



RP 1.0: INSPECTION AND CERTIFICATION OF MASTS

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

EDITION: 6

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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 January 2019 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.

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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RANGE OF OBLIGATION

Throughout this RP the terms ‘must’, ‘shall’, ‘should’, ‘may’, and ‘can’ are used as indicated below:

TERM	USAGE
MUST	A specific or general regulatory and/or legal requirement that must be followed.
SHALL	An accepted industry practice or provision that the reader is obliged to satisfy to comply with this RP.
SHOULD	A recommendation or action that is advised.
MAY	An option or action that is permissible within the limits of the RP.
CAN	Possibility or capability.

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CAODC Recommended Practices are reviewed and revised, reaffirmed, or withdrawn at least every three years.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.

REVISION SCHEDULE

REVISION DATE	REVISION DETAILS
Edition 1	Sanctioned, 1994
Edition 2	Revised, 2002
Edition 3	Revised, August 2012
Edition 4	Revised, April 2015 <ul style="list-style-type: none"> – One-time extension provision revised to encompass blocks, top drives and crown assemblies – Provision to allow major repairs in field, revised
Edition 5	Revised, October 2016 <ul style="list-style-type: none"> – Content standardized and reformatted for alignment
Edition 6	Industry review, March 2019

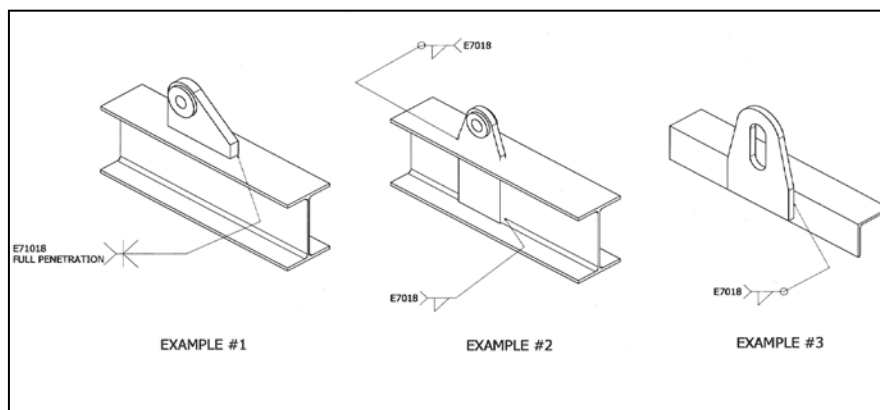
1. **SCOPE**

- 1.1 This recommended practice (RP) describes the inspection and certification schedule for masts currently utilized in the Canadian drilling industry, and is intended to ensure the safe and reliable operation of masts by emphasizing where the mast is handled and/or repaired.
- 1.2 For the purposes of this RP, a mast on a drilling rig is considered to be the entire mast structure and accessories, and includes but is not limited to:
- a) Crown assemblies;
 - b) Cross members;
 - c) Deadline anchor;
 - d) Escape line and fall arrest anchor points;
 - e) Fan braces;
 - f) Girts;
 - g) Mast lifting and attachment points;
 - h) Main legs;
 - i) Overhead attachments to the mast;
 - j) Racking boards.

2. **MAST LIFTING POINTS - TRANSPORTATION AND HANDLING**

- 2.1 Lifting points, also commonly referred to as lifting lugs, must be designated and designed to withstand the rigors of typical field transportation and handling operations.
- 2.2 Lifting points must be designed and clearly marked for handling a completely assembled mast or separate disassembled mast sections.
- 2.3 Lifting points must be visible for pre-use inspections and evaluations. Personnel must be made aware of their locations, importance, and proper use, and orientation.
- 2.4 Lifting points shall be designated and rated by either a [Professional Engineer](#) or [OEM Agent](#).

- 2.5 Any new lifting point installed on a mast must be identified with a capacity rating and certified by either a [Professional Engineer](#) or [OEM Agent](#).
- 2.6 Mast certification must require that properly designed lifting points be installed or designated prior to issuing final certification to the owner.
- 2.7 Application of a load to any load bearing component within the mast structure, not considered in the original design, must be approved and certified by either a [Professional Engineer](#) or [OEM Agent](#).
- 2.8 Where a sling is used at a lifting point, the type of sling utilized will be at the discretion of the contractor and certifying party. All rigging and slinging must be approved by the responsible party prior to use.
- 2.9 The figure below, depicting typical mast lifting lugs, provide an example of some typical lifting points that may be employed at designated attachment points on a mast:



3. OVERHEAD ATTACHMENT POINTS TO THE MAST

- 3.1 Any equipment mounted within the mast structure is considered an overhead attachment point.
- 3.2 Examples of overhead attachment points include but are not limited to:
- Block hanging chains, slings, and operational lugs;
 - Casing handling equipment that is not overhead equipment;
 - Kelly hoses, Kelly hose safety clamps, and/or any attachments to the mast via lug or sling around a mast member;
 - Lights mounted within the mast structure and their cable securement points.

- 3.3 Any new load bearing attachment point must be identified with a capacity rating and certified by either a [Professional Engineer](#) or [OEM Agent](#).
- 3.4 Application of a load to any load bearing component within the mast structure, not considered in the original design, must be approved and certified by either a [Professional Engineer](#) or [OEM Agent](#).
- 3.5 No work shall be performed when the application of a load to any load bearing component within the mast structure has not been rated and certified by either a [Professional Engineer](#) or [OEM Agent](#).
- 3.6 All rigging and slinging must be approved by the responsible party prior to use.

4. **INSPECTION TYPES**

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

4.1 **PRE AND POST MOVE INSPECTION**

- 4.1.1 When transporting a mast it is imperative that damage does not occur to the critical structures within the mast structure. To prevent damage from occurring:
 - a) Proper handling procedures must be observed;
 - b) Affected personnel must be trained accordingly, and
 - c) A pre-move safety meeting must take place that includes discussion on the location of the lifting points to be used as well as any other handling issues unique to the mast structure.
- 4.1.2 To ensure damage has not occurred to the mast structure, pre-move (loaded) and post-move (unloaded) visual inspections must be performed.
- 4.1.3 **PRE AND POST MOVE INSPECTION PERSONNEL**
Pre and post move inspections should be performed by both the Rig Manager and the trucking company representative.
- 4.1.4 **PRE AND POST MOVE INSPECTION DOCUMENTATION**
Pre and post move inspections should be documented and retained according to company policy and procedures.

4.2 LEVEL I INSPECTION

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

4.2.2 LEVEL I INSPECTION PERSONNEL

Level I inspections are performed by [Operating Personnel](#) and should also be included as part of the daily rig walk around carried out by the Driller or Rig Manager.

4.2.3 LEVEL I INSPECTION DOCUMENTATION

Level I inspections shall be recorded in the tour sheet.

4.3 LEVEL II INSPECTION

4.3.1 A Level II inspection is a Level I inspection that includes a more thorough inspection of the load bearing components and sheaves that includes checking for:

- a) Proper lubrication;
- b) Obvious external cracks;
- c) Damage and/or premature wear or deterioration;
- d) Missing parts or guards.

4.3.2 Utility sheaves should be thoroughly checked for:

- a) Excessive wear, damage or cracking;
- b) Proper line size, and lubrication;
- c) Unrestricted rotation.

4.3.3 Sheave and wire rope retention shall be included in the inspection of all sheave applications.

4.3.4 LEVEL II INSPECTION PERSONNEL

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

4.3.5 LEVEL II INSPECTION DOCUMENTATION

Level II inspections shall be recorded in the tour sheet.

4.4 LEVEL III INSPECTION

- 4.4.1** A Level III inspection requires rig equipment to be thoroughly checked in the field to determine serviceability and may include or require:
- a) Non-destructive testing (NDT) techniques on load bearing components;
 - b) Some minor disassembly of guards;
 - c) Outside technical assistance.
- 4.4.2** Upon reaching the required number of operating days, as outlined in [Section 6 - Inspection Frequency](#), a thorough visual inspection of the following critical components is required to determine the condition of the mast:
- a) All load bearing components;
 - b) All structural and non-structural welds, and
 - c) All lifting and load bearing attachment points.
- 4.4.3** All repairs required shall be done in accordance with [Section 7 – Repairs, Maintenance and Documentation](#).
- 4.4.4** **LEVEL III INSPECTION PERSONNEL**
Personnel qualified to perform and sign-off a Level III inspection include [Inspection Personnel](#).
- 4.4.5** **LEVEL III INSPECTION DOCUMENTATION**
Level III inspections must be documented in the CAODC Mast and Overhead Equipment Log Book, or suitable equivalent.

4.5 LEVEL IV INSPECTION AND CERTIFICATION

- 4.5.1** 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.
- 4.5.2** Upon reaching the required number of operating days, as outlined in [Section 6 - Inspection Frequency](#), the entire mast shall be Level IV inspected. At a minimum the following procedure is recommended for completing this inspection:

- a) Place fully assembled mast on suitable supports;
- b) Clean mast as required to prepare for inspection;
- c) All lifting and attachment points are to be inspected for their:
 - i. Structural condition, and
 - ii. Intended use.

Note: *inspecting these elements provides an opportunity to certify existing attachment points suitable to the typical working environment of the mast.*

- 4.5.3** For the purposes of this RP, the crown assembly, regardless if it is welded or pinned, is considered to be everything above the water table, including but not limited to the structure, crown cluster, fastline, and deadline sheaves.

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

- a) Sheaves must be removed from the crown shaft and be dimensionally inspected;
- b) Bearing races must be removed;
- c) Sheaves must be gauged using a sheave gauge;
- d) Tread thickness shall be evaluated and documented;
- e) Wall thickness shall be evaluated and documented;
- f) An NDT inspection of structure, sheaves, shafts, pedestals, and guards for cracks must be performed.

- 4.5.4** Inspection requirements will be at the discretion of the certifying party.

- 4.5.5** All repairs required should be done in accordance with [Section 7 – Repairs, Maintenance and Documentation](#).

- 4.5.6** Prior to reaching the required number of operating days, as outlined in [Section 6 - Inspection Frequency](#), a one-time extension of 100 operating days for the mast, blocks, top drive and crown assembly

may be granted providing a [Professional Engineer](#) performs a complete visual inspection, along with the following provisions:

- a) A single well spudded prior to reaching the required number of operating days may be completed and released;
- b) This one-time extension applies to a single well, and not a pad of multiple wells.

4.5.7 LEVEL IV INSPECTION AND CERTIFICATION PERSONNEL

Personnel qualified to perform a Level IV inspection typically include either a [Professional Engineer](#) or [OEM Agent](#).

4.5.8 LEVEL IV INSPECTION AND CERTIFICATION DOCUMENTATION

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

- a) Items outlined in the [CAODC Mast Inspection Checklist](#);
- b) Static hook load rating (daN) with maximum lines strung;
- c) Clear height;
- d) Mast boom ratings;
- e) Escape line and fall arrest anchor point ratings;
- f) A diagram of lugs or designated lifting points on the mast, and a chart of the ratings applied that includes the intended use of each lug or designated lifting point;
- g) Document author;
- h) Date and period of certification;
- i) Mast serial number (if available);
- j) Name of manufacturer (if available);
- k) Date of manufacture (if available);
- l) Results of the Level IV inspection;
- m) Location of repairs (if applicable).

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

5. CONTACT WITH CRITICAL MAST COMPONENTS

5.1 If during a Level III or IV inspection it becomes apparent that routine rig operations have resulted in, or may result in, a regular occurrence of significant contact with critical components of the mast, suitable equipment or procedures must be utilized to prevent damage. This may include the installation of sacrificial plating:

- a) Any sacrificial plates or other equipment installed for this purpose must be certified by either a [Professional Engineer](#) or [OEM Agent](#);
- b) Deflection plates, if required, should be installed so as not to hamper the line of sight, or the Driller's visibility.

6. INSPECTION FREQUENCY

6.1 At a minimum, the inspection frequency for masts shall be conducted in accordance with the schedule below:

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

6.2 Should circumstances, OEM recommendations or individual experience dictate otherwise, CAODC member companies may conduct these inspections at greater frequencies.

6.3 One operating day = 24 accumulated operating hours from spud to rig release.

7. REPAIRS, MAINTENANCE AND DOCUMENTATION

7.1 Occasionally repairs and/or maintenance following a Level III or IV inspection may be required to retain the operating integrity of the mast.

7.2 Any damage that requires repair will be categorized as minor or major.

7.3 If there is any question as to whether the damage is minor or major, either a [Professional Engineer](#) or [OEM Agent](#) must be consulted.

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

- a) Ladder damage;
- b) Cosmetic damage and/or minor distortion to girts, and diagonal and fan braces;
- c) Walk around platforms on masts used for personnel positioning;
- d) Tong hangers;
- e) Monkeyboard fingers, wind walls, handrails, and diving board.

7.4.1 **MINOR DAMAGE REPAIR PERSONNEL**

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

7.5 Major damage is considered geometrical distortion or structural damage and includes:

- a) Repairs to:
 - i. Main legs of the mast requiring any welding or replacement;
 - ii. A-legs requiring any welding or replacement;
 - iii. Crown that are not cosmetic (i.e. replacement or repair of members);
 - iv. Bridle line attachments and load path points;
 - v. Section pinning points;
 - vi. Any other load bearing component;
- b) Repair to, or replacement of, strongbacks on the mast;
- c) Weld repairs to:
 - i. Locking assemblies on telescopic masts;
 - ii. Monkeyboard, excluding fingers and diving board;
 - iii. The escape line frame and fall arrest anchor points;

- iv. Mast raising and lowering cylinders or cylinder mounting lugs (raising assembly).

7.5.1 All major damage must be repaired and, upon completion requires NDT inspection and documentation in the form of a repair certification.

7.5.2 Upon completion of repair to all major damage, a Level IV inspection is required that is specific to the equipment that was repaired. **Note:** *recertification provides an opportunity to certify existing attachment points suitable to the typical working environment of the mast.*

7.5.3 Repairs may be completed in a field environment provided they can be performed adequately and are accessible for NDT inspection.

7.5.4 All major repairs shall be completed with the assistance of a [Professional Engineer](#) or [OEM Agent](#) approved procedure. The certifying party would supply the repair facility with a repair procedure and provide notes on the repair certification.

7.5.5 **MAJOR DAMAGE REPAIR PERSONNEL**
Personnel qualified to instruct, oversee and certify major repairs include either a [Professional Engineer](#) or [OEM Agent](#).

7.6 **REPAIR AND MAINTENANCE DOCUMENTATION**

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

- a) Date repairs and/or maintenance was conducted;
- b) Description of repairs and/or maintenance that was completed;
- c) For minor repairs, [Operating Personnel](#) that completed the repair and/or maintenance;
- d) For major repairs, certifying party of the repair.

7.6.2 **MAJOR REPAIR DOCUMENTATION (RECERTIFICATION)**

- a) The certifying party should supply the repairing party with a certification document for the equipment requiring major repairs;

- b) Repair certification is issued for the repair of 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 4.5 - Level IV Inspection and Certification](#).

8. PERSONNEL QUALIFICATIONS, TRAINING AND DOCUMENTATION

8.1 PERSONNEL QUALIFICATIONS

Mast damage primarily occurs when the mast is being transported or handled. As such, ensuring that affected personnel are properly trained and competent is one of the best methods for preventing damage from occurring.

8.1.1 INSPECTION PERSONNEL

Typical Inspection Personnel are considered to be individuals designated by the company that have:

- a) Knowledge of working principles of the equipment referenced in this RP;
- b) Mechanical competency in the disassembly of the equipment type and model, and
- c) Experience and knowledge in drilling rig maintenance.

Examples of Inspection Personnel include: Professional Engineers, Journeymen Heavy Duty Mechanics and/or Millwrights, OEM Agents, Mechanical and/or Maintenance Managers and senior operations personnel such as Rig Managers, Field Superintendents, Technologists, Rig-up Superintendents, Shop Foremen, and Operations Managers.

8.1.2 OPERATING PERSONNEL

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

- a) Knowledge of working principles of the equipment referenced in this RP, and
- b) Experience and knowledge in drilling rig maintenance.

8.1.3 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.

8.1.4 PROFESSIONAL ENGINEERS

Professional Engineer's shall have:

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

8.1.5 ORIGINAL EQUIPMENT MANUFACTURERS (OEM)

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

8.1.6 ORIGINAL EQUIPMENT MANUFACTURER AGENT

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

8.1.7 WELDERS

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

8.2 PERSONNEL TRAINING

To satisfy provincial regulations and ensure that equipment will operate in the manner for which it was designed, [Inspection](#) and [Operating Personnel](#) 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.

8.3 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 the date training took place, and who was in attendance.