



RP 1.0: INSPECTION AND CERTIFICATION OF MASTS

A Recommended Practice (RP) for the
Canadian Land-Based Drilling Industry

CANADIAN ASSOCIATION OF OILWELL DRILLING CONTRACTORS
RECOMMENDED PRACTICE 1.0
INSPECTION AND CERTIFICATION OF MASTS (DR)

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INTRODUCTION

The Canadian Association of Oilwell Drilling Contractors (CAODC) Engineering & Technical (E&T) Committee has developed a Recommended Practice (RP) for the inspection and certification of masts (DR). This document dated October 2016 supersedes all prior editions of this Recommended Practice.

The information contained herein is a recommendation only of certification schedules for masts currently utilized in the Canadian drilling industry. An attempt has been made to establish some practical recommended operating practices for masts in the Canadian drilling industry.

The recommendations contained in this document should be considered in conjunction with the requirements of the original equipment manufacturers (OEM). Companies should operate and maintain the equipment within the operating limitations, such as load ratings, as designed by the OEM.

If the OEM stipulates increased levels of inspection or accelerated inspection/certification cycles, the contractors must follow the OEM guidelines unless granted approval to follow this CAODC Recommended Practice by a Professional Engineer (P. Eng).

CAODC has produced this Recommended Practice based on industry experience. However, this document should be considered in conjunction with all relevant legislation and the requirements of provincial regulatory authorities. This document should not be construed as a legal opinion, and users are advised to seek legal counsel to address their specific facts and circumstances.

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HISTORY

The E&T Committee set out to draft guidelines for improving the overall safety of masts with an emphasis on those operations where the mast is handled or repaired. During drilling operations, it is evident that few problems occur and those that do are often related to a previous difficulty when handling the mast.

Factors which affect the condition of a mast include loads imposed on the mast, frequency of raising/lowering, mast design, method of transporting and handling, materials utilized, age of mast and types of wells drilled.

The E&T Committee has drawn upon a number of resources in the formation of these guidelines. Input was received from independent manufacturers, Professional Engineers, welders and operations personnel. The E&T Committee wishes to thank all who were involved.

REVIEW PROCESS

CAODC Recommended Practices are reviewed and revised, reaffirmed, or withdrawn at least every three years. A one-time extension of up to two years may be added to this review cycle. Email any comments or items of concern to rpfeedback@caodc.ca.

RP REVISION SCHEDULE

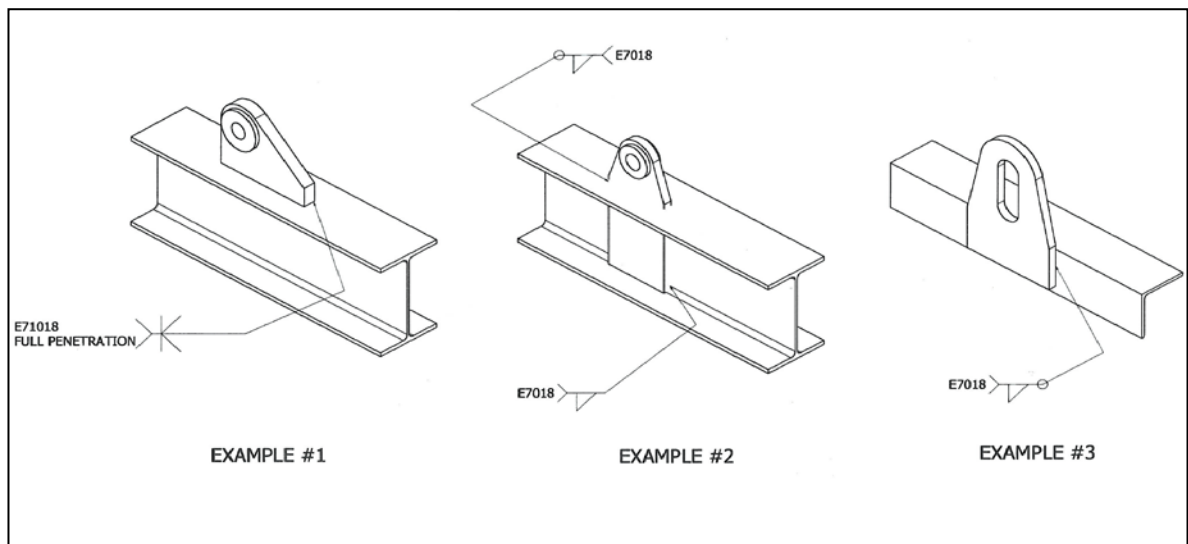
| Revision Date | Revision Details |
|---------------|---|
| Edition 1 | Sanctioned, 1994 |
| Edition 2 | Revised, 2002 |
| Edition 3 | Revised, August 2012 |
| Edition 4 | Revised, April 2015 |
| | – (Section 2.5.1.1) One-Time Extension Provision revised to encompass blocks, top drives and crown assemblies |
| | – (Section 4.2) Provision to allow major repairs in field, revised |
| Edition 5 | Revised, October 2016 |
| | – Content standardized and reformatted for alignment |

1. LIFTING POINTS

Lifting points are designated locations on a mast which are designed to withstand the rigors of typical field transportation handling operations. The E&T Committee has agreed that properly designed lifting points must become a standard requirement for all masts.

Mast lifting points must be designed for handling the completely assembled mast and the disassembled mast sections. The lifting points on a mast must be clearly marked and rig and transportation personnel must be made aware of their importance.

The figure below provides some typical lug designs which may be employed at the designated lifting points. With training and proper supervision, the use of lifting points will greatly reduce handling damage.



Typical Mast Lifting Lugs – lifting lugs shown above are representative only. The certification of the mast requires that properly designed lifting lugs and/or lifting point be installed or designated prior to receiving final certification.

1.1 OVERHEAD ATTACHMENT TO THE MAST

Any equipment mounted within the mast structure must have a review of the attachment points to ensure the structure can accept the anticipated loads. Examples of such attachments include:

- Lights mounted within the mast and their cable securement points;
- Kelly hoses, the safety clamps, and the attachment to the mast via lug or sling around a mast member;

- Casing handling equipment that is not overhead equipment;
- Stabbing board;
- Block hanging chains, slings, and lugs.

Note: any new load bearing attachment points must be identified with a capacity rating and certified by either a Professional Engineer or OEM Agent as described in [Section 5.1 - Personnel Qualifications](#).

Note: application of loads to members within the mast structure, not considered in the original design, must be approved and certified by either a Professional Engineer or OEM Agent as described in [Section 5.1 - Personnel Qualifications](#).

Note: lifting point designation shall be designated by either a Professional Engineer or OEM Agent as described in [Section 5.1 - Personnel Qualifications](#).

2. **INSPECTION TYPES**

To ensure that masts are properly maintained and serviceable, five levels of inspection are recommended:

2.1 **PRE/POST MOVE INSPECTION**

Mast transportation, handling training and vigilance are the most effective ways to ensure that damage does not occur to critical structures within the mast during a move.

A pre-move (loaded) and post-move (unloaded) visual inspection of the mast structure must be conducted by the Rig Manager and the trucking company representative to ensure damage has not occurred.

The pre-move safety meeting must include a discussion on the location of the correct lifting points as well as any other handling issues which may be unique to the individual mast structure being moved.

2.2 **LEVEL I INSPECTION**

A Level I inspection is a visual observation of the mast prior to, and/or during normal operation, and/or during routine maintenance.

2.2.1 **LEVEL I INSPECTION PERSONNEL**

Level I inspections are performed by the rig crew and should also be included as part of the daily rig walkaround carried out by the Driller or Rig Manager.

2.2.2 **LEVEL I INSPECTION DOCUMENTATION**

Level I inspections shall be recorded in the tour sheet.

2.3 **LEVEL II INSPECTION**

A Level II inspection is a Level I inspection that includes a more thorough inspection of, but not limited to, load bearing components and sheaves that includes checking for:

- Proper lubrication;
- Obvious external cracks;
- Damage and/or premature wear or deterioration;
- Missing parts or guards.

2.3.1 **LEVEL II INSPECTION PERSONNEL**

Level II inspections should be carried out by the Driller or Rig Manager.

2.3.2 **LEVEL II INSPECTION DOCUMENTATION**

Level II inspections shall be recorded in the tour sheet.

2.4 **LEVEL III INSPECTION**

A Level III inspection requires rig equipment to be thoroughly checked in the field to determine serviceability. This may include Non Destructive Testing (NDT) techniques on load bearing components, and may require some minor disassembly of guards.

Note: *Level III inspections for masts require outside technical assistance.*

Upon reaching the required number of operating days, as outlined in [Section 3 - Inspection Frequency](#), a thorough visual inspection of all load bearing components, welds and pick-up points must be conducted to determine the condition of the equipment.

If during a Level III inspection, it becomes apparent that the routine rig operation has resulted in (or may result in) a regular occurrence of significant contact with critical parts of the mast, suitable equipment or procedures must be utilized to prevent mast damage. This may include the installation of sacrificial plating to ensure critical structure is not damaged:

- Any plates or other equipment installed for this purpose must be certified by either a Professional Engineer or OEM Agent as described in [Section 5.1 - Personnel Qualifications](#);

- Deflection plates, if required, should be installed so as not to hamper the Driller's visibility.

Any repairs required shall be done in accordance with [Section 4 - Repairs, Maintenance and Documentation](#).

2.4.1 LEVEL III INSPECTION PERSONNEL

Personnel qualified to supervise and/or provide technical assistance for a Level III inspection include:

- Inspection Personnel as described in [Section 5.1.1](#);
- NDT Technicians as described in [Section 5.1.3](#);
- Professional Engineer's as described in [Section 5.1.4](#).

2.4.2 LEVEL III INSPECTION DOCUMENTATION

Level III inspections must be documented in the CAODC Mast and Overhead Equipment Log Book, or suitable equivalent.

2.5 LEVEL IV INSPECTION AND CERTIFICATION

A Level IV inspection requires the equipment to be disassembled as required to do a complete inspection and may, at the certifying party's discretion, include NDT of all critical load bearing components.

All deficiencies and repairs required shall be done in accordance with [Section 4 – Repairs, Maintenance and Documentation](#).

2.5.1 MASTS

Upon reaching the required number of operating days, as outlined in [Section 3 - Inspection Frequency](#), the entire mast shall be Level IV inspected. The following procedure is recommended for completing this inspection:

- Place mast, fully assembled, on suitable supports;
- Clean mast as required to prepare for inspection;
- All lugs and attachment points are to be inspected for their structural condition and their intended use (this provides an opportunity to certify existing attachment points suitable to the typical working environment of the mast).

If during a Level IV inspection, it becomes apparent that the routine rig operation has resulted in (or may result in) a regular occurrence of

significant contact with critical parts of the mast, suitable equipment or procedures must be utilized to prevent mast damage. This may include the installation of sacrificial plating to ensure critical structure is not damaged:

- Any plates or other equipment installed for this purpose must be certified by either a Professional Engineer or OEM Agent as described in [Section 5.1 - Personnel Qualifications](#);
- Deflection plates, if required, should be installed so as not to hamper the Driller's visibility.

Note: *actual inspection requirements will be at the discretion of the certifying party.*

2.5.1.1 ONE-TIME EXTENSION PROVISION

Prior to the 1000th operating day, a one-time extension of 100 operating days for the mast, blocks, top drive and crown assembly may be granted providing a Professional Engineer (as described in [Section 5.1.4](#)) performs a complete visual inspection.

Note: *a well spudded prior to the expiry of the original 1000 operating days may be completed.*

2.5.2 CROWN ASSEMBLY

In conjunction with a Level IV mast inspection, the entire crown assembly shall also be Level IV inspected. The following procedure is recommended for completing this inspection:

- Sheaves must be removed from the crown shaft;
- Bearing races must be removed;
- Sheaves must be gauged using a sheave gauge;
- Tread thickness shall be evaluated and documented;
- Wall thickness shall be evaluated and documented;
- An NDT inspection for cracks must be performed.

2.5.3 LEVEL IV INSPECTION AND CERTIFICATION PERSONNEL

Personnel qualified to perform a Level IV inspection typically include:

- Professional Engineer's as described in [Section 5.1.4](#);
- OEM Agent as described in [Section 5.1.6](#).

Note: *Level IV inspections must include contractor personnel familiar with the use of lugs and attachment points.*

2.5.4 LEVEL IV INSPECTION AND CERTIFICATION DOCUMENTATION

A certification document will be provided by the certifying party and should include the following:

- Items outlined in [Section 7 – Sample of Typical Damage Report](#);
- Static hook load rating (daN) with maximum lines strung;
- Clear height;
- Mast boom ratings;
- Escape line and fall arrest anchor point ratings;
- A diagram of lugs on the mast and a chart of the ratings applied with the intended use of each lug;
- Document author;
- Date and period of certification;
- Mast serial number (if available);
- Name of manufacturer (if available);
- Date of manufacture (if available);
- Results of the Level IV inspection;
- Location of repairs (if applicable).

Additionally, Level IV inspections must be documented in the CAODC Mast and Overhead Equipment Log Book, or suitable equivalent, and signed by the certifying party.

Sample - Drilling Rig Mast Certification

for

ABC DRILLING COMPANY

RIG 1

102 Ft Lee C Moore Cantilever Mast

Date: March 1, 2012

The Mast Specifications and Ratings are as follows:

Serial No: XX-XXX
Clear Height: XXX Ft / XX.X Meters
Base Width: XX'-X" / X.XX meters
Rated Capacity a/p API 4F
with no Setback XXX mph / XXX kph
with Full Setback XXX mph / XXX kph

Maximum Static Hook Load

6 Lines Strung XXX,XXX lbs / XXX,XXX daN
8 Lines Strung XXX,XXX lbs / XXX,XXX daN

Caution: Acceleration or impact, also setback and wind loads will reduce the maximum static hookload rating

During February 2012 the ABC Drilling Rig 1 mast was refurbished in ABC's yard in Nisku, Alberta. Repairs to defects as identified by XYZ Engineering's P.Eng and MPI Company (file no. xxxx) were repaired by the DEF Welding Company (Work Order no. xxxx). The Crowns Sheaves were disassembled by ABC replacing 4 bearings with new ones. The bridle line was replaced with new. The mast was sandblasted and painted.

Based on these repairs and inspections, it is my opinion that the mast is safe to operate within its rated capacity when used in accordance with manufacturers specifications and/or industry standards provided that the owner performs routine inspections as/per the CAODC RP1.0 Guidelines. This certification is valid for **1000 Operating Days** or until such time that the mast is structurally damaged by operations, handling, or transportation.

XYZ Engineering Ltd.

John Smith, P.Eng
123 Avenue Street
Edmonton, Alberta, XXX-XXX
Phone: (XXX) XXX-XXXX
Fax: (XXX) XXX-XXXX
File No: XXXX

Engineer's Stamp
with Appropriate
Jurisdiction

Permit to Practice Stamp
or Permit Number

3. **INSPECTION FREQUENCY**

At a minimum, the inspection frequency of masts shall be conducted in accordance with the schedule below.

Note: *should circumstances, OEM recommendations or individual experience dictate otherwise, CAODC member companies may conduct these inspections at greater frequencies.*

| DOCUMENTATION | DAILY | RAISE & LOWER | 250 DAYS | 500 DAYS | 750 DAYS | 1000 DAYS |
|--------------------------------------|-------|---------------|----------|----------|----------|-----------|
| TOUR SHEET | I | II | | | | |
| MAST AND OVERHEAD EQUIPMENT LOG BOOK | | | III | III | III | IV |

Note: *one operating day = 24 accumulated operating hours from spud to rig release.*

4. **REPAIRS, MAINTENANCE AND DOCUMENTATION**

Occasionally repairs and/or maintenance following a Level III or IV inspection may be required to retain the operating integrity of the mast. Any damage that requires repair will be categorized as minor or major as follows:

4.1 **MINOR DAMAGE**

Minor damage is considered damage or distortion to secondary equipment and includes:

- Ladder damage;
- Cosmetic damage to diagonal girts and minor fan distortions;
- Walk around platforms on masts used for personnel positioning;
- Tong hangers;
- Monkeyboards.

4.1.1 **MINOR DAMAGE REPAIR PERSONNEL**

Minor repairs may be completed by Operating Personnel, as described in [Section 5.1.2](#), at the discretion of the Rig Manager or higher authority, and do not require certification.

If there is any question as to whether the damage is minor or major, either a Professional Engineer or OEM Agent as described in [Section 5.1 - Personnel Qualifications](#) must be consulted.

4.2 MAJOR DAMAGE

Major damage is considered geometrical distortion or structural damage and includes the following:

- Repairs to:
 - Main legs of the mast requiring welding or replacement;
 - A-Legs requiring welding or replacement;
 - Crown that are not cosmetic (i.e. replacement or repair of members);
 - Bridle line attachments and load path points;
 - Section pinning points;
 - Any other load bearing member;
- Repair to or replacement of strongbacks on the mast;
- Weld repairs to:
 - Locking assemblies on telescopic masts;
 - Monkeyboard, excluding fingers and diving board;
 - Fall arrest points and escape line frames;
 - Mast raising and lowering cylinders or cylinder mounting lugs (raising assembly).

All major damage must be repaired and requires an NDT inspection upon completion. Repairs may be completed in a field environment provided they can be performed adequately and are accessible for NDT inspection.

For the purposes of this RP, upon completion of repair to all major damage, a Level IV inspection is required specific to the equipment that was repaired. Recertification provides an opportunity to certify existing attachment points suitable to the typical working environment of the mast.

4.2.1 MAJOR DAMAGE REPAIR PERSONNEL

Personnel qualified to consult, complete and certify major repairs include:

- Professional Engineers as described in [Section 5.1.4](#);
- OEM Agents as described in [Section 5.1.6](#).

4.3 REPAIR AND MAINTENANCE DOCUMENTATION

All repairs and maintenance performed shall be documented in the CAODC Mast and Overhead Equipment Log Book, or suitable alternative, and include the following information:

- Date repairs and/or maintenance was conducted;
- Description of repairs and/or maintenance that was completed;
- For minor repairs:
 - Operating Personnel (as described in [Section 5.1.2](#)) that completed the repair and/or maintenance;
- For major repairs:
 - Certifying party of the repair, including signature.

4.3.1 MAJOR REPAIR DOCUMENTATION (RECERTIFICATION)

The certifying party will provide a certification document for the equipment requiring major repairs.

Repair certification is issued for the repair of actual damage and is intended to maintain Level IV certification. It does not extend the Level IV certification requirements unless a complete Level IV inspection is conducted in accordance with [Section 2.5 - Level IV Inspection and Certification](#).

5. PERSONNEL QUALIFICATION, TRAINING AND DOCUMENTATION

5.1 PERSONNEL QUALIFICATIONS

Proper training of personnel continues to be one of the most critical considerations in the care of a mast. This does not only include the rig personnel but also the truckers that are handling these masts and the welders repairing them. Most mast damage occurs during moving and handling, thus trained and alert personnel are the best method of eliminating handling damage to masts.

5.1.1 INSPECTION PERSONNEL

Typical Inspection Personnel are considered to be senior operations personnel designated by the company that have:

- Knowledge of working principles of masts and attachments to masts;
- Mechanical competency in the disassembly of the equipment type and model;
- Experience and knowledge in drilling rig maintenance.

Examples of senior operations personnel include: Rig Managers, Field Superintendents, Technologists, Rig-up Superintendents, Shop Foremen, and Operations Managers.

5.1.2 OPERATING PERSONNEL

Typical Operating Personnel are considered to be members of the rig crew that have:

- Knowledge of working principles of the equipment referenced in this RP;
- Experience and knowledge in drilling rig maintenance.

5.1.3 NDT TECHNICIANS

At a minimum, NDT Technicians are required to have Level II, Canadian Government Standards Board (CGSB) certification or other approved certification/training at the discretion of the certifying party.

5.1.4 PROFESSIONAL ENGINEERS

Professional Engineer's shall have:

- Previous experience and training in structural and/or mechanical analysis;
- A practical working knowledge of equipment referenced in this RP;
- Previous experience and training in the repair of the equipment referenced in this RP;
- Experience with general quality control standards;
- Professional status in Canada.

5.1.5 ORIGINAL EQUIPMENT MANUFACTURERS (OEM)

The company who built the original piece of equipment under inspection.

5.1.6 ORIGINAL EQUIPMENT MANUFACTURER AGENT

A designate of the OEM that has a practical working knowledge of the specific equipment under inspection.

5.1.7 WELDERS

Welders must hold a valid Journeyman Welder certificate and have experience in drilling rig maintenance.

5.2 PERSONNEL TRAINING

To satisfy provincial regulations and ensure that equipment will operate in the manner for which it was designed, Inspection and Operating Personnel (as described in [Section 5 - Personnel Qualification, Training and Documentation](#)) shall be adequately trained to conduct inspections (including visual) in accordance with this Recommended Practice. At a minimum, training should outline the inspection criteria for all critical components outlined in this Recommended Practice.

5.3 PERSONNEL DOCUMENTATION

Companies shall have a process in place that documents and retains all training administered to company personnel referenced in this Recommended Practice and should include:

- Date training took place;
- Who was in attendance.