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Petroleum and natural gas industries — Drilling and production equipment — Inspection, maintenance, repair and remanufacture of hoisting equipment

*Industries du pétrole et du gaz naturel — Équipement de forage et de
production — Vérification, maintenance, réparation et fabrication à partir de
matériaux recyclés du matériel de levage*



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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 3.

Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

Attention is drawn to the possibility that some of the elements of this International Standard may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

International Standard ISO 13534 was prepared by Technical Committee ISO/TC 67, *Materials, equipment and offshore structures for petroleum and natural gas industries*, Subcommittee SC 4, *Drilling and production equipment*.

Introduction

This International Standard is based on API RP 8B, 6th edition, December 1997 [1].

Users of this International Standard should be aware that further or differing requirements may be needed for individual applications. This International Standard is not intended to inhibit the user from utilizing alternative equipment, methods or engineering solutions for individual applications. This may be particularly applicable where there is innovative or developing technology. Where an alternative is offered, the vendor should identify any variations from this International Standard and provide details.

Petroleum and natural gas industries — Drilling and production equipment — Inspection, maintenance, repair and remanufacture of hoisting equipment

1 Scope

This International Standard gives guidelines and establishes requirements for inspection, maintenance, repair and remanufacture of items of hoisting equipment used in drilling and production operations, in order to maintain the serviceability of this equipment.

Items of drilling and production hoisting equipment covered by this International Standard are:

- crown-block sheaves and bearings;
- travelling blocks and hook blocks;
- block-to-hook adapters;
- connectors and link adapters;
- drilling hooks;
- tubing hooks and sucker-rod hooks;
- elevator links;
- casing elevators, tubing elevators, drill-pipe elevators and drill-collar elevators;
- sucker-rod elevators;
- rotary swivel-bail adapters;
- rotary swivels;
- power swivels;
- power subs;
- spiders, if capable of being used as elevators;
- dead-line tie-down/wireline anchors;
- drill-string motion compensators;
- kelly spinners, if capable of being used as hoisting equipment;
- riser-running tool components, if capable of being used as hoisting equipment;
- wellhead-running tool components, if capable of being used as hoisting equipment;
- safety clamps, capable of being used as hoisting equipment.

2 Normative reference

The following normative document contains provisions which, through reference in this text, constitute provisions of this International Standard. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent edition of the normative document indicated below. For undated references, the latest edition of the normative document referred to applies. Members of ISO and IEC maintain registers of currently valid International Standards.

ISO 9712, *Non-destructive testing — Qualification and certification of personnel*.

3 Terms, definitions and abbreviated terms

For the purposes of this International Standard, the following terms, definitions and abbreviated terms apply.

3.1 Terms and definitions

3.1.1 critical area

highly stressed region of a primary-load-carrying component as defined by the manufacturer

3.1.2 expendable parts

parts normally used up or consumed in service,

EXAMPLES Seals, gaskets, filters, packing, V-belts, covers, guards, breathers, drains and miscellaneous hardware and fasteners.

3.1.3 inspection

comparison of equipment conformity to predetermined standards, followed by a determination of action required

3.1.4 load test

test wherein a load is applied under controlled and monitored conditions to verify the serviceability of equipment

3.1.5 maintenance

actions including inspection, adjustments, cleaning, lubrication, testing, and replacement of expendable parts, as necessary to maintain the serviceability of the equipment

3.1.6 manufacturer

individual or company that makes or processes equipment or material covered by this International Standard

3.1.7 owner

individual, legal entity or organization holding legal title to the equipment

3.1.8 primary load

axial load to which the equipment is subjected in operation

3.1.9 primary-load-carrying component

component of the equipment through which the primary load is carried

3.1.10**remanufacture**

action performed on equipment that involves a special process or re-machining

3.1.11**repair**

action performed on equipment that involves replacement of parts, other than expendable parts, but excludes remanufacture

3.1.12**serviceability**

condition of a piece of equipment at any point in time that affects the ability of the equipment to perform its function(s) as intended

3.1.13**special process**

operation that can change or affect the mechanical properties, including toughness, of the materials used in equipment

3.1.14**testing**

action carried out on a piece of equipment to ensure that it can perform a required function

3.1.15**user**

individual or company that uses equipment or material, or implements standards

3.2 Abbreviated terms

MT magnetic particle testing

NDT non-destructive testing

PSL product specification level

PT liquid penetrant testing

RT radiographic testing

UT ultrasonic testing

4 General principles**4.1 Procedures****4.1.1 General**

Users/owners of hoisting equipment shall establish written procedures for inspection, maintenance, repair and remanufacture of each item of equipment.

4.1.2 Procedure development**4.1.2.1 User/owner and manufacturer joint procedure development**

The user/owner and manufacturer should jointly develop and update inspection, maintenance, repair and remanufacture procedures consistent with equipment application, loading, work environment, usage, and operational conditions.

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These factors may change as a result of new technology, product improvements or fundamental changes in service conditions.

4.1.2.2 User/owner procedure development

If the manufacturer of the equipment no longer exists or is unable for any reason to provide suitable recommendations, the user/owner shall develop inspection, maintenance, repair and remanufacture procedures consistent with widely-accepted industry practices.

4.1.2.3 Parts and tooling

NDT, maintenance, and dismantling equipment shall be properly selected and adapted to the parts to be inspected and maintained.

4.2 Personnel qualification

4.2.1 NDT personnel qualification levels

4.2.1.1 Qualification

Inspectors shall be aware of the type of equipment to be evaluated and the NDT methods to apply.

The users/owners shall verify that the NDT inspector has the following information:

- assembly drawings and drawings identifying critical areas;
- rejection criteria.

In addition, the users/owners may provide the history of grinding or remanufacture, if available.

In the absence of critical area drawings, all areas of primary-load-carrying components shall be considered critical.

These data shall be used by the inspector to adapt the inspection procedure.

4.2.1.2 Certification

The NDT inspector shall be certified according to ISO 9712 or by other recognized NDT certification programmes or standards.

4.2.2 Welding personnel qualification levels

Welders shall be qualified to a recognized standard.

5 Inspection and maintenance

5.1 General

5.1.1 Criteria

Inspection and maintenance are closely linked. Inspection and maintenance actions may be initiated based on, but not limited to, one or more of the following criteria:

- specific time intervals;
- measurable wear limits;
- load cycle accumulation;

- non-performance of equipment;
- environment;
- experience (history);
- regulatory requirements.

5.1.2 Safety considerations

Operators shall review safety considerations applicable to the site where the maintenance activity is performed.

5.2 Maintenance

5.2.1 General

Maintenance of equipment consists of actions such as adjustments, cleaning, lubrication, and replacement of expendable parts. The complexity of these activities and the safety risks involved shall be considered in the assignment of appropriate resources such as facilities, equipment and qualified personnel.

5.2.2 Procedures

In addition to the procedures developed in accordance with 4.1, the manufacturer should define any special tools, materials, measuring and inspection equipment, and personnel qualifications necessary to perform the maintenance. The manufacturer should also specify those procedures that should be performed solely by the manufacturer, either within the manufacturer's facility or within another approved facility.

5.3 Inspection

5.3.1 General

The existence of cracks can indicate severe deterioration and impending failure. Their detection, identification and evaluation require accurate inspection methods.

Prompt attention is then required either to remove the equipment from service immediately or to provide appropriate service and/or repair.

Caution shall be exercised to take into account the increased susceptibility to brittle fracture of many steels when operating at low temperatures.

If any manufacturing defects are discovered, they should be reported to the manufacturer or supplier.

5.3.2 Inspection categories

5.3.2.1 General

The objective of these inspections is to detect service defects and possible hidden manufacturing defects.

Inspection results shall be reported on equipment files and drawings.

5.3.2.2 Category I

This category involves observing the equipment during operation for indications of inadequate performance.

When in use, equipment shall be visually inspected on a daily basis for cracks, loose fits or connections, elongation of parts, and other signs of wear, corrosion or overloading. Any equipment found to show cracks, excessive wear, etc., shall be removed from service for further examination.

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The equipment shall be visually inspected by a person knowledgeable in that equipment and its function.

5.3.2.3 Category II

This is Category I inspection plus further inspection for corrosion, deformation, loose or missing components, deterioration, proper lubrication, visible external cracks, and adjustment.

5.3.2.4 Category III

This is Category II inspection plus further inspection, which should include NDT of critical areas and may involve some disassembly to access specific components and to identify wear that exceeds the manufacturer's allowable tolerances.

5.3.2.5 Category IV

This is Category III inspection plus further inspection for which the equipment is disassembled to the extent necessary to conduct NDT of all primary-load-carrying components as defined by manufacturer.

Equipment shall be:

- disassembled in a suitably-equipped facility to the extent necessary to permit full inspection of all primary-load-carrying components and other components that are critical to the equipment;
- inspected for excessive wear, cracks, flaws and deformations.

Corrections shall be made in accordance with the manufacturer's recommendations.

Prior to Category C III and Category IV inspections, all foreign material such as dirt, paint, grease, oil, scale, etc. shall be removed from the concerned parts by a suitable method (e.g. paint-stripping, steam-cleaning, grit-blasting).

5.3.3 Frequency

5.3.3.1 Periodic inspection

The user/owner of the equipment should develop schedules of inspection based on experience, the manufacturer's recommendations, and one or more of the following factors:

- environment;
- load cycles;
- regulatory requirements;
- operating time;
- testing;
- repairs;
- remanufacture.

As an alternative, the user/owner may use Table 1 guidelines. Long-term planning shall be adjusted in order not to interfere unnecessarily with the running operations.

5.3.3.2 Non-periodic inspection

A complete, on-job, shut-down inspection equivalent to the periodical Category III or Category IV (for the concerned equipment) should be made before (if anticipated) and after critical jobs (e.g. running heavy casing strings, jarring, pulling on stuck pipes and/or operating at extreme low temperatures).

Table 1 — Periodic inspection and maintenance — Categories and frequencies

Equipment	Frequency							
	days		months			years		
	1	7	1	3	6	1	2	5
Inspection category								
Crown-block sheaves and bearings	I	II			III			IV
Drilling hooks (other than sucker-rod hooks)	I	II			III			IV
Travelling blocks, hook block and block-to-hook adapter	I	II			III			IV
Connectors and link adapters	I	II			III			IV
Tubing hooks and sucker-rod hooks	I	II			III	IV		
Elevator links	I	II			III	IV		
Casing elevators, tubing elevators, drill-pipe elevators and drill-collar elevators;	II				III	IV		
Sucker-rod elevators	II				III	IV		
Rotary swivel-bail adapters	I	II			III	IV		
Rotary swivels	I	II			III		IV	
Power swivels	I	II			III			IV
Power subs	I	II			III			IV
Spiders, if capable of being used as elevators	I	II			III	IV		
Dead-line tie-down/wireline anchors	I	II			III			IV
Drill-string motion compensators	II				III			IV
Kelly spinners, if capable of being used as hoisting equipment	I	II			III			IV
Riser- and wellhead-running tools, if capable of being used as hoisting equipment	II				III	IV		
Safety clamps, if capable of being used as hoisting equipment	II				IV			

NOTE The above recommended frequencies apply for equipment in use during the specified period.

5.3.4 Inspection of remanufactured components

5.3.4.1 Unless specific and more stringent recommendations apply, welds of primary-load-carrying components shall be inspected as follows:

- a) immediately after grinding;
- b) after welding, but no sooner than 24 h after the part has reached ambient temperature;
- c) in service, after a period of time to be specified in the user/owner/manufacture's procedures except (unless otherwise recommended by the manufacturer) for non-accessible inner parts remanufactured under the full guarantee of the manufacturer.

5.3.4.2 The same NDT methods and procedures that detected the initial defects shall be used after remanufacture. In the event of remanufacture of primary-load-carrying components by welding, at least two of the most appropriate of the following methods shall apply with regard to 5.3.4.1 (b):

- a) MT, for ferromagnetic materials, or PT, for non-ferromagnetic materials, to detect possible surface defects;
- b) UT to detect possible defects below the surface. RT may be used as an alternative to UT if shown to be at least as effective as UT on the same configuration.
- c) proof load test in accordance with 8.3, followed by surface NDT of the tested component(s).

Other NDT techniques applied to hoisting equipment shall be submitted for the specific approval of both user/owner and manufacturer.

5.3.5 Results of inspections

5.3.5.1 Acceptance criteria

Acceptance criteria shall be established based on experience and manufacturer's recommendations. Worn equipment that does not meet the acceptance criteria shall not be accepted for operation.

5.3.5.2 Rejected equipment

Rejected equipment shall be marked and removed from service.

5.3.5.3 Surface indications

Surface indications identified by NDT may be allowable or non-allowable depending on their size, shape and location, as defined by the manufacturer.

5.3.5.4 Allowable surface indications

Allowable surface indications are surface indications of such a size, shape and location that they need not be removed.

5.3.5.5 Non-allowable surface indications

Non-allowable surface indications shall be classified as follows:

- a) minor surface indications

Minor surface indications may be removed by filing or grinding if this can be achieved within the limits specified by the manufacturer, otherwise they shall be classified as major surface indications. Caution should

be exercised to prevent heating to an extent that could change the mechanical properties, including toughness, of the material.

b) major surface indications

Major surface indications, which require material removal beyond the limits specified by the manufacturer, should be corrected by remanufacture.

5.3.6 Inspection and maintenance (lubrication) of wire rope

Inspection and maintenance (lubrication) of wire rope used in hoisting shall be carried out on a regular basis. API RP 9B [2] may be consulted for further information on inspection and maintenance of wire rope.

6 Repair

6.1 Procedures

Manufacturers should provide adequate information to allow the equipment user/owner to identify the nature of repairs that may be required. Repairs shall be performed using methods or procedures established in accordance with 4.1.

6.2 Bearings

Anti-friction bearings play an important part in the serviceability of equipment. The most likely causes of the need for bearing replacement are very loose or bent cages (rolling element retainers), corrosion, abrasion, inadequate (or improper) lubrication and spalling due to fatigue. Excessive clearance may indicate improper adjustment or assembly and should be corrected. Repair of anti-friction bearings should not be attempted by field or shop personnel. The equipment manufacturer should be consulted in the event of unexplained or repeated bearing failure.

6.3 Replacement parts

All replacement primary-load-carrying components shall meet or exceed the original manufacturer's criteria and the following requirements:

- a) the primary-load-carrying components shall be subject to the same minimum requirements and standards as the original equipment components;
- b) the documentation and traceability requirements shall be the same as for the original equipment components.

7 Remanufacture

7.1 Procedures

Remanufacture of equipment shall be performed using methods and procedures developed in accordance with 4.1. The material used for the remanufacture shall be qualified to the manufacturer's requirements for mechanical properties, ductility and toughness. The equipment rating resulting from remanufacture should be in accordance with the equipment manufacturer's recommendations. Equipment that cannot be remanufactured shall be destroyed.

If welding is necessary, it shall be performed in accordance with a written procedure that has been qualified in accordance with a recognized standard.

7.2 Verification

Following remanufacture, verification shall be performed in accordance with 5.3.4.

8 Load testing

8.1 General

Two types of load test are described in this International Standard, as follows.

8.2 Performance load test

A performance load test may be used to verify the function of the equipment and/or its ability to perform under specific conditions or in conjunction with other equipment or materials (e.g. it may be used to determine the effects of gripping a specific pipe with a given elevator). A performance test may consist of any number of cycles (as needed) of loads up to, but not exceeding, the rated load of the equipment under test.

8.3 Proof load test

A proof load test is performed by applying a load equal to 1,5 times the rated load of the equipment for a period of not less than 5 min. Proof load tests should not consist of more than one cycle and shall not be used in lieu of performance load tests. Hoisting equipment should be proof load tested only once following manufacture or remanufacture, since loads above the rated load may cause cumulative (fatigue) damage. A proof load test shall be followed by surface NDT. Materials that are prone to delayed cracking should be subjected to surface NDT no earlier than 24 h after proof load testing.

9 Documentation and records

9.1 General

The user/owner shall maintain an equipment file containing pertinent information regarding the equipment. The equipment file should include the following:

- a) documentation delivered by the manufacturer;
- b) documentation established by the user/owner during the life of the equipment.

9.2 User/owner equipment file

9.2.1 General

The user/owner shall build, for each item of equipment, equipment file which includes the following information, where available:

- a) equipment description, type and style, serial number, PSL, specifications, manufacturer;
- b) nominal capacities;
- c) list of components and assembly drawings, highlighting the steel grades, PSL, and minimum service temperature of critical components. Critical areas shall be clearly defined;
- d) categories/frequencies of recommended inspection/maintenance and related safety measures;
- e) repairable defects with their (maximal) dimensions and location (as applicable);

- f) activity records;
- g) effective running time (when possible) and critical jobs.

9.2.2 Identification/traceability

Unit serial number or identification marking provided by the manufacturer should be maintained on the equipment. Identification marking shall be provided by the user/owner for unidentified equipment. Serial numbers or identification marking shall be recorded in the equipment file.

9.2.3 History

Changes in equipment status that could affect equipment safety, serviceability or maintenance should be recorded in the equipment file.

9.3 Activity records

Records of Category III and Category IV inspections shall be entered in the equipment file as well as any load test data related to or indicating the load-carrying capacity of the equipment.

Entries describing repair, remanufacture and testing activities shall be included in the user/owner equipment file.

Records shall indicate:

- a) significant defects (type, dimensions) reported on a drawing;
- b) location and extent of repairs;
- c) NDT methods and results;
- d) primary-load-carrying components replaced or remanufactured;
- e) the date and the name of the responsible person(s) involved in the inspection, maintenance, repair or remanufacture.

Bibliography

- [1] API RP 8B, *Recommended practice for procedures for inspection, maintenance, repair and remanufacture of hoisting equipment*, 6th edition, December 1997.
- [2] API RP 9B, *Application, care, and use of wire rope for oil field service*.
- [3] ISO 13535, *Petroleum and natural gas industries — Drilling and production equipment — Hoisting equipment*.

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