INTERNATIONAL STANDARD

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Cranes — Inspections —

Part 1: General

Appareils de levage à charge suspendue — Vérifications —

Partie 1: Généralités

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Foreword

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The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2. www.iso.org/directives

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The committee responsible for this document is ISO/TC 96, *Cranes*, Subcommittee SC 9, *Bridge and gantry cranes*.

This third edition cancels and replaces the second edition (ISO 9927-1:2009), which has been technically revised.

ISO 9927 consists of the following parts, under the general title *Cranes — Inspections*:

— *Part 1: General*

— *Part 3: Tower cranes*

Bridge and gantry cranes are to form the subject of a future Part 5. Other parts are planned.

Cranes — Inspections —

Part 1: General

1 Scope

This International Standard specifies the general requirements for inspections to be carried out on cranes as defined in ISO 4306-1. Additional requirements for particular types of cranes are intended to be covered by relevant specific parts of ISO 9927.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 4306 (all parts), *Cranes — Vocabulary*

ISO 4310, *Cranes — Test code and procedures*

ISO 8686, *Cranes – Design principles for loads and load combinations*

ISO 10245-1, *Cranes — Limiting and indicating devices — Part 1: General*

ISO 12480-1, *Cranes — Safe use — Part 1: General*

ISO 12482-1, *Cranes — Condition monitoring — Part 1: General*

ISO 23814, *Cranes — Competency requirements for crane inspectors*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 4306 and the following apply:

3.1
critical component
component, the failure of which would result in a risk to the health and safety of persons using the crane or located in its vicinity

3.2
design life
estimation of the allowable service life of a crane based on its original design specifications and taking into consideration the stress cycles and stress collectives (design constraints) before a special assessment and general overhaul are required

Note 1 to entry: The design life of a crane as a whole is usually governed by the life of a limited number of critical components (see ISO 12482-1).

Note 2 to entry: The design life may vary from the estimation if the stress cycles and stress collectives experienced during its service life deviate from those expected.

3.3
inspection
all relevant activities for the inspection of a crane including testing, as applicable

3.4
user organization instructions
instructions issued by the user organization for the use of the crane

4 General

4.1 General

In order to ensure safe operation of cranes, the proper working and operational condition shall be maintained.

4.2 Instructions

The user organization instructions shall incorporate the manufacturer's instructions and shall be written in plain language, in the language of the country where the crane is in use. The instructions shall be made available to all persons carrying out inspections. All persons performing inspections shall have read and understood the instructions.

The user organization instructions shall be assessed by a competent person against the requirements of this clause. Where they are determined to be adequate and appropriate they shall be applied to the crane's inspections.

NOTE A suitable checklist for this assessment is shown in Annex A.

Where the manufacturer's instructions are not available, a competent person shall develop suitable guidance.

5 Inspections

5.1 General

All inspections shall be carried out by a competent person (see Annex D) according to the instructions.

Inspections shall be carried out at a frequency to enable the crane to be kept in a safe and satisfactory condition. Inspections shall be carried out in conformance with the ISO 9927 series of standards, and instructions written in accordance with this International Standard. Any such work shall be noted in the records.

The results of all inspections shall be recorded and the records maintained in accordance with Clause 10. Where deleterious conditions are observed, they shall be rectified.

All safety-related issues shall be resolved prior to the use of the crane.

The following inspections are applicable.

NOTE These are general requirements. For additional requirements for a particular type of crane, refer to the relevant specific part of ISO 9927 and the applicable product standard.

a) Daily inspection — required for all cranes.

b) Frequent inspection — required for all cranes.

c) Periodic inspections — required for all cranes.

d) Enhanced periodic inspection (optional).

e) Exceptional inspection.

f) Major inspection — required for those cranes not subject to an enhanced periodic inspection regime (see 5.6.1).

A competent person shall either implement an enhanced periodic inspection after the first five years of service or continue with periodic inspections, followed by a major inspection by the end of the design life. Regardless of the option chosen, all critical components shall have been inspected by the end of the design life.

The intent of the inspections is to ensure the continued safe use of the crane. As cranes remain in service it is essential to ensure that the critical components are inspected and the necessary maintenance is carried out. This becomes important after five years of service and should be completed by the end of the design life.

NOTE 1 Annex B provides flow charts to guide the sequence of inspections outlined above.

NOTE 2 Testing is considered a subset of inspection (see 3.3).

5.2 Daily inspection

Before the commencement of each work shift, the crane shall be given a visual inspection and functional test to find any evidence of deficiencies.

Such inspections may be carried out by the operator. The functional tests should be made without load, where appropriate from the control station.

5.3 Frequent inspection

Frequent inspections are service inspections and shall be carried out with the manufacturer's routine servicing, at no more than three-monthly intervals, unless the crane is not in service. The frequency shall be based upon the frequency and severity of use of the crane while in service and the working environment.

It shall not be inferred that dismantling of any part is necessary during this inspection, but opening of covers (for example, limit switch covers), required for service and inspection purposes, shall be included.

The inspection procedure shall include verification that the current logbook and operator's manual(s) are available on the crane and that this documentation is up-to-date.

The inspection shall include all items specified in instructions written in accordance with this International Standard for frequent inspections.

A written report shall be furnished on completion of the inspection

A competent person may recommend that frequent inspections be carried out more often.

5.4 Periodic inspection

A program of periodic inspection shall be carried out. The frequency of periodic inspection shall be based on the working environment and the frequency and severity of use of the crane. For all cranes that remain in service, the inspection interval shall not exceed 12 months.

The inspection shall include all items specified in instructions for the periodic inspection, written in accordance with this International Standard.

A competent person shall identify components that require particular attention in subsequent periodic inspections.

A written report shall be furnished on completion of the inspection and retained with the crane logbook or record book. The report shall include an assessment of the reasonable practicability of applying the requirements of the latest edition of the applicable International Standards.

5.5 Exceptional inspection

Exceptional inspections shall be performed in the following circumstances:

a) following any exceptional circumstances which may have resulted in damage to the crane, such as
   1) extreme weather conditions outside of the design parameters of the crane,
   2) earthquake or seismic condition,
   3) collision with other structures,
   4) overload above those values normally controlled by limiting devices fitted to the crane,
   5) fire, or
   6) safety device failure;

b) following repair of damaged components or a change of
   1) load rating,
   2) load-bearing mechanical or structural components,
   3) hoisting mechanism,
   4) control station and system,
   5) prime mover,
   6) fixed and non-fixed load-lifting components, and/or
   7) carrier, foundation and support structure.

Exceptional inspections shall be performed by the appropriate inspector (see Annex D), to ensure that deviations from safe operation of the crane do not occur. The initial inspection following an incident or accident may be completed by an experienced technician.

NOTE 1 A repair requires a procedure by a competent person.

NOTE 2 Replacement of parts to the manufacturer's or original specification does not constitute a change.

5.6 Major inspection

5.6.1 Special assessment

A major inspection shall be performed for cranes where

a) the enhanced periodic inspection regime has not been carried out, or

b) they are to be re-commissioned or imported and do not have previous continuous working and maintenance records as specified in Clause 10.

The major inspection shall include a special assessment according to the requirements of ISO 12482-1.

5.6.2 Critical components

The major inspection shall involve examination of those critical components identified by the manufacturer or a competent person. Where necessary, the crane shall be stripped down and paint, grease and corrosion removed from critical components to allow a complete and thorough inspection.

Particular attention shall be given to the following:

a) past state of loading and utilization as compared with the crane's classifications (refer to ISO 12482-1);

b) future intended state of loading and utilization, as required by the user of the crane;

c) structural, mechanical, electrical, instrumentation, control and operational anomalies;

d) non-destructive testing of all nominated critical areas which show evidence of cracking due to fatigue and excessive stress;

e) components whose maintenance records indicate repeated failures;

f) controls and emergency stop;

g) braking systems;

h) platform levelling systems;

i) platform, handrails and gate;

j) adequacy of safety instructions and manuals for operation and maintenance;

k) manufacturer's safety upgrades;

l) emergency retrieval system.

5.6.3 Written report and follow-up

A written report shall be furnished on completion of the inspection. An expert engineer shall assess the results and shall

a) specify the defects, wear and where attention is necessary to ensure its continued safe operation,

b) identify components that require particular attention in subsequent periodic inspections, and

c) determine the reasonable practicability of applying the requirements of the latest edition of the relevant International Standard.

For those cranes and components listed in 5.6.1 b) and 5.6.2 e), the assessment should be supervised by an expert engineer.

Following the major inspection, a deemed design life, where required, shall be determined by the expert engineer (see Annex D) supervising the last major inspection. Subsequently, the crane shall either be subjected to the programme of inspection as part of the periodic inspection specified in 5.4, or reassessed by a competent person within a five-year period. The critical components identified by the assessment shall be inspected.

5.7 Enhanced periodic inspection

Enhanced periodic inspection may be carried out as an alternative to major inspection (see 5.6). After the first five years of service, and within five years thereafter, periodic inspections shall be structured to ensure all critical components are inspected, and tested where appropriate. The manufacturer's or user organization instructions may also detail requirements for enhanced periodic inspections. The scheduling of components for inspection shall be based on the crane's operational history and anticipated future usage, and the criticality and condition of the component or as assessed by ISO 12482-1 procedures. The schedule shall be recorded and updated when altered.

NOTE The periods indicated in this clause are based upon a 10 year design life.

The sequence of inspections may be altered based on the crane's usage, providing all critical components are inspected in the five year period.

The inspections shall include all items specified in the instructions for periodic inspection (see 5.4) together with all frequent inspection items (see 5.3), which should include

a) a detailed visual inspection of all structural components,

b) tolerance checking of wearing components,

c) checks for corrosion and environmental degradation,

d) visual examination of all critical areas (including appropriate NDT) for evidence of cracking,

e) possible replacement of selected critical components,

f) any exceptional inspection,

g) adequacy of safety instructions and manuals for operation and maintenance, and

h) manufacturer's safety upgrades.

For cranes older than five years, the report specified in 5.4 shall indicate those critical components that have been inspected. After 10 years, the report shall confirm that all critical components have been inspected.

6 Methods of inspection

6.1 Visual examination

Visual examinations shall be carried out on every part of the crane in order to detect any abnormalities or deviations from the normal conditions, by means of visual checks, e.g. a hammering test, and measurements.

Generally, the visual examination is to be carried out without dismantling. However, dismantling shall be performed where it is necessitated by the crane condition.

6.2 Non-destructive test

Depending on the result of visual examination, non-destructive tests (e.g. penetrant testing, ultrasonic testing, magnetic particle testing, radiographic testing, acoustic emission testing) may be carried out.

6.3 Functional test

The functions of controls, switches and indicators shall be checked. The measurement of the electrical and/or hydraulic system shall be carried out if necessary.

Functional tests shall be carried out for the following limiting and indicating devices in order to ensure that they are functioning and calibrated correctly for safe operation:

a) rated capacity limiters and indicators;

b) motion limiters and indicators;

c) performance limiters and indicators.

6.4 No-load test

No-load tests shall be carried out for all crane motions, (e.g. hoisting, travelling, traversing, slewing and luffing) at the rated speeds and without lifting loads, in order to check for any abnormalities and/or defects.

6.5 Load test

Load tests shall be carried out on basic crane motions, such as hoisting, travelling, traversing and slewing, while suspending a test load (where permitted), in order to check for any abnormalities and/or defects. The test load should not exceed the rated capacity.

Where systematic load testing is applied, the frequency of load testing shall be in accordance with the legislation of the location where the crane is being used.

NOTE Depending upon national legislative requirements, it may also be necessary to increase the test load beyond the rated capacity.

6.6 Static, dynamic and stability tests

Static, dynamic and stability tests shall be performed in accordance with ISO 4310.

7 Inspection personnel

The inspection personnel shall be competent to inspect the crane. Annex D provides a table of competent personnel.

8 Precautions for inspection

ISO 12480-1 shall apply for the safety of the personnel involved in the crane inspection.

Annex C should also be considered.

9 Repairs

Repairs shall be carried out in accordance with the relevant International Standard and manufacturer's instructions (where available).

10 Records

10.1 General

A continuous working record, including logbook and service/maintenance history of the significant events concerning the safety and operation of the crane, shall be kept and be readily available and assessable. This includes the checks, adjustments, replacement of parts, repairs, modification or relocation, as well as inspections performed and all irregularities or damage concerning the unit's safe use.

The records shall be readily understood and in plain language, in the language of the country where the crane is in use. Any suitable format and system that records these events and is readily available to the operator and inspector should be accepted as meeting the intent of this clause.

The records shall be transferred with ownership of the crane.

10.2 Logbook

The minimum records that shall be retained in the logbook are copies of

a) a summary statement of the last major inspection,

b) a summary statement of the last periodic inspection,

c) a summary statement of the last frequent inspection,

d) the complete daily pre-operation reports for not less than the last 90 days of operation, or since the last frequent inspection, whichever is the greater, and

e) action taken or repairs carried out to rectify malfunctioning or damaged components.

Each log entry shall be signed by the responsible person making the entry and should contain details of that person's identification and qualifications.

10.3 Inspection records

Inspection records shall be readily available showing the results of the inspections, including documentation that the crane has been inspected by a competent person and is in a safe and satisfactory condition, together with the following details:

a) damage or other deleterious conditions which require repair or other rectification of a component (cracks, severe corrosion, etc.);

b) other components which are likely to suffer deleterious effects from a degraded component;

c) details of all components inspected and assessed by an expert engineer;

d) details of the repair or rectification, modification;

e) the condition of the component, mechanism or crane on completion of rectification work.

11 Change of rated capacity

Where the rated capacity of the crane has been varied, this shall be considered as a change of design.

The inspection to be applied is the major inspection procedure and load testing shall be in accordance with the design standard(s) and national occupational health and safety (OH&S) regulations for new cranes.

12 Limiting and indicating devices

All indicating and limiting devices shall be inspected for installation to the device manufacturer's installation instructions or instructions written in accordance with this International Standard. Testing shall ensure that the operation is within the tolerances permitted by ISO 10245-1. All calibration of the devices shall be performed by a competent person.

Annex A
(informative)

Checklist to determine suitability of user organization instructions

A.1 General

Annex A sets out a checklist for assessing the adequacy of the instructions available for the crane (see 4.2).

A.2 Application

The checklist shall be applied to each model type. Where an item can be confirmed as adequate, the reference section in the table shall be completed noting the reference clause or section(s) contained in the instructions. Where the item cannot be confirmed as adequate, the matter shall be referred to the manufacturer or competent person for assessment and preparation of supplementary instruction.

Where some items contained in the checklist cannot be adequately addressed, the crane shall be subject to the appropriate series of inspections specified in Clause 5.

Crane make:	
Model number:	
Year of manufacture:	

Item	Description	Yes/No[a]	Reference[a]
0	**Identification**		
0.1	The instructions correspond with the subject crane (i.e. the model number and serial number declared in the manual correspond with that on the crane).		
0.2	The instructions incorporate the manufacturer's instructions, where available, including the manufacturer's safety alerts specific to the subject crane.		
0.3	The owner of the crane is registered with the manufacturer.[b]		
1	**Use**		
1.1	The instructions for inspection, maintenance and use apply to the environment in which the crane is being used, e.g. at temperatures within the range permitted by the manufacturer.		

[a] Where the answer is "Yes", the reference should be quoted; where "No", refer to B.2.

[b] Registration with the manufacturer should be confirmed.

Item	Description	Yes/No[a]	Reference[a]
1.2	The operating instructions apply to the manner in which the crane is used.		
1.3	*Modifications* Instructions have been prepared and address any additional procedures that arise as the result of modifications to the crane.		
1.4	*History* There is no history of repeated repairs or defects that are not addressed within the instructions.		
2	**Specifications**		
2.1	*Operating hours* (sometimes expressed as *cycles*) The allowable operating conditions are as specified by the manufacturer. The classification is in accordance with the relevant part of ISO 8686.		
2.2	*Elapse of designed operating hours* Guidance is provided as to the necessary action required once the designed operating conditions have elapsed.		
2.3	Hydraulic and electric circuits provided.		
2.4	Operating specifications provided (e.g. lift and drive speeds, hydraulic pressure settings, etc.).		
2.5	Specifications are provided for the adjustment or assembly of components. (e.g. bolt torques, pad clearances and proximity switch gap settings).		
3	**Inspection procedures**		
3.1	*Frequent inspection procedures* Inspection schedules are specified and apply over the entire life of the crane.		
3.2	*Preventative maintenance procedures* Preventative maintenance instructions are specified and apply over the entire life of the crane.		
3.3	*Critical areas* Details are provided that identify critical areas requiring periodic inspection and or frequency of inspection (e.g. axles, chassis welds).		
3.4	*Inspection procedures* Procedures are provided detailing the method of inspection of critical areas (e.g. visual inspection, magnetic particle inspection).		
3.5	*Acceptance criteria* Criteria are provided against which critical areas can be assessed.		

[a] Where the answer is "Yes", the reference should be quoted; where "No", refer to B.2.

Item	Description	Yes/No[a]	Reference[a]
4	**General**		
4.1	Safety warnings and residual risks declared in the operating and maintenance manuals.		
5	**Replacements parts** (where applicable)		
5.1	*Consumables* Specifications provided relating to the replacement of consumable items (e.g. hydraulic oil, filters).		
5.2	*Components* Details provided relating to parts replacement and required frequency of replacements (e.g. wire ropes, bushes).		
6	**Documentation**		
6.1	Checklists are provided which clearly identify the areas and procedures necessary at each inspection.		
6.2	Test report formats are provided that facilitate the recording of inspection or test measurements against specified criteria.		

[a] Where the answer is "Yes", the reference should be quoted; where "No", refer to B.2.

Annex B
(informative)

Inspection flow charts

B.1 General

Annex B provides flow charts for guiding the sequence of inspections given in Clause 5 applicable to the crane.

B.2 Application

The flow charts shown in Figures B.1 to B.4 should be applied as follows.

a) Figure B.1 applies where the available instructions can be confirmed as adequate (see 4.2), and the manufacturer's model specific inspection regime is followed.

b) Figure B.2 applies on a crane less than five years old, where the instructions are not available or are deemed inappropriate or inadequate by a competent person (see 4.2), and an enhanced periodic inspection program is adopted.

c) Figure B.3 applies on a crane more than five years old where the instructions are not available or are deemed inappropriate or inadequate by a competent person (see 4.2), and an enhanced periodic inspection program is to be adopted in preference to continuing with major inspections.

d) Figure B.4 applies where the instructions are not available, or are deemed inappropriate or inadequate by a competent person (see 4.2), and critical components inspection is deferred to the 10th year, requiring a major inspection [see 5.6.1 a)].

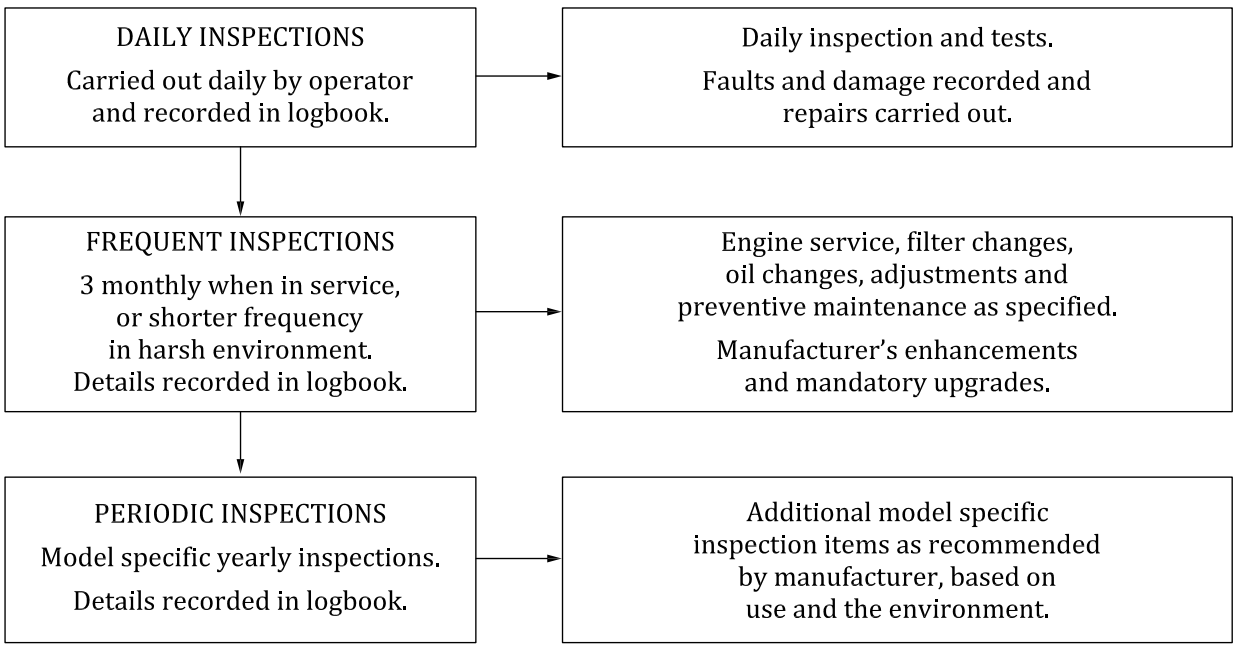

Figure B.1 — Instructions available and adequate and manufacturer's model specific inspection regime followed

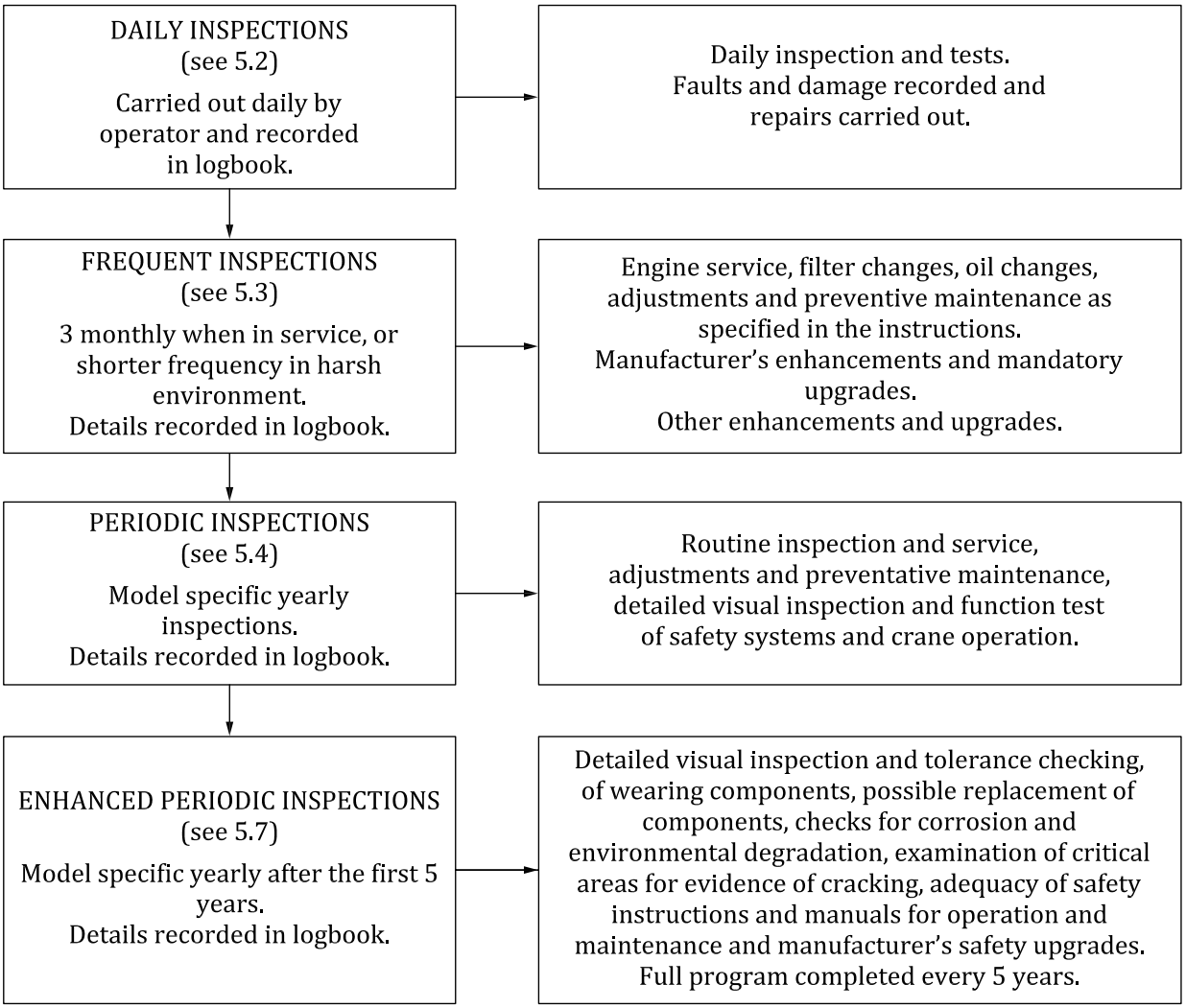

Figure B.2 — Crane less than five years old and instructions not available or deemed inappropriate or inadequate by competent person

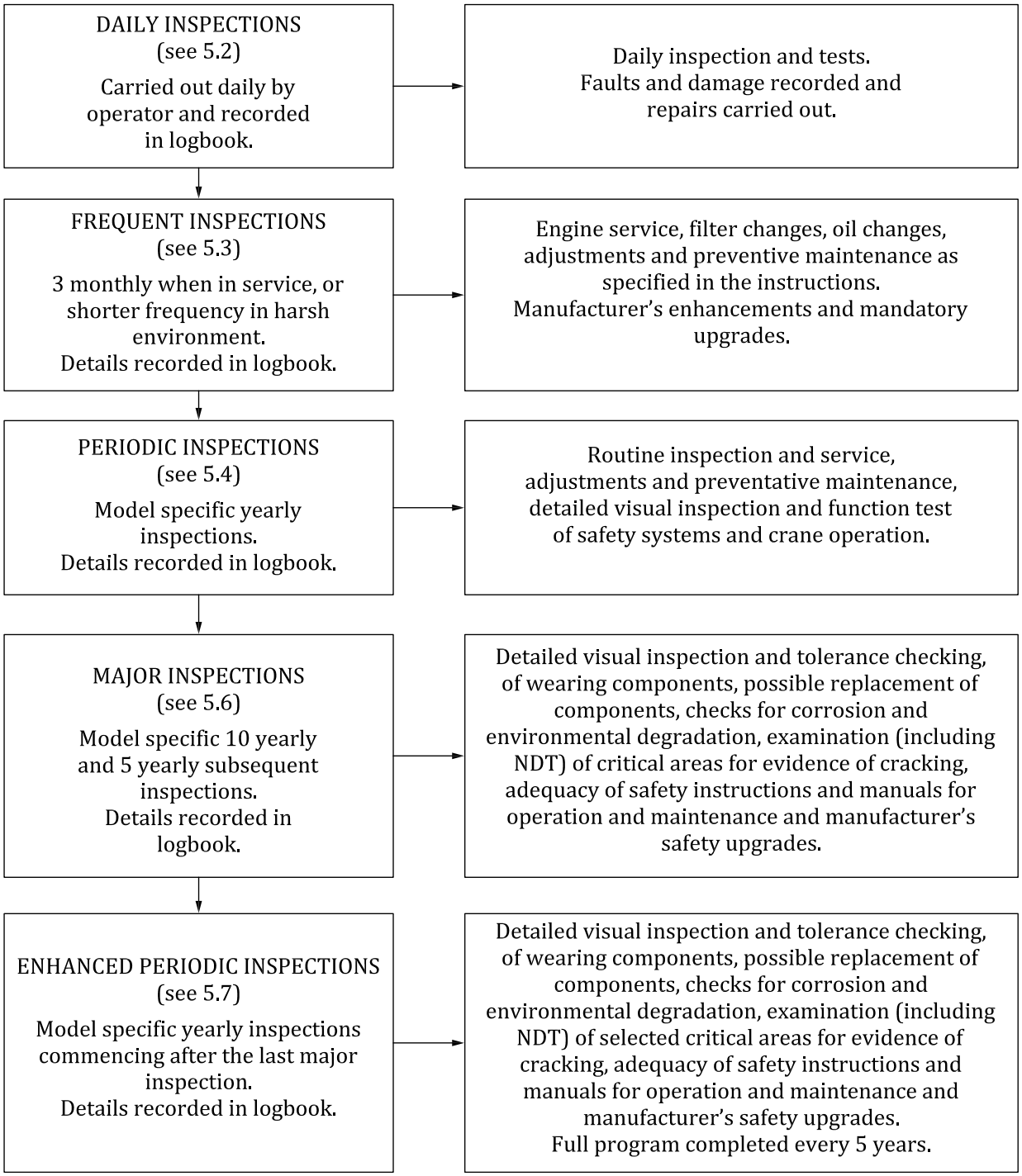

Figure B.3 — Crane more than five years old and instructions not available or deemed inappropriate or inadequate by competent person and enhanced periodic inspection to be adopted

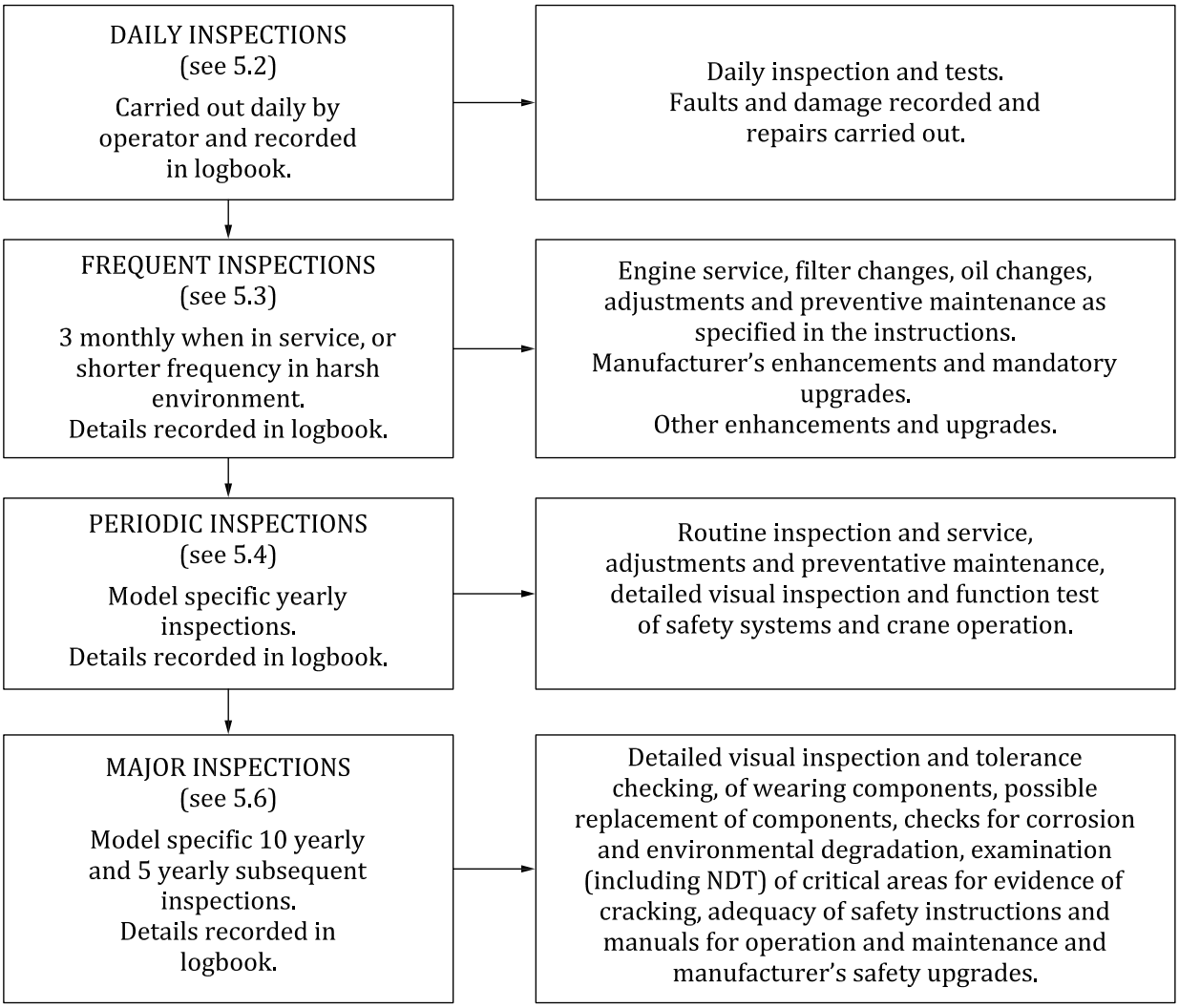

Figure B.4 — Crane more than five years old and instructions not available or deemed inappropriate or inadequate by competent person and critical components inspection deferred to 10th year

Annex C
(informative)

Inspection precautions

The following precautions are recommended to be taken prior to and/or during inspection.

a) The place of inspection and its vicinity should be checked to ensure that the inspection is carried out safely.

b) When hazards are predicted due to extreme weather conditions, the inspection should be postponed until the weather improves.

c) When hazards are predicted due to weak ground conditions, the crane should be moved to a place with firmer ground conditions or measures should be taken to improve ground conditions.

d) Where required by the working environment, inspection personnel should use personal protective equipment, such as a hard hats and goggles, at the site of inspection.

e) In order to protect users from electric shocks, the tools used during inspection should be of safe construction.

f) Wherever they may be exposed to the danger of falling from a height during the inspection, inspection personnel should be properly guarded including by the use of safety harnesses, elevating work platforms and workbox.

g) It should be indicated at the control station of the crane under inspection that the inspection is in progress.

h) When inspecting electrical parts, electrical circuits, power sources and/or power switches should be de-activated and tagged.

i) During the inspection, the activation and de-activation of power switches should be strictly prohibited except when instructed by the inspection person.

j) When entering a place where there is a danger of electric shock during the inspection, the power switch should be in the off position and locked or tagged out. It should be indicated on the control station that the inspection is in progress.

k) During the inspection, crane operation should be strictly prohibited except when instructed by the inspection person.

l) When two or more cranes are installed in the same area or other cranes are installed on a neighbouring location, measures should be taken to prevent the movement of the crane under inspection by other cranes.

m) Prior to the load test, the lifting gear and load support equipment should be checked to ensure there are no deleterious defects and the load is secure.

n) The inspection personnel and other personnel in the vicinity should be strictly prohibited from entering the nip points or crushing areas.

o) When it is predicted that the slewing jib will endanger neighbouring buildings or public areas, the operating test should be prohibited from those spaces.

Annex D
(normative)

Competent persons for the type of inspection

See Table D.1.

Table D.1 — Competent persons

Daily inspection	Frequent inspection	Periodic inspection	Enhanced periodic inspection	Exceptional inspection	Major inspection
Operator					
Maintenance person	Maintenance person				
Experienced technician	Experienced technician	Experienced technician			
Crane inspector	Crane inspector	Crane inspector	Crane inspector	Crane inspector	
Expert engineer	Expert engineer	Expert engineer	Expert engineer	Expert engineer	Expert engineer

Maintenance person is as specified in ISO 12480-1

Crane inspector is as specified in ISO 23814.

An *experienced technician* is a person who, due to his or her vocational background and experience, has sufficient skill and knowledge in the field of cranes and is sufficiently familiar with the relevant regulations to determine deviations from the proper conditions (i.e. specially trained personnel).

An *expert engineer* is an engineer with experience in the design, construction or maintenance of cranes, sufficient knowledge of the relevant regulations and standards and the equipment necessary for carrying out the inspection. Further, an expert engineer is an engineer who is in a position to judge the safe condition of the crane and to decide which measures shall be taken in order to ensure continued safe operation.

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