

**PERIODICAL INSPECTION****AND****TESTING OF CRANES****ORIGINAL EDITION****DEC. 1997**

**This standard specification is reviewed and updated by the relevant technical committee on Oct. 2012. The approved modifications are included in the present issue of IPS.**

**FOREWORD**

The Iranian Petroleum Standards (IPS) reflect the views of the Iranian Ministry of Petroleum and are intended for use in the oil and gas production facilities, oil refineries, chemical and petrochemical plants, gas handling and processing installations and other such facilities.

IPS are based on internationally acceptable standards and include selections from the items stipulated in the referenced standards. They are also supplemented by additional requirements and/or modifications based on the experience acquired by the Iranian Petroleum Industry and the local market availability. The options which are not specified in the text of the standards are itemized in data sheet/s, so that, the user can select his appropriate preferences therein.

The IPS standards are therefore expected to be sufficiently flexible so that the users can adapt these standards to their requirements. However, they may not cover every requirement of each project. For such cases, an addendum to IPS Standard shall be prepared by the user which elaborates the particular requirements of the user. This addendum together with the relevant IPS shall form the job specification for the specific project or work.

The IPS is reviewed and up-dated approximately every five years. Each standards are subject to amendment or withdrawal, if required, thus the latest edition of IPS shall be applicable

The users of IPS are therefore requested to send their views and comments, including any addendum prepared for particular cases to the following address. These comments and recommendations will be reviewed by the relevant technical committee and in case of approval will be incorporated in the next revision of the standard.

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**GENERAL DEFINITIONS**

Throughout this Standard the following definitions shall apply.

**COMPANY :**

Refers to one of the related and/or affiliated companies of the Iranian Ministry of Petroleum such as National Iranian Oil Company, National Iranian Gas Company, National Petrochemical Company and National Iranian Oil Refinery And Distribution Company.

**PURCHASER :**

Means the "Company" where this standard is a part of direct purchaser order by the "Company", and the "Contractor" where this Standard is a part of contract document.

**VENDOR AND SUPPLIER:**

Refers to firm or person who will supply and/or fabricate the equipment or material.

**CONTRACTOR:**

Refers to the persons, firm or company whose tender has been accepted by the company.

**EXECUTOR :**

Executor is the party which carries out all or part of construction and/or commissioning for the project.

**INSPECTOR :**

The Inspector referred to in this Standard is a person/persons or a body appointed in writing by the company for the inspection of fabrication and installation work.

**SHALL:**

Is used where a provision is mandatory.

**SHOULD:**

Is used where a provision is advisory only.

**WILL:**

Is normally used in connection with the action by the "Company" rather than by a contractor, supplier or vendor.

**MAY:**

Is used where a provision is completely discretionary.

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**0. INTRODUCTION**

Cranes shall be subjected to frequent and periodical inspection concerned to the services they are used. Details of inspection and testing necessary to guarantee safe operation of mobile, overhead, gantry and off-shore cranes are covered in this Standard specification.

## 1. SCOPE

This Standard specification covers minimum requirements for periodical inspection and testing of mobile, overhead, gantry and off-shore cranes to be used in refinery services, gas, chemical, and petrochemical plants, and production services.

### Note:

**This standard specification is reviewed and updated by the relevant technical committee on Oct. 2012. The approved modifications by T.C. were sent to IPS users as amendment No. 1 by circular No. 356 on Oct. 2012. These modifications are included in the present issue of IPS.**

## 1.1 REFERENCES

Throughout this Standard the following dated and undated standards/codes are referred to. These referenced documents shall, to the extent specified herein, form a part of this standard. For dated references, the edition cited applies. The applicability of changes in dated references that occur after the cited date shall be mutually agreed upon by the Company and the Vendor. For undated references, the latest edition of the referenced documents (including any supplements and amendments) applies.

### IPS (IRANIAN PETROLEUM STANDARDS)

<a href="#">IPS-E-GN-100</a>	"Engineering Standards for Units"
<a href="#">IPS-M-GN-330</a>	"Material and Equipment Standard for Offshore Cranes"
<a href="#">IPS-M-GN-340</a>	"Material and Equipment Standard for Mobile Cranes-Power Driven"
<a href="#">IPS-M-GN-350</a>	"Material and Equipment Standard for Overhead and Gentry Cranes (Overhead Traveling and Portal Bridge Cranes)"

## 1.2 UNITS

This standard is based on international system of units (SI), as per [IPS-E-GN-100](#) except where otherwise specified.

## 2. INSPECTION CLASSIFICATION

### 2.1 Initial Inspection

Prior to initial use, all new and altered cranes shall be inspected by a qualified person to ensure compliance with the provisions of the appropriate Standard.

### 2.2 Regular Inspection

Inspection procedure for cranes in regular service is divided into two general classifications based upon the intervals at which inspection should be performed. The intervals are dependent in turn upon the nature of the critical components of the crane and the degree of their exposure to wear, deterioration, or malfunction. The two general classifications are herein designated as frequent and periodic, with respective intervals between inspections as defined below:

#### A) Mobile cranes

##### 1) Frequent inspection

Daily to monthly intervals, by a designated person;

**2) Periodic inspection**

One to twelve month intervals, or as specifically recommended by the manufacturer or by a qualified person.

**B) Overhead and gantry cranes****1) Frequent inspection**

Visual examinations by the operator or other designated personnel with records not required.

- a) Normal service- monthly;
- b) Heavy service-weekly to monthly;
- c) Severe service-daily to weekly;
- d) Special or infrequent service-as recommended by a qualified person before and after each instance of special or infrequent service.

**2) Periodic inspection**

Visual inspection by an appointed person making records of apparent external conditions to provide the basis for a continuing evaluation.

- a) Normal service ----- equipment in place ----- yearly;
- b) Heavy service ----- equipment in place ----- yearly;
- c) Severe service ----- as in (b) ----- quarterly;
- d) Special or infrequent service ----- as recommended by a qualified person before and after each instance of special or infrequent service.

**C) Off-shore cranes****1) Frequent inspection**

Daily to monthly intervals, by a designated person.

**2) Periodic inspection**

One to twelve month intervals, or as specifically recommended by the manufacturer or by a qualified person.

**Note:**

**In any case, inspection intervals for mobile cranes shall not be more than one year and for over head cranes more than three years.**

**3. FREQUENT INSPECTION****3.1 Mobile Cranes**

Items such as the following shall be inspected by a designated person for defects at intervals as defined in Paragraph 2.2.A or as specifically indicated by the manufacturer, including observation during operation for any deficiencies which might appear between regular inspections. Any deficiencies, such as those listed, shall be carefully examined and a determination made as to whether they constitute a hazard:

- a) All control mechanisms for maladjustment interfering with proper operation-daily, when used;
- b) All control mechanisms for excessive wear of components and contamination by lubricants or other foreign matter;

- c) All safety devices for malfunction;
- d) All hydraulic hoses, and particularly those which flex in normal operation of crane functions, should be visually inspected once every working day, when used;
- e) Hooks and latches for deformation, chemical damage, cracks, and wear;
- f) Rope reeving for compliance with crane manufacturer's specifications;
- g) Electrical apparatus for malfunctioning, signs of excessive deterioration, dirt, and moisture accumulation;
- h) Hydraulic system for proper oil level-daily, when used;
- i) Tires for recommended inflation pressure.

### 3.2 Overhead and Gantry Cranes

Items such as the following shall be inspected for defects and damage at intervals as defined in 2.2.B. This includes observations during operation of any defects or damage that might appear between periodic inspections. A designated person shall determine whether any defects or damage constitute a hazard or will require more frequent inspection.

- a) All functional operating mechanisms for misadjustment interfering with proper operation;
- b) All limit switches should be checked, without a load on the hook, at the beginning of each work shift. Care shall be exercised. Each motion shall be inched into its limit switch, or run in at a low speed;
- c) Leakage in lines, tanks, valves, pumps, and other parts of air or hydraulic systems;
- d) Deformed or cracked hooks-visual inspection. For hooks with cracks, or having more than 15% in excess of normal throat opening, or having more than 10° twist from the plane of the unbent hook;
- e) Hook latches, if used;
- f) Hoist ropes, including end clamps and rope clips;
- g) Rope reeving for noncompliance with crane manufacturer's recommendations.

### 3.3 Off-Shore Cranes

Items such as the following shall be inspected by designated person for defects at intervals as defined in Paragraph 2.2.C or as specifically indicated by the manufacturer:

- a) All control mechanism for maladjustment interfering with proper operation;
- b) All control mechanism for excessive wear of components and contamination by lubricants or other foreign matter;
- c) All safety devices for malfunction;
- d) All hydraulic hoses;
- e) Hooks and latches for deformation, cracks, and wear;
- f) Hoist ropes;
- g) Loop reeving for non-compliance with crane manufacturer's recommendations.

## 4. PERIODICAL INSPECTION

### 4.1 General

**4.1.1** The inspector shall establish the conditions of the following parts:

- Hooks and hook attachments (swivels, safety latches, cross-heads, shanks, nuts etc.);
- Ropes and rope attachments (bulldog grips, sockets, thimbles, shackles, wedge clamps, swaged terminals, etc.);
- Chains and chain attachments (rings, bordeaux connections, etc.);
- Clutches and clutch drums (Linings, shoes, friction discs, etc.);
- Brakes and brake attachments (shoes, linings, metal bands, shoes pins);
- Sheaves, pulleys and runners;
- Sheave and pulley pins and attachments (keep plates, locking screws, and shell plates);
- Interlocking mechanisms, (mechanical locks, ratchets, pawls etc.);
- Safety devices (over-luffing and over-hoisting cut outs, overload warning devices, limit switches, and overspeed brakes);
- Slewing rollers, their pins and retainers;
- Gears directly connected with lifting, derricking, slewing and traveling systems;
- Stabilizer jacks and outrigger system;
- Booms and boom foot pins, splice pins, and load indicators.

**4.1.2** The inspector shall examine shafts at bearing locations, the anchoring attachments, guide rollers and any other parts deemed by him to affect the safety of the cranes.

The examination of slewing rollers and gears may be waived at the discretion of the inspector, but these parts shall be examined at least at every other inspection, and the report shall be clearly marked to this effect.

**4.1.3** Hoisting and luffing ropes are to be unwound from drums and the full length of the ropes examined, together with the anchorage arrangements. Care shall be taken to ensure that any unwound portions of the rope are kept free from any dust, sand, etc., during the examination. All portions of the rope shall be properly lubricated (including those cleaned for examination) before reassembly on the lifting appliance.

**4.1.4** Main bearings directly connected with the hoisting, luffing and slewing parts of the lifting appliances shall be removed for examination of journals and verification of lubrication efficient.

**4.1.5** Axle bearings shall be exposed to enable bearing surfaces to be examined, and efficiency of lubrication verified.

**4.1.6** The overhauling weights (dead weights) at the hook end of hoisting rope shall be removed and the inspector shall examine the hidden parts of the rope, such as splicing, swivel joints and pins.

**4.1.7** All accidents to cranes, runway beams and trolley blocks and any other lifting appliances, when in use shall be reported to the inspection department and where damage resulted, the lifting equipment shall be taken out of service until inspected and examined by the inspector and defects repaired and approved for service again.

**4.1.8** When the cranes are electrically operated, overhaul and inspection of the electrical gears shall be carried out concurrently with the mechanical inspection.

**4.1.9** The inspector shall finally witness the crane operating through all its motions under the corresponding safe working load, and shall test the performance of safe load indicators, limit switches and interlocking devices, as described in Clauses, 4.2.3, 4.3.3 and 4.4.3.

**4.1.10** Dated inspection reports or comparable records shall be made on critical items such as hoisting machinery, sheaves, hooks, chains, ropes, and other lifting devices. Records should be available to appointed personnel.

## **4.2 Overhead and Gantry Cranes**

### **4.2.1 Preparation for periodical inspection**

**4.2.1.1** At each examination the following parts shall be cleaned and prepared for inspection in such a way that will enable the inspector to establish their condition.

- a)** Hooks and hook attachments (swivels, safety latches, cross head, shanks nuts, etc.);
- b)** Ropes and rope attachments (bull dog grips, sockets, thimbles, shackles, wedge clamps, swaged terminals, etc.);
- c)** Clutches and clutch drums (linings, shoes, friction discs, etc.);
- d)** Brakes and brake attachments (shoes, linings, metal bands, shoe pins);
- e)** Sheaves, pulleys, and runners;
- f)** Sheave and pulley pins and attachments (keep plates, locking screws, and shell plates);
- g)** Interlocking mechanisms (turntable, house locks, ratchets, pawls etc.);
- h)** Safety devices (overluffing and overhoisting cut outs, overload warning devices, limit switches, and overspeed brakes);
- i)** Gears directly connecting with lifting and traveling system.

**4.2.1.2** At no time shall any wire rope or any chain be exposed to any sand, abrasive dust, or dirt when being examined.

**4.2.1.3** Provision shall be made, when required by the Inspector, for facilities to examine shafts at bearing locations, of the track wheels guide rollers, and any other parts deemed by him to affect the safety of the crane.

**4.2.1.4** Complete removal of wire rope may be waived at the discretion of the inspector.

### **4.2.2 Inspection**

#### **4.2.2.1 Structure**

**4.2.2.1.1** Girders shall be inspected for any distortion.

All welded, bolted or riveted work shall be checked for general soundness.

**4.2.2.1.2** Struts, tie bars, pin joints and attachments shall be inspected. It should be established that all are in order.

**4.2.2.1.3** End carriages shall be checked to be robust and in order, specially in way of track wheel axle bearing.

**4.2.2.1.4** Rails and supports shall be checked for soundness, correct leveling, perfect alignment and security which is absolutely essential.

#### **4.2.2.2 Trolleys**

Trolleys shall be dismantled if possible and checked for soundness of check plates and bolts, rollers and roller pins.

#### **4.2.2.3 Winding drums**

Winding drums shall be inspected and checked for any severe grooving and abrasion of the barrel and defective barrel grooves.

#### **4.2.2.4 Rope and chain attachments**

The principal attachments which are at hoisting drum dead end and hook shall be checked for soundness and proper attachments.

#### **4.2.2.5 Gears and gear wheels**

Gears, pinions, and sprockets directly connected to the hoisting shall be cleaned and exposed or preferably removed.

They shall be thoroughly checked and examined, to be free from wear, crack and other defects.

#### **4.2.2.6 Shafts and pins**

Shafts and pins shall be inspected for wear, crack, scores and other defects.

#### **4.2.2.7 Brakes (for hoists, trolleys and bridges)**

Brakes should be completely opened up. All linings and their methods of attachment should be satisfactory. Any traces of Oil and grease must be entirely removed.

Brake shoes, brake nipples and brake wheels shall be inspected to be free from wear, crack, scores and other defects.

#### **4.2.2.8 Runway beam**

Beams shall be checked for corrosion, wear, distortion and deflection.

The condition of attachments of beam to the cross-beams pillars, supporting walls and other steel structures shall be controlled. Any abnormalities such as cracks in welds, accidental deformation of the members and struts, dislocated or dislodged trusses, cross members, etc. shall be rectified.

Beams shall be checked for missing attachment bolts, taper washers and improper attachment welds.

End-stops shall be inspected for proper position and security.

#### **4.2.2.9 Interlocking mechanism and load sustaining devices**

The condition of the interlocking system will entail or check on the pawls, racks, sprocket wheels, sprockets, screw operated friction disc linings and faces, etc. A study of the various types of load sustaining devices is well worth while.

#### **4.2.2.10 Safe load indicator**

Safe load indicators shall be checked for significant inaccuracies over their full range and also for any damage sustained.

#### **4.2.2.11 Overload warning devices**

Overload warning devices shall be checked and tested, to be sound and free from defects.

#### **4.2.2.12 Limit switches**

Limit switches shall be checked and/or tested for secureness and soundness.

#### **4.2.2.13 Foundations**

Inspection shall be made of all foundations concerning the relevant components of the crane assembly.

#### **4.2.2.14 Wire ropes**

The rope should be thoroughly cleaned before inspection, taking care that at no time is the rope exposed to any abrasive dust, dirt or sand.

The size of the rope shall be checked against the design requirements. (See clause 5.6)

Particular attention should be paid to tucked splices, and those sections of rope lying close to the terminal fittings. In the case of ropes which are composed of more than one layer of strands, such as non-rotating ropes, deterioration may occur internally at the interface between the layers, and it is therefore essential that the rope is opened, and the inner strands also examined. Where multilayer drums are used, it is necessary to examine not only that part of the rope which is in constant use, but also the rope which may remain spooled and inoperative on the drum for long periods. Wire rope faults may be: broken wires, needling, corrosion, crushing, flattening, kinking; all make their contribution to deterioration, fatigue or corrosion fatigue. When broken wires are encountered, no wire rope shall be used in hoisting or lowering. The length of the rope should be checked so that when the hook is lowered to its maximum designed level, at least 2 complete turns of wire should still be on the hoisting drum.

#### **4.2.2.15 Chains**

In no circumstances shall the chains be exposed to abrasive dust, dirt or sand. Chains shall be inspected for thinning of the ends of links, notching, socketing, abrasion caused by the chain wheels, stretch and bending of links. Links shall be checked for adequate fall into place.

#### **4.2.2.16 Hoisting sheaves**

Sheaves shall be checked for groove wear, rim thinning, broken sections, cracked spokes, correct radius to accommodate the rope properly, crushing, flattening and generally misshapen. Bores shall be tested for slackness and Oil holes and channels shall be checked for cleanliness.

### **4.2.3 Testing**

The inspector shall finally witness the crane operating through all its motions under the corresponding safe working load, and shall test the performance of safe load indicators, limit switches, and interlocking devices. In the case of major or considerable repairs and/or renewals having been carried out, an overload test to 10-25 percent in excess of the safe working load shall be witnessed.

#### **4.2.3.1 Operational testing**

Cranes shall be tested by qualified person to ensure compliance with the following functions:

- a) Lifting and lowering;

- b) Trolley travel;
- c) Bridge travel;
- d) Limit switches. The trip setting of hoist limit devices shall be determined by tests with an empty hook traveling in increasing speeds up to the maximum speed. The actuating mechanism of the upper limit device shall be located so that it will trip the device under all conditions, in sufficient time to prevent contact of the hook or load block with any part of the trolley or crane;
- e) Locking, limiting and indicating devices, if provided.

#### 4.2.3.2 Overload testing

- a) A visual examination of the track rails should be made, prior to commencing the test.
- b) At the start of the test, the crane should be positioned over a supporting stanchion or column.
- c) With the crab adjacent to one track, the safe working load should be raised, the crab traversed to mid span, and the deflection measured if deemed necessary by inspector.
- d) With the safe working load suspended, the crane should be operated through all its motion trolley upper). The safe working load should then be increased to the appropriate overload, and this load should be hoisted sufficiently to ensure that each tooth of each train of gears is subjected to the overload. The hoist brake should be proved capable of sustaining this overload.
- f) The crab should then be traversed to each end of the crane girders.
- g) The crane should then be traveled along the gantry, with the test load suspended at mid span, and thereafter with the crab at each end of the main girders.
- h) During these operations, the crane should be capable of handling the overload without difficulty, and the brakes on each motion should function for free lowering of the test weight, and stopping by brake safely.
- i) For cranes with two or more load ratings, separate tests should be carried out for each hoisting motion.
- j) The maximum measured deflection caused by the safe working load and the weight of the crab in the central position, shall not exceed 1/900 of the span except otherwise recommended by manufacturer.

### 4.3 Mobile Cranes

#### 4.3.1 Preparation for periodical inspection

4.3.1.1 Following parts shall be cleaned and prepared for inspection in such a way that will enable the inspector to satisfy himself as to their conditions:

- a) Hooks and hook attachments;
- b) Ropes and rope attachments;
- c) Chains and chain attachments;
- d) Clutches and clutch drums (linings, shoes, friction discs);
- e) Brakes and brake attachments (shoes, linings, metal bands shoespin);
- f) Sheaves, pulleys and runners;
- g) Sheave and pulley pins and attachments (keep plates, locking screws and shell plates);
- h) Inter locking mechanisms (turntable, house, locks, ratchets, pawls, etc.);
- i) Safety devices (overluffing & overhoisting cut outs, overload warning devices and overspeed brakes);

- j) Slewing rollers and their pins and retainers;
- k) Gears directly connected with lifting, derricking, slewing and traveling system;
- l) Stabilizer jacks and outrigger system;
- m) Boom and boom foot pins, splice pins and load indicators.

**4.3.1.2** At no time shall any wire rope, or any chain be exposed to any sand, abrasive dust, or dirt when being examined.

**4.3.1.3** When required by the inspector, provision shall be made for facilities to inspect shafts at bearing locations, the anchoring attachments, and any other parts deemed by inspector to affect the safety of the crane.

The inspection of slewing rollers and gears may be required by the inspector.

**4.3.1.4** Complete removal of wire ropes may be waived at the discretion of the inspector.

## **4.3.2 Inspection**

### **4.3.2.1 Booms**

Booms shall be inspected for bent, twisted and distorted members. All fabrication welding shall be checked to be free from any cracking or other defects.

Main members shall be observed for signs of bending.

The hinge pin or splice pin should be withdrawn and inspected for excessive worn.

### **4.3.2.2 Hoisting sheaves**

Sheaves shall be inspected to be free from groove wear, rim thinning, broken sections and cracked spokes. Grooves shall be checked to have correct radius so that the rope is properly accommodated, not being coached, flattened and/or misshaped.

### **4.3.2.3 Wire ropes**

Size of ropes shall be checked against design requirements.

Inner Strands and inter face of layers of multilayer ropes shall be inspected for internal deteriorations.

Generally wire ropes shall be inspected and observed to be proper and not being broken, needed, corroded, crushed, flattened and kinked.

The length of the rope shall be checked so that when the hook is lowered to its maximum designed level, at least two complete turns of wire should still be on the hoisting drum.

### **4.3.2.4 Winding drums**

Winding drums shall be checked and they shall be free from severe grooving, abrasion of the barrel and defective barrel grooves.

### **4.3.2.5 Rope and chain attachments**

The principal attachments which are at hoisting drum dead end and hook shall be checked for soundness and proper attachments.

#### **4.3.2.6 Brakes**

Brakes should be completely opened. All linings and their methods of attachment should be satisfactory. Any traces of Oil and grease must be entirely removed.

Brake shoes, brake nipples and brake wheels shall be inspected to be proper and free from wear, crack, score and other defects.

#### **4.3.2.7 Gears and gear wheels**

Gears, pinions and sprockets directly connected to the hoisting shall be cleaned and exposed or preferably removed.

Gears and gear wheels shall be checked to be free from wear, crack and other defects.

#### **4.3.2.8 Interlocking mechanism and load sustaining devices**

Interlocking devices are of vital importance and require to operate to maximum efficiency.

The condition of pawls, racks, sprocket wheels, sprockets and screw operated friction disc linings and faces shall be checked to be sound and free from defects.

#### **4.3.2.9 Rollers**

Defects include wear on the tracks and rollers both on the outside surfaces and the bore. Where a roller is seized flattening will occur on working surface. These conditions all add up to slackness and increase in permissible clearance. The importance of roller clearance is greatly amplified in the case of the dual roller fitted crane which has no king-pin. Excessive gaps between the guiding gyrating and jib retaining rollers may mean that during rapid slewing action enormous sudden impact forces can be brought into play so that the stability of the crane is seriously affected and could produce disastrous tipping consequences, especially if operating on uneven or sloping ground.

#### **4.3.2.10 Jacks and outriggers**

Jacks and out riggers should be in a good working condition, careful examination being made of all screw threads operating and housing mechanism. All bed-plate or chassis framework should have overall attention.

#### **4.3.2.11 Tyres**

All tyres should be maintained in good condition and whenever tread is badly worn they should be renewed.

#### **4.3.2.12 Safe load indicator**

Safe load indicator shall be checked for significant accuracies over their full range and also any damage sustained.

#### **4.3.2.13 Overload warning devices**

Overload warning devices shall be checked and tested, for soundness and being free from defects.

#### **4.3.2.14 Pulleys**

Pulleys shall be inspected to be free from wear, thinning, breaking, cracking and crushing. All defected pulleys shall be renewed and no welding repair procedures on pulleys shall be permitted.

#### **4.3.2.15 Counter weights**

Counter weights shall be checked to be in proper position.

#### **4.3.2.16 Crawler cranes chain**

Chains of crawler type cranes shall be checked to be in order and good condition.

#### **4.3.2.17 Hydraulic and pneumatic hoses**

Hydraulic and pneumatic hoses, fittings, and tubes shall be inspected as follows:

- 1) Evidence of leakage at the surface of the flexible hose or its junction with the metal and couplings;
- 2) Blistering or abnormal deformation of the outer covering of the hydraulic or pneumatic hose;
- 3) Leakage at threaded or clamped joints that cannot be eliminated by normal tightening or recommended procedures;
- 4) Evidence of excessive abrasion or scrubbing on the outer surface of a hose, rigid tube, or fitting. Means shall be taken to eliminate the interference of elements in contact or otherwise protect the components.

#### **4.3.2.18 Hydraulic and pneumatic pumps and motors**

Hydraulic and pneumatic pumps and motors shall be inspected for proper functions as per following:

- 1) Loose bolts or fasteners;
- 2) Leaks at joints between sections;
- 3) Shaft seal leaks;
- 4) Unusual noises or vibration;
- 5) Loss of operating speed;
- 6) Excessive heating of the fluid;
- 7) Loss of pressure.

#### **4.3.2.19 Hydraulic and pneumatic valves**

Hydraulic and pneumatic valves shall be inspected for the following:

- 1) Cracks in valve housing;
- 2) Improper return of spool to neutral position;
- 3) Leaks at spools or joints;
- 4) Sticking spools;
- 5) Failure of relief valves to attain correct pressure setting;
- 6) Relief valve pressures shall be checked as specified by the manufacturer.

#### **4.3.2.20 Hydraulic and pneumatic cylinders**

Hydraulic and pneumatic cylinders shall be inspected for:

- 1) Drifting caused by fluid leaking across the piston;

- 2) Rod seals leakage;
- 3) Leaks at welded joints;
- 4) Scored, Nicked, or dented cylinder rods;
- 5) Dented case (barrel);
- 6) Loose or deformed rod eyes or connecting joints.

#### 4.3.2.21 Hydraulic filters

Evidence of rubber particles on the filter element may indicate hose, "O" ring, or other rubber component deterioration. Metal chips or pieces on the filter may denote failure in pumps, motors, or cylinders. Further checking will be necessary to determine the origin of the problem before corrective action can be taken.

#### 4.3.3 Tests

##### 4.3.3.1 General

**4.3.3.1.1** The crane should be positioned on a firm, smooth, and level surface, preferably of concrete, to ensure there is no ground indentation or subsidence, and is not subject to any appreciable wind force.

**4.3.3.1.2** The pressure of the pneumatic tyres of wheeled cranes should be checked, to ensure that it is as stipulated by the crane manufacturer. It is essential that the tyres being of the correct size, type, and rating.

**4.3.3.1.3** The accuracy of marking of the load radius indicator should be checked, by measuring the radius with the appropriate safe working load suspended from the hook.

**4.3.3.1.4** Crane system for uncontrolled conditions such as two speed winch, free fall of load and etc., shall be examined.

##### 4.3.3.2 Stability test

**4.3.3.2.1** To prove the stability of the crane complies with the required margin, an overload should be applied when the crane is in its least stable condition. This can be achieved by:

- a) Lifting a load not exceeding 25% overload at the appropriate radius, and adding weights in gradual increments until the stability margin is demonstrated.
- b) Lifting a load not exceeding 25% overload at the appropriate radius, and derricking out slowly until the stability margin is demonstrated.

##### Notes:

- 1) The load should be raised just clear of the ground.
- 2) When the required margin of stability has been demonstrated, the test shall cease, even though the crane may not have reached the point of tipping.

**4.3.3.2.2** Where a crane has load rating for "Free on wheels", and "blocked", the stability should be proved for each condition.

**4.3.3.2.3** Where a crane has several stability margins, the stability should be proved in each case.

**4.3.3.2.4** The crane is considered to be in a state of instability when the wheels or jacks remote from the load are just clear of the ground. This is a dangerous condition for cranes, and must not occur.

**Note:**

**The above tests apply to cranes in working order; however, it shall be pointed out, that such cranes must be stable in the backwards direction in all conditions, or with the jib removed.**

**4.3.3.3 Overload test**

**4.3.3.3.1** With the jib set at the minimum radius for the maximum load a 25% overload should be raised just clear of the ground and the crane operated through all its motions to ensure that the overload is applied to all parts. The hoist brake and, where applicable, the derrick brake, should be proved capable of sustaining this overload. The same overload should then be raised just clear of the ground to the maximum safe working radius of the jib.

**4.3.3.3.2** These tests should be repeated for selected lengths of booms including fly jibs at the discretion of the inspector.

**4.3.3.4 Operational test**

Cranes shall be tested by the inspector to ensure compliance with the following functions:

- a) Lifting and lowering;
- b) Boom lengthening and shortening;
- c) Outriggers operation;
- d) Boom slowing;
- e) Locking, limiting and indicating devices;
- f) Lifting and lowering of the boom.

**4.3.3.5 Load test**

For load testing, the maximum safe working load should be raised just clear of the ground and crane operated through all its motion, satisfactorily. Test procedure of the crane shall be determined by the Inspector.

**4.4 Off-Shore Cranes**

**4.4.1 Preparation for periodical inspection**

For preparing the off-shore cranes for periodical inspection see Paragraph 4.2.1.

**4.4.2 Inspection**

**4.4.2.1 Structure**

Structure members such as girders, struts, tie bars and pin joints shall be inspected for any distortion.

All welded, bolted or riveted work shall be checked to be sound and free from defects.

Revolving upper structure may be jacked up at the descertion of the inspector to free slewing rollers and king pins for examination.

#### **4.4.2.2 Booms**

Booms shall be inspected for bent, twisted and distorted members. All fabrication welding shall be checked to be free from any cracks or other defects.

The booms of off-shore cranes shall be lowered and all pins in the boom and tie rods withdrawn, if not completely, far enough to enable the inspector to observe the condition of the bearing surfaces.

Joints in the boom structure and the welds of tie rods shall be inspected.

#### **4.4.2.3 Brakes**

All brakes including hoists, powers, statics and dynamics shall be opened and inspected. All brake linings and their methods of attachment should be satisfactory.

Brake shoes, nipples and wheels shall be examined to be proper and free from wear, crack, score and other defects.

#### **4.4.2.4 Hoisting sheaves**

Sheaves shall be examined to be sound and free from groove wear, rim thinning, broken sections and cracked spokes.

Groove radius shall be checked to be correct.

#### **4.4.2.5 Wire ropes**

In some cranes where the tie rods of the jib head composed of a heavy steel wire rope passing round a small sheave, a thorough examination shall be made of wire rope, tie rods and attachment pins. These parts are liable to corrosion and may be overlooked.

For other aspects of inspection see Clause 4.3.2.3.

#### **4.4.2.6 Winding drums**

For winding drums inspection see Clause 4.3.2.4.

#### **4.4.2.7 Gears and gear wheels inspection**

For gears and gear wheels inspection see 4.3.2.7.

#### **4.4.2.8 Interlocking mechanism and load sustaining devices**

See Clause 4.3.2.8 for appropriate inspection.

#### **4.4.2.9 Mast**

Masts shall be inspected for roundness, alignment and general security of foundation. For detailed inspection of mast see Clauses 4.4.2.1 and 4.4.2.2.

#### **4.4.2.10 Rollers**

See Clause 4.3.2.9 for inspection of rollers.

#### 4.4.2.11 Chains

For chains inspection see Clause 4.3.2.13.

#### 4.4.2.12 Rope and chain attachments

For rope and chain attachments inspection see Clause 4.3.2.5.

#### 4.4.2.13 Pulleys

Pulleys shall be inspected to be sound and free from wear, thinning, breaking, cracking and crushing.

#### 4.4.2.14 Foundations

Foundations of offshore cranes shall be inspected concerning structure members, bolts and other relevant components to be sound and free from defects.

### 4.4.3 Tests

#### 4.4.3.1 Operational test

Cranes shall be tested to ensure compliance with the following functions:

- a) Lifting and lowering of hook;
- b) Lifting and lowering of boom;
- c) Boom lengthening and shortening, if applicable;
- d) Boom slowing;
- e) Locking, limiting and indicating devices.

#### 4.4.3.2 Load test

For load testing of off-shore cranes, the maximum safe working load should be raised just clear of the platform and crane operated through all its motion, satisfactorily.

#### 4.4.3.3 Overload test

The stability of the crane shall be verified at the discretion of the inspector by overload test.

With the boom at the minimum load a 25% overload shall be raised just clear of the platform, and the crane operated through all its motions to ensure that overload is applied to all parts. The hoist brakes and boom hoist brakes should be proved capable of sustaining this overload.

These tests should be repeated for selected lengths of booms at the discretion of the inspector.

## 5. CRITERIA FOR REPAIR OR REJECTION

The following should be considered as guidelines and recommended practice for repairs or rejection of the different parts of the lifting appliances and are not mandatory. However, the final decision on rejection or acceptance is left to the general knowledge and judgment of the inspector.

### 5.1 Pins and Shafts in Sliding Bearings

No pins and shafts should be in service if the contact surface wear reaches 0.01 inch per inch of the

pin or shaft diameter.

The above tolerances apply to low speed bearings, i.e. the shaft and bearing speed not exceeding 1000 RPM.

**Note:**

**All shafts and axle pins in crane motions should be considered as slow speed bearing.**

### **5.2 Rolling Bearings**

In case of rolling bearings, roughness of the balls and/or rollers creating excessive noise, slackness, and side play in the cage or ball races should be taken as reasons for rejection. However, these values are for uniform surface wear. No hesitation should be made in the rejection of grooved, seized, cracked or deteriorated bearings, pins and shafts, or cracked or defective hook roller housings.

### **5.3 Brakes and Clutches**

The brake and clutch linings should be renewed if the total uniform surface wear reaches 50% of the original thickness of the lining.

A burnt lining, or unevenly worn lining, and a lining whose rivet heads are exposed and in touch with the mating surface, shall also be renewed.

A grooved, scored, or rough brake or clutch drum working surface may be skimmed to a bright surface. The total thickness removed by skimming shall not exceed one tenth of the original drum or brake wheel thickness.

Any welding repair on the brake and clutch drum and wheel shall be carried out with extreme caution, in accordance with metallurgist written instruction.

### **5.4 Gears and Gear Wheels**

A broken, cracked, severely corroded or deformed gear keyway should be discarded from service. In case of uniform teeth wear, the amount shall not exceed 30% of the thickness of the teeth at the crown of the gear.

### **5.5 Winding Drums**

Barrels with broken flanges should be rejected. A close examination should be made of sprocket teeth and the engaging sprocket or pawl. Defective load retaining mechanism of any kind should be rejected.

A wire winding drum which has its groove landings worn, (run deep) and edges are too sharp, shall be machined and dressed to the original size of the wire rope operating on it. The groove landing wear may be measured with a groove gage. The depth of wear shall not exceed 1/8 at the bottom of groove. It should be born in mind that a wire rope will wear its groove landing narrower than its diameter, and may entangle the wire rope, which is extremely dangerous.

### **5.6 Wire Ropes**

No rope shall be used in hoisting or lowering, if in any length of eight diameters, the total number of visible broken wires exceeds 5 percent of total number of wires.

Reduction from nominal diameter greater than those listed in the following table is a cause for rejection and renewing the wire rope.

<u>ROPE DIAMETER</u>	<u>MAXIMUM ALLOWABLE REDUCTION FROM NOMINAL DIAMETER</u>
Up to 8 mm	0.4 mm
Over 8 mm to 13 mm	0.8 mm
Over 13 mm to 19 mm	1.2 mm
Over 19 mm to 29 mm	1.6 mm
Over 29 mm to 38 mm	2.4 mm

**5.7 Hooks**

Hooks having any of the following deficiencies shall be removed from service unless a qualified person approves their continued use and initiates corrective action. Hooks approved for continued use shall be subjected to periodic inspection.

- a)** Crack (s);
- b)** Wear exceeding 10% (or as recommended by the manufacturer) of the original sectional dimension;
- c)** A bend or twist exceeding 10° from the plan of the unbent hook;
- d)** An increase in throat opening exceeding 15% (or as recommended by the manufacturer).

APPENDICES

APPENDIX A
CRANE INSPECTION AND TEST CERTIFICATE SHEETS

- 1. Crane: Date of Inspection:
a) Type
b) Manufacturer's name
c) Description
d) Serial number

- 2. Inspection Results:
a) Boom
b) Wire ropes
c) Drums and rope reeving components
d) Lifting hooks
e) Rope pulleys
f) Clutches
g) Brakes for crane motions
h) Controllers
i) Engines
j) Pneumatic types
k) Chains
l)
m)
n)

3. Static Overload Test

Static overload tests were carried out as follows:

Table with 4 columns: Configurations tested, Safe working load, Radius, Test load\*. Rows contain dotted lines for data entry.

\* Includes the weight of any hook, attachments, slings, etc.

4. Stability Test

Stability test were carried out as follows:

Table with 3 columns: Configurations tested, Radius, Test load. Rows contain dotted lines for data entry.

5. Signature \_\_\_\_\_ Qualification \_\_\_\_\_