chain to a terminal fitting shall be of the material specified for the chain and heat treated to provide mechanical properties and strength equivalent to those of the load chain.

6 Quality and material composition of each lifting chain is confirmed by test certificate 3.1 to EN 10204 The hook shall be made from high grade forged stainless steel complying with' EN 1677 and provided with a safety catch. The hook shall be supported on a ball thrust bearing to allow free swivelling under full loads.

7 The sheaves of the hook block shall be guarded to prevent a hand or fingers being trapped.

8 The crab hoisting gear shall be such that one man is capable of easily raising the maximum load.

9 A galvanised mild steel chain collecting box shall be incorporated.

10 A reliable and effective braking and locking arrangement shall be provided.

11 Lifting blocks supplied for lifting equipment from wet wells shall be of stainless steel and shall include the facility for obtaining a fresh lift on the equipment lifting chains at 1 metre intervals.

7.2.7 Electrically operated Rope Lifting Hoist

1 All hoists above a height of 8 m shall be electrically operated.

2 The hoist rope drum shall be of high quality cast iron with left and right hand spiral grooves to accommodate the hoist rope in one layer. As far as possible, the drive gearing shall be fixed directly to the rope drum to obviate high torsional stress in the drum shaft. The rope shall be securely clamped to the drum.

3 The hoist drum shall incorporate a wire rope rewind system and guides to prevent the hoist rope skipping and damaging the lay.

4 The hoist braking system shall be of the automatic electro-mechanical fail safe type which, when the current is cut off or fails will automatically arrest the motion and hold at rest any load up to and including the rated load. The system shall safely control the lowering of the same load form the highest to the lowest point of lift and shall not allow any slippage of the suspended load to occur when the 'Raise' motion is initiated.

5 The hoist rope shall be a flexible wire rope specially designed for usage with cranes and in accordance with EN 12385, with a safety factor of not less than six times the maximum tension induced by the safe working load.

6 The crane hook shall be of high grade forged stainless steel trapezoidal section in accordance with EN 1677. The hook shall be supported on a ball thrust bearing to allow free swivelling under full loads and shall also be fitted with a safety catch. The safe working load shall be marked in the hook in accordance with EN 1677.

7 The sheaves of the hook block shall be guarded to prevent a hand or fingers from being trapped between the sheaves and the in-running rope.

8 A limit switch shall be fitted to prevent over hoisting. This shall be self-resetting, closing automatically when the hoist motor is put in reverse.

9 Brakes shall be well protected from oil and grease leakage or spillage, and from adverse effects of atmospheric condensation or dust. A simple and easily accessible means of carrying out adjustment for wear of the shoes or linings shall be provided for all brakes.

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10 Automatic brakes, operating when the drive motor stops shall be supplied for the long and cross travel motions.

7.2.8 Mechanical Components

1 End Carriage

(a) both end carriages of electrically operated cranes shall be powered either by a duplicate geared motor drive, or by a single motor unit and a layshaft system. Longitudinal and cross traverse motions shall be provided on the crane such that the operation is speedy without impairing safety in working. The longitudinal and traverse motions shall be operated by means of hand chains extending to within 600 mm of the operating floor. The hoisting and lowering chains shall be of the same length. The hook and load chain shall be such that the hook will reach to the lowest floor level. The operating chain for the longitudinal motion of the crane shall be suitably positioned to enable the operator to move the unit easily, without dragging the operating chains over the control panels or other equipment

(b) the runner wheels shall be of cast steel, with double flanges, mounted on roller bearings, or fitted with phosphor-bronze bushes running on hardened steel axles.

2 Crab Unit(s)

(a) the crab frame shall be in accordance with EN 13001 and shall provide a strong rigid framework for the hoist and cross-travel machinery mounted thereon. The placement and layout of mechanical and electrical items shall facilitate easy inspection, service and maintenance of the motors, reduction gearing and braking system

(b) the runner wheels shall be of cast steel with double flanges and mounted on roller bearings. Gearing shall be of totally enclosed type with machine cut gears. Bearings shall be ball or roller.

3 Endstops. Resilient or spring type buffers shall be provided on all runway/cross beams and crane rails. Where carriages are equipped with electric travel the endstops shall be provided with limit switches at the end of each direction of travel.

4 Crane Rails. These shall comply with BS 449 and EN 10155 The line of the rails shall not vary by more than 3mm throughout the whole length of travel. Whenever possible, rails shall be one piece. Where rails are to be jointed this shall be by electrical induction welding.

5 Access Platforms And Ladders

(a) safe means of access shall be provided for examination and maintenance of the crane or other equipment only accessible from the crane. Guards shall be fitted where possible under the crab and long travel motor and gearbox assembly to prevent persons on the ground being endangered by falling objects during maintenance

(b) all ladders, platforms and access ways shall comply with Section 8. Open mesh flooring shall not be used. Access ways shall be not less than 800mm wide. The platforms and access ways shall be securely fenced with double tiered guard rails and steel ‘toe boards’ or ‘kicking plates’.

6 Painting. This shall be in accordance with Section 8.

7 Materials. Steel used for the fabrication of the lifting equipment shall comply with BS 449, BS 7613, BS 7668, EN 10113, EN 10155 and EN 10210 as applicable. Welding procedures shall comply with EN 287 and EN 288

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7.2.9 Electrical Components

1 Motors

motors shall comply with the Part 1 of this Section and Section 21 except they shall be rated for 360 starts per hour with 60% duty rating as minimum shaft output power at least 15% greater than the maximum power which will be required for operation and testing of the crane in the ambient temperature specified, at the maximum rated load.

2 Control Gear

(a) a triple pole isolating switch with HRC fuses shall be provided at ground level for each lifting assembly. This switch shall be lockable in the 'OFF' position only and shall be provided with a Yale type lock and three keys. The switch shall have a label marked 'CRANE ISOLATING SWITCH' in English and Arabic.

(b) starters and controllers for the crane motors shall be designed and constructed in accordance with the requirements of EN 13001, BS 4941, EN 60947 and section 21. All control circuits shall operate at 110 volts (as per project specification and KAHRAMAA regulations)

(c) mechanically and electrically interlocked reversing contactors shall be provided for each motion including speed control of the hoist. Accelerating contactors shall cut out the rotor circuit resistance of the motor in steps with suitable delays. Contacts shall be adjustable and renewable

(d) controller and resistors shall be rated such that temperatures do not exceed the limits specified in BS 4941 during operation of the crane under maximum temperature conditions. Starting resistors shall have not less than a 'ten minute' rating. Speed control resistors shall be one hour rated

(e) the control gear and cabling shall be suitable for 'inching' i.e. many repeated small movements at both creep and normal speed, in any direction of motion

(f) the starters and controllers shall be housed in well constructed sheet steel panel cabinets of not less than 2mm thick, sprayed and painted with an anti-condensation paint. The enclosures shall be protected against dust and damp to classifications IP 54. Starting resistors shall be mounted in a ventilated section of each control cubicle. The resistors shall all be fitted with terminal bars. The control cubicles shall be provided with lockable hinged access doors, also interlocked with the main isolating switch.

3 Controls

(a) the long-travel, cross-travel and slow and normal speed hoist motions of each crane shall all be controlled from the lowest level by a pendant push button station. The controls shall operate on a low voltage system supplied by a double wound isolating transformer. Both primary and secondary sides of the transformer shall have HRC fuse protection. One pole of the secondary winding shall be effectively earthed

(b) push button controls shall be of the pendant type with 'hold-on' type push buttons automatically returning to the 'off' state on release of the button. Push buttons shall be provided for 'SLOW -UP', SLOW DOWN' 'NORMAL UP', 'NORMAL DOWN', 'LEFT', 'RIGHT', 'FORWARD' AND 'REVERSE'. A larger size red 'Emergency Stop' button shall initiate tripping of the control gear main circuit breaker and automatic application of the brakes on all motions. Re-closure of the main circuit breaker shall be initiated by a separate 'Reset' button also on the pendant. The pendant shall be oil tight polyethylene, totally enclosed to IP65, shockproof, and shall be suspended from the crab unit. The voltage at the pendant shall not exceed 55 volts to earth

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(c) limit switches shall be provided for all motors at the end of each direction of travel

(d) infrared or radio remote control shall be provided, where specified, or if necessary for safe operation of the crane. Two battery packs with battery charger, sensors, sensor connecting cables with clips, receiver and decoder shall be provided. Adequate sensors shall be provided at each level (minimum three) to ensure continuous control in all zones of operation. If radio is used then approval shall be obtained by the Contractor for the frequencies used.

4 Cables wiring and earthing

(a) an insulated conductor system shall be provided for electrically powered cranes supply. The insulated conducted system shall be of the type where each phase is individually insulated and supported on a metal support. The type where all conductors are contained within a single extruded or moulded insulation will not be permitted. A 'festoon' insulated cable system shall be provided for the cross-travel supply

(b) the wiring and earthing of the cranes shall conform to EN 13001. Cables and wiring shall be of 600/1,000 volt grade PVC insulated cables in accordance with BS 6231 and BS 6346. Wherever possible, the cables shall be run in screwed heavy gauge galvanised steel conduit. All cable ends shall be clearly labelled with identification of the appropriate terminals

(c) the selection installation and testing of cables and wiring shall be in accordance with BS 7671 except that maximum current ratings shall be raised by a factor of 1.4 times the rating for continuous duty obtained (after applying all necessary de-rating factors for high ambient temperature, grouping and disposition form of installation, etc). The up-rating factor of 1.4 is based on the one hour motors specified for crane operation

(d) the crane structure, tracks, motor frames and metal cases of all electrical equipment, including metal conduit and cable guards, shall be earthed in accordance with BS 7671.

7.2.10 Factory Inspection and Testing

1 The Contractor shall secure from the lifting equipment manufacturer certification that the following inspections and tests have been conducted on each lifting equipment at the factory, and submit to the Engineer prior to shipment.

2 Cranes shall be inspected and tested in accordance with the requirements of EN 13001 with the difference that the "Tests on Purchaser's Premises" (Clause 54) shall also be carried out in the manufacturer's works and witnessed by the Engineer.

3 The works tests shall include overload tests during which a 25% overload shall be lifted by the hoist at the middle of the crane span and sustained under full control whilst it is moved up and down at both normal and creep hoist speeds. Whilst still under overload the crab unit of each crane shall be operated form end to end of its travel.

4 The mechanism and controls for the long travel motions shall be tested under light running conditions without moving the crane.

5 Tests on manually operated cranes and hoists shall comply with the above insofar as they are applicable.

6 Control panels, motor and any factory installed wiring shall be inspected tested in accordance with Part 1 of this Section and Section 21.

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7.2.11 Spare Parts and Tools

1 Two years supply of spare parts and lubricants shall be supplied for each lifting device supplied.

7.3 INSTALLATION AND COMMISSIONING

7.3.1 Installation

1 Lifting equipment shall be installed in accordance with the requirements and instructions of the manufacturer. If specified in the Project Specification, the lifting equipment manufacturer shall provide a representative to supervise the installation and testing.

7.3.2 Site Tests

1 After erection cranes and hoists shall be inspected, tested and certification provided by a qualified independent crane testing specialist in accordance with the requirements of EN 13001 and the tests witnessed by the Engineer. Hand cranes shall be similarly tested.

2 Electrical equipment shall be tested in accordance with the requirements of Section 21

END OF PART

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