FEDERATION EUROPEENNE DE LA MANUTENTION

SECTION I

HEAVY LIFTING APPLIANCES

F.E.M.

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RECOMMANDATIONS

TO MAINTAIN TOWER CRANES

IN SAFE CONDITIONS

This edition is also available in French and German

FEM 1.007

Recommendations to maintain tower cranes in safe condition

CONTENT

1 Scope

The aim of this recommendation is to identify the different operations (content and periodicity) needed to maintain tower cranes in a safe condition.

It gives also guidance for detection of defects and actions to be taken.

This recommendation should be used in absence of manufacturer's requirements or national regulations. It can also be a guidance for the manufacturer to establish his requirements.

The manufacturer's instructions have priority over this recommendation.
National regulations shall also be considered.

2 Inspections

To maintain tower cranes as a whole and/or its components in a safe working condition they shall be submitted to the following inspections:

- Daily inspections
- Frequent inspections;
- Periodic inspections;
- Thorough inspections (special assessment).

Note : This recommendation deals only with recurrent inspections, not with the inspection after the first erection of the tower crane.

Furthermore tower cranes shall be used and maintained in accordance with the manufacturer's instructions.

Annex A summarises the recommended inspections (periodicity, content, persons in charge, results and reports).

2.1 Daily inspections

2.1.1 General

Daily inspections shall comprise a visual inspection (in general no dismantling is required) and functional tests as defined hereafter and shall be carried out by a designated person (e.g. the crane driver).

2.1.2 Content

The inspections before each start shall contain :

a) functioning of mechanisms, in particular the brakes (generally without load);

b) functioning of limiting and indicating devices;

c) observation of conspicuous defects including ropes.

2.1.3 Results

Any defect shall be pointed out to a person who can take a suitable decision (to leave the tower crane in use, repair, thorough inspection of a part of the tower crane or the whole tower crane, limitation of use).

The causes of these defects shall be searched depending on the type of component and the criticized defect.

The record book shall be updated (date of the repair, method)

2.2 Frequent inspections

2.2.1 General

Frequent inspections are inspections made with a periodicity as indicated in clause 2.2.3.

They shall comprise visual inspections (in general no dismantling is required) as described in 2.2.2. and functional tests listed in 2.1.2.

They shall be carried out by a designated person (e.g. experienced technician, see ISO 9927-1).

2.2.2 Content

a) **Level of lubricants**
leak of lubricants, greasing;

b) **Hydraulic equipment**
leakage;

c) **Hooks and latches**
visible deformation, cracks, wear;

d) **Connections, joints**
corrosion, visual inspection;

e) **Wearing of the brakes**
thickness of brakes linings, adjustment, noise, etc.;

f) **Hydraulic and pneumatic hoses**
in particular those which are bent during operations;

g) **Electrical installation**
state, signs of deterioration, moisture accumulation;

h) **Anchorage**
braces or guys supporting cranes (condition);

2.2.3 Periodicity

The periodicity of the frequent inspections has to be determined taking into account the real use of the tower crane and the environment in which the tower crane is working.

The minimum periodicity is

a) For clauses a) to d) of 2.2.2 : monthly;

b) For clauses e) to h) of 2.2.2 : twice a year.

2.2.4 Results

Any defect shall be pointed out to a person who can take a suitable decision (to leave the tower crane in use, repair, thorough inspection of a part of the tower crane or the whole tower crane, limitation of use).

The causes of these defects shall be searched depending on the type of component and the criticized defect.

The record book shall be updated (date of the repair, method).

2.3 Periodic inspections

2.3.1 General

Periodic inspections are inspections made periodically as indicated in clause 2.3.3.

Periodic inspections shall comprise visual inspections (in general no dismantling is required), functional tests with and without load as defined below .

They shall be carried out by a competent person (e.g. an experienced technician, see ISO 9927-1).

The competent person shall have
- the report of the previous inspections and
- the automatic registered data, where available, (cycles, hours, days, loads…) permitting to know the service time of the components for which data exist .

2.3.2 Content

The periodic inspections shall include the content of frequent inspections (see clause 2.2.2) and the following points.

The functional tests for all components shall be performed in the most unfavourable position for these components.

a) Verification of the tower crane's identification and plates;

b) Presence of the instruction handbook;

c) Verification of the records of maintenance

d) Verification of the components, equipment and steel structure

compare the component installed on the tower crane with the component listed in the documentation

e) Consideration of the condition of equipment which warn on damages

- the gear or it's components are leak;
- visible couplings between particular components (e.g. motor, gear, brakes, drums) show wear or damages;
- unusual noise is noticed;
- unusual high temperature is noticed;
- fastening bolts are loose, fissured or defect;
- brake linings are worn or damaged;
- the general condition (corrosion, dirt) is to criticize;
- the electrical installation (cable entries, cable attachments) shows damages;
- ropes in accordance with ISO 4309;
- hooks (see Annex C).

f) functional tests

functioning and efficiency, with the rated load, of

- mechanisms, in particular the brakes;
- limiting and indicating devices;

g) Steel structure and rails

Welding, corrosion, remaining deformation, cracks

h) Support of the tower crane/crane track

As an example, Annex B gives a list of components to be checked (identical to Annex A of ISO 9927-1).

2.3.3 Periodicity

Tower cranes shall be inspected at least each year and after each re-erection.

Note 1 : Some verifications can be performed when the tower crane is dismantled.

Note 2 : Changing of the pulley block or addition of a jib extension or tower section are not considered as dismantling and re-erection.

Note 3 : After folding and unfolding of a self erecting tower crane, the inspection is limited to points b), c), f), g) and h) of clause 2.3.2.

2.3.4 Results

Periodic inspections shall be recorded. This report shall indicate the components verified and remaining defects. An example for such report is given in Annex D.

The report shall be given to a person who can take a suitable decision (to leave the tower crane in use, repair, thorough inspection of a part of the tower crane or the whole tower crane, limitation of use).

The causes of these defects shall be searched depending on the type of component and the criticized defect.

The record book shall be updated (date of the repair, type, etc.).

2.4 Thorough inspections

2.4.1 General

Thorough inspections are detailed inspections made with a periodicity as defined in clause 2.4.3 or following a detected serious defect.

They shall be performed by an expert who has a competence which permits him to define the actions to be taken depending on the results of these inspections (e.g. an expert engineer, see ISO 9927-1).

The expert shall have
- the report of the previous inspections and
- the automatic registered data, where available, (cycles, hours, days, loads…) permitting to know the service time of the different components for which data exists

2.4.2 Content

The thorough inspections shall comprise at least all the elements of the periodic inspections.

The thorough inspection could need non destructive tests and/or dismantling if it is justified considering
- the content of the previous verifications (daily, frequent periodic or thorough),
- the results of the current tests,
- the result of the current visual checks.

When dismantling, special care has to be taken to avoid mistake or wrong operation following the maintenance instructions. If they are not available, the manufacturer of the tower crane or of the component should be contacted for assistance.

During the thorough inspection, a particular attention shall be taken for the following:
- vibration;
- unusual noise or temperature;
- poor general condition, corrosion;
- alignment of machinery, motors and gears, rails, wheels, shafts;
- brakes;
- connections, bolts, pins.

2.4.3 Periodicity

2.4.3.1 Periodicity for tower cranes or components for tower cranes with no automatic registration on use

Thorough inspection of a component or the tower crane is recommended at periodic intervals as follows:

- 4 years
- 8 years
- 10 years
- 12 years
- 14 years
- every year after 14 years
- after detection of a serious defect or substantial modification

Modification is substantial for example in case of increase of the rated capacity, change of the mechanisms, transfer of the control station, change of power, change of the design of the load bearing structure, welding on the load bearing structure, modification of the control system or change of the operating condition relative to the class of utilisation and the load spectrum.

2.4.3.2 Periodicity for tower cranes or components for tower cranes with automatic registration of data on use

The instruction handbook should contain the periodicity of the thorough inspection of the crane and of the corresponding components based on the registered data, at least the intervals as given in 2.4.3.1.

In addition to the periodicity, the manufacturer should give guidance to reinitialise the value of the parameter (return to zero, keep the value as new origin…).

2.4.4 Results

The report of the thorough inspections shall contain the result of the inspection made by the expert as well as his conclusions and recommendations including the delay for the next thorough inspection.
An example of such report is given in Annex D.
When the tower crane or a component is not used as classified or in a condition which seems to be hazardous, the expert (see clause 2.4.1 above) will recommend accordingly.

The causes of defects shall be searched depending on the type of component and the criticized defect.

The record book shall be updated (date of the repair, type, etc.).

Annex A Synthesis of the recommended inspections

	Daily inspection	Frequent inspection	Periodic inspection	Thorough inspection
When **(Periodicity)**	- before each start up of the tower crane	- monthly or every six months and/or according to the manufacturer's	- at a determined period (legal, given by the manufacturer or a recommendation) - after dismantling/re-erection	- after finding a fundamental failure - at a determined period either - Legal - Given by the manufacturer - Given by recommendation following a report (frequent or periodic inspection), - Given by this recommendation
What (content)	Clause 2.1.2	Clause 2.2.2	Clause 2.3.2	Clause 2.4.2
How	- Visual inspections - Functional tests Without dismantling	Visual inspections - Functional tests Without dismantling	- Visual inspections including the reading of recording instruments - Functional tests (loaded and unloaded) Without dismantling if not otherwise required by the manufacturer	- Same as for the periodic inspection -If necessary with dismantling or measurement (play) or specific tests on all or part of the tower crane.

	Daily inspection	Frequent inspection	Periodic inspection	Thorough inspection
By who	Designated person (e.g.crane driver)	Designated person (experienced technician)	Competent person (experienced technician)	Expert (expert engineer)
Inspection results	- OK or, - request for repair if fault found or, - can give rise to a request for a thorough inspection (repetitive cases, major fault, etc.) - can give rise to a request for a training action (driving, instructions, limit of use, etc.)	- OK or, - request for repair if fault found or, - can give rise to a request for a thorough inspection (repetitive cases, major fault, etc.) - can give rise to a request for a training action (driving, instructions, limit of use, etc.)	- OK or, - request for repair if fault found or, - can give rise to a request for a thorough inspection (repetitive cases, major fault, etc.) - can give rise to a request for a training action (driving, instructions, limit of use, etc.)	- date of the next inspection - partial or total changes[1] or - scrapping or - request for repair - can give rise to a request for a training action (driving, instructions, limit of use, etc.)
Report	Not systematic	Not systematic	The report shall include a check list of the points checked and a summary of the detected defects.	The report shall contain the findings of the expert as well as his conclusions, for instance, the list of repairs, period before the next thorough inspection, tests to be performed, proposal for general overhaul…
Maintenance book	Updating the maintenance book if repair is involved	Updating the maintenance book with reports on maintenance work, defects, damages, repairs…	Updating the maintenance book with reports on maintenance work, defects, damages, repairs…	Updating the maintenance book with reports on maintenance work, defects, damages, repairs…

[1] Systematic changes of certain parts can be recommended by the manufacturer or by way of recommendations .

Annex B List of the periodic inspections to be performed

Identical to Annex A of ISO 9927-1

Element	Verification to be made
1 Components and mechanical equipment	
1.2 Access ladders and walkways	
Steps, rungs, beams, covering of walkways, platforms, etc. Protective guarding (railing, intermediate bars, hoop guard, toe guards) Information labels and boards marking hazardous areas	Installation, condition
1.3 Crane and trolley tracks	
Travel rails, runway stops	Installation and condition, track gauge, span, deformation
Locking and latching devices	Condition, function
1.4 Crane structure (bridge, portal mast, jib, tower)	
Girders, bars, connections, buffers, end stops, bracing	Cracks, deformation, wear, fastening elements, condition, alignment
1.5 Trolley structure (structure, jib)	
Girders, bars, connections, slewing rims	Condition
1.6 Assemblies	
Travel wheels, shafts, couplings, drums, sheaves, compensating sheaves with pins	Fitting and securing of removable parts, condition
Gear wheels, worm gears	Function
Screws, nuts, wedges	Support
Hydraulic and pneumatic components	Protection of assembly
Mechanical warning devices, limit stop devices, overload protection	Condition, function
1.7 Brakes	
Discs, shoes, belts, levers, release units, weights, pins, springs	Condition, function, brake test with load (test load in the capacity range)
1.8 Lubrication	
Lubrication systems and lubrication points	Sufficient filling, accessibility, identification
1.9 Clearances	Compliance, also with regard to subsequently added elements
1.10 Foundations anchorage	Condition and installation

ANNEX C Verification of the hooks

This annex gives an example for the verification of the hooks

To apply the following method , the initial dimensions of the hooks need to be known. They are available near the manufacturer of the tower crane of the hook.

- **Deformation**

  If the opening "a" and "y" have widened more than 10%, which is the max. permissible limit, replace the load hook.

- **Surface fissures**

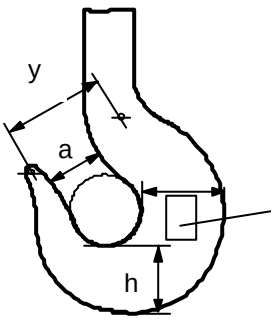
  Damage and surface fissures may be removed notch-less, provided that the permissible tolerance levels are not exceeded.

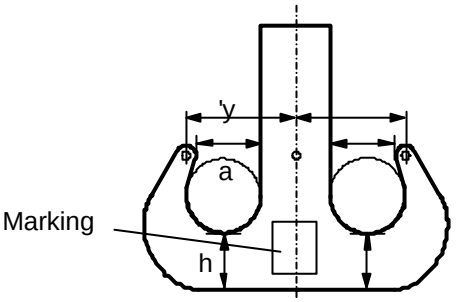
- **Wear**

  Wear on single or twin hooks may not be greater than 5% of the height "h". It is not permitted to carry out welding work on load hooks, e.g. to compensate for wear.

- **Hook neck** shaft

  Cracks





Reference values for "a", "h" and "y" are to be taken form the instruction manual. If they are not available, the manufacturer of the tower crane or of the hook shall be contacted.

Annex D Example of report for periodic and thorough inspections

Company: _____ Date: _____

Crane type: _____ Serial No.: _____

Manufacturer: _____ Year of construction: _____

Address of customer/hirer: _____

Construction site: _____ Stock number: _____

Examiner: _____ Signature: _____

Number	Subassembly	part to be checked	existing or complete		condition or maintenance		function		repair or replacement		re-examination		
											necessary		carried out
			+	-	+	-	+	-	+	-	yes	no	date signature
1	Crane documents	Crane book											
		Instruction handbook											
		spare parts lists											
2	Rail track / crab for the erection	Substructure horizontal											
		Substructure able to take the loads											
		Length of sleepers											
		Condition of sleepers											
		Distance of sleepers											
		Gauge											
		Inner radius of curved rail											
		Rail dimensions											
		Rail fixings											
		Rail joints/joint plates											
		Running-up key for travelling limiter											
		Travel limits											
3	Signs / safety distances	Type plate											
		Signs											
		Warning signs											
		Safety distances											
		to											
		to											
		to											
		to											
		barriers											

met = x not met = - not necessary = O

Number	Subassembly	part to be checked	existing or complete		condition or maintenance		function		repair or replacement		re-examination		
											necessary		carried out
			+	-	+	-	+	-	+	-	yes	no	date signature
4	Undercarriage or portal	Free of cracks											
		Outrigger arm support											
		Outrigger arm lock											
		Rail wheels											
		Wheel flanges											
		Travelling gears											
		Travelling brakes (travelling test)											
		Guarding of danger spots											
		Devices to limit fall due to wheel failure											
		Rail clamps											
		Track clearer											
		Supporting devices											
		Transport safety retainer removed											
5	Slewing gear	Clearance of the slewing ring											
		Fastening of the slewing ring											
		Test run of the slewing ring											
		Slewing gear pinion											
		Fastening of the gear											
		Slewing gear brake											
		Free jib slewing											
		Guarding of danger spots											
6	Hoisting winch	Coupling											
		Changing gear											
		Interlock of changing gear											
		Rope drum mounting											
		Fastening of the hoisting winch											
		Clearance of brake linings											
		Brake disk											
		Brake release unit											
		Springs											

met = x not met = - not necessary = O

Number	Subassembly	part to be checked	existing or complete		condition or maintenance		function		repair or replacement		re-examination		
											necessary		carried out
			+	-	+	-	+	-	+	-	yes	no	date signature
6	Hoisting winch	Brake test											
		Lowering without power											
		Rope fastening											
		2 safety turns											
7	Luffing gear	Coupling											
		Changing gear											
		Interlock of changing gear											
		Rope drum mounting											
		Fastening of the luffing winch											
		Clearance of brake linings											
		Brake disk											
		Brake release unit											
		Springs											
		Brake test											
		Lowering without power											
		Rope fastening											
		2 safety turns											
8	Auxilary hoisting winch	Coupling											
		Changing gear											
		Interlock of changing gear											
		Rope drum mounting											
		Fastening of the auxilary winch											
		Clearance of brake linings											
		Brake disk											
		Brake release unit											
		Springs											
		Brake test											
		Lowering without power											
		Rope fastening											
		2 safety turns											

met = x not met = - not necessary = O

Number	Subassembly	part to be checked	existing or complete		condition or maintenance		function		repair or replacement		re-examination		
											necessary		carried out
			+	-	+	-	+	-	+	-	yes	no	date signature
9	Trolley travelling mechanism	Rail wheels											
		Rope pulleys											
		Wheel flanges / guide rollers											
		Trolley travelling limiter											
		Coupling											
		Fastening of the trolley travelling drum											
		Rope fastenings											
		Limit stops											
		2 safety turns											
		Fetch back of the maintenance cage											
10	Ballast	Ballast											
		Loose ballast (weight)											
		Fixed ballast (weight)											
		Secured against moving											
		Secured against falling down											
		Slinging points											
11	Tower construction	Welds free of cracks											
		Corner posts											
		Diagonals											
		Bolt connections											
		Pin connections											
		Tower joints											
12	Jib construction	Welds free of cracks											
		Upper and lower chords											
		Diagonals											
		Bolt connections											
		Pin connections											
		Jib joints											

met = x not met = - not necessary = O

Number	Subassembly	part to be checked	existing or complete		condition or maintenance		function		repair or replacement		re-examination		
											necessary		carried out
			+	-	+	-	+	-	+	-	yes	no	date signature
13	Counter-jib	Welds free of cracks											
		Counter-jib chords / girder											
		Diagonals											
		Bolt connections											
		Pin connections											
		Counter-jib joints											
14	Access, walkways, platforms	Ladders											
		Hoop guards											
		Personal protective equipment against											
		falls from a height											
		Walkways											
		Platforms											
		Safety device against falling down											
15	Cabin / control station	Walls											
		Windows											
		Floor											
		Entrance											
		Doors											
		Seat											
		Ventilation											
		Heating											
		Electric Installation											
		Windscreen wiper											
		Side protection											
16	Controls	Actuating devices											
		Signs and warnings											
		Radius indicator											
		Indicators											

met = x not met = - not necessary = O

Number	Subassembly	part to be checked	existing or complete		condition or maintenance		function		repair or replacement		re-examination		
											necessary		carried out
			+	-	+	-	+	-	+	-	yes	no	date signature
17	Electric installation	Groud fault protection system											
		Feed line											
		Cable drum											
		Crane switch											
		No-volt release											
		Deadman's switch (movable control)											
		Electric installation											
		Strain reliefs											
		Lighting											
18	Rope drives, pendants	Hoisting rope											
		Luffing rope											
		Jib tie(s)											
		Trolley travel rope(s)											
		Erection rope(s)											
		Rope pulleys											
		Rope hoop guard											
		Rope guides											
		Rope end terminations											
		Other rope connections											
		Pendant ropes											
		Other pendants											
		Locating points of ropes											
19	Block assembly	Fastening at hoisting rope											
		Wear of the hook											
		Deformation of the hook											
		Surface cracks											
		Load hook's nut safety catch											
		Hook catch											
		Hook block											

met = x not met = - not necessary = O

Number	Subassembly	part to be checked	existing or complete		condition or maintenance		function		repair or replacement		re-examination		
											necessary		carried out
			+	-	+	-	+	-	+	-	yes	no	date signature
20	Motion limiters / safety devices	Travelling limiter											
		Hoisting limiter											
		Lowering limiter											
		Derricking limiter up											
		Derricking limiter down											
		Trolley travelling limiter forward											
		Trolley travelling limiter reverse											
		Max. load limiter											
		Load moment limiter											
		Slewing limiters											
21	Other subassemblies, e.g. in accordance with the instruction handbook												

met = x   not met = -   not necessary = O