GUIDE TO

MAJOR

INSPECTIONS

Revised July 2011

Prepared by:
The Crane Industry Council of Australia
The recent release of Australian Standards AS2550.1 2011 has promoted CICA to relook at its original 2006 Guide to 10 Year Major Inspections. In the past 5 Years we have seen a number of States that have mandated the requirement to carry out Major Inspections. The QLD Code of Practice has been well accepted and this State clearly has its act into gear. Other States have not been so proactive, with the result being that predominately Owners of older cranes have recognised that they have an obligation to have their cranes in a safe condition and have acted accordingly. There is a huge gulf between what QLD has determined is required versus some Owners, Used Crane Distributors and Sellers of used cranes are actually doing to ensure that their cranes comply. We have witnessed many Major Inspections that are basically fraudulent; they simply do not come even close to what is required. The resulting documentation will not stand up to any scrutiny and ultimately, someone will be penalized in the very near future. Buyers of Cranes will be acting in good faith, but the piece of paper that they receive is simply worthless.

Regulators have been reluctant to intervene other than QLD, so CICA has taken the decision to introduce a CICA Gold Compliance Plate that provides all in the Crane Industry with a method of determining that the Major Inspection has been carried out in accordance with the requirements of Australian Standards AS2550.1 2011 and Manufacturers recommendations. The CICA Gold Major Inspection Verification Plate will be provided to those who submit their Major Inspection Reports to CICA for auditing and confirmation that the work carried out complies with the Australian Standards and good engineering practice.

The Standard itself clearly spells out what is required, but unlike pre 2002 Standards, the end result has been stipulated, and how that result is achieved is the responsibility of the owner or controller of the mobile crane. The purpose of this new guide is to hopefully dispel some of the myths that have developed in the crane industry and provide a way forward that everyone connected with the Crane Industry can understand.

We have witnessed the good, bad and just plain fraud with some of the major inspections carried out so far, and it certainly appears that some practitioners are doing a really good job while others are, at best, decidedly suspect. The $700 single page report has gone but it is still happening where an “Engineer” has done two Major Inspections in a single day. Obviously the Owners concerned are at fault, but given that most hirers or users only request to see a document that the Major Inspection has been carried out, it is no wonder that this practice still happens. There is no consistency with the outcomes and like most of our industry these days nobody really cares until an accident occurs. This is a by-product of the self regulation that we all wanted, however, if we are not careful, then many of the various members of our State Associations will be adversely affected with expensive Court appearances.

We all know that a similar situation existed with the periodic annual inspections required also in AS2550.1, and this issue was largely resolved by the introduction of CraneSafe into Australia. We now have a consistent inspection throughout Australia that is recognised
and supported by the majority of the State OH&S Authorities and indeed the vast majority of crane owners.

Since the introduction of CraneSafe we have obtained a tremendous amount of data about the age of the various cranes in Australia and are very much aware that over 2,000 of all Cranes that we have assessed in the past 12 months are now older than 10 years of age. With such a number of cranes to be inspected, we feel it is appropriate to introduce the updated CICA Guidelines for Major Inspections to assist the industry with a structured and understandable method of carrying out Major Inspections.

This is by no means the absolute or only solution. It is CICA’s interpretation of what is required. Wherever possible, we have tried to obtain Manufacturers’ recommendations as these are really the only true indication of how the mobile cranes need to be inspected to guarantee ongoing additional life out of what is a very expensive tool. We will attempt to take the process through a step-by-step method which can assist the persons responsible for the ongoing use of the mobile crane to make some valued judgements and give an insight to how the CICA Gold Major Inspection Verification Plate will be checked for proper compliance with all obligations.

It is important to understand that a complete generic check-list does not exist, nor is it possible to provide one. Each Major Inspection is different and only the Competent Person can determine the extent of the Inspections required which will enable him, or her, to determine that the Crane is safe for continued use and provide this documentation to the owner.

Major Inspections are mandatory in South Australia and Queensland and most other States place an obligation on the owner to have Cranes that are safe and in good working order through Regulations. Don’t waste your time taking shortcuts to save money. You are better off selling the Crane and getting out of the business if this is your approach.
1. **Selection of a Competent Person**

This is the first step and probably the most important and critical one. A mistake here will jeopardise the whole process. The Competent Person selected needs to carefully assess the condition of the crane and decide what level of strip-down is required, what components require replacing or repair, and ensure that the crane after it is re-assembled is tested to its designed performance and the crane is signed off as being safe to continue working for a stipulated period of time. In some instances, the life left in the Crane may mean that it requires another Major Inspection in less than the suggested 10 Years.

The Competent Person as defined in Australian Standards and Occupational Health and Safety Legislation across Australia is “A person who has acquired through training, qualification, experience or a combination of these, the knowledge and skill enabling that person to correctly perform the required task”.

Queensland’s WHSQ has given quite specific requirements for Competent Persons and anyone intending to use Cranes in Queensland should be totally aware of these requirements.

You need to be totally satisfied that the Competent Person is fully conversant with the Make, Model and Type of crane undergoing the assessment. They also need to have a good knowledge of Australian Standards, individual State Regulations and Codes of Practice where applicable.

Normally, this Competent Person cannot fulfil all of the tasks associated with doing a Major Inspection, so it may be necessary for the appointed Competent Person to sublet sections of the inspection to other Competent Persons who specialize in areas such as Crack Testing, Electronics, etc. You do however require a head person (read Competent Person) that oversees the total process.

It is strongly recommended that this Competent Person be a third party independent person not employed by, or having any connection with, the owner or the company whose crane is being assessed.

If the Competent Person is not a qualified Engineer, it would be expected that an Engineer (the “supervising Engineer”) endorsed as a CICA Engineer, or equivalent Engineer with similar qualifications and experience, oversees the conclusions that the Competent Person makes, and along with the Competent Person signs a Certificate stating that the crane has undergone a Major Inspection and is safe to continue to work for another 10 or 25 years, or a period mutually agreed to if this is less than 10 or 25 years.

The CICA Engineer is to provide a thorough basis for an assessment of the prospective life of a crane in certain circumstances as follows:
(a) At the expiry of the design life (if known).
(b) When the design life is unknown, at a frequency of 10 years of age unless a competent person determines a different period such as the DWP method as described in Chapter 9 of the Australian Standards.
(c) After a crane has suffered a major departure from normal operation or a failure of any major structure or mechanical component.
(d) When a crane is to be a recommissioned and previous operating record are unavailable or the Crane was designed and built to unknown standards.
(e) A crane is to be upgraded to a higher load rating.
(f) The design of a crane has been altered.
This inspection shall include electrical systems and components.

A major inspection shall incorporate the following:

(i) The disassembly of critical components of the crane and removal of paint, grease and corrosion to allow a complete and thorough inspection.
(ii) Detailed visual inspection and tolerance checking of all wear components.
(iii) Thickness testing as required checking for wear and corrosion.
(iv) Non-destructive testing of all critical areas for evidence of cracking, fatigue and excessive stress.
(v) A review of power, control, electrical, hydraulic and pneumatic systems, as applicable as, and no less thorough than required for an annual inspection.

Don’t employ an Engineer who does not think it is necessary to visit the Crane. It is a crucial part of the whole exercise and must not be taken lightly. The CICA Gold Compliance Plate will not be issued to any process that does not have direct supervision by the Engineer.

2. **Records**

10 years is the nominal number of years estimated to be the design life for the mechanical components of a mobile crane in the absence of any other information. Please note that this nominal figure will be reduced if the Crane Duty History is unknown by 30%. It is absolutely critical that a means of recording the duty history is recorded, either by an automatic system, or periodic manual records. Good records of Crane Duty are essential for the Competent Person and the supervising Engineer to make an assessment whether the crane has, or has not, used all of its available life.

If the crane has been subjected to low duty cycle applications for minimal duration on an in-frequent basis, it may very well be that the mechanical life is far greater than 10 years, or, on the other hand, the records may indicate that the crane has frequently been used at its maximum capacity for double shifts and has a poor maintenance record so it has reached the end of its mechanical life before ten years. This would
indicate that 10 years is far more than its design life and may even require a 25 Year Structural Major Inspection.

We cannot stress enough that records are a crucial component for the Competent Person to correctly assess where the crane is in its life cycle. Without proper records the Competent Person can only assume that the life is exhausted and that a maximum amount of inspection and strip-down must be carried out at a far earlier time that would normally be the case.

Records are also mandated in the planned 2012 introduction of National OH&S Regulations by Safe Work Australia. Failure to keep records could result in a $36,000 fine and the failure to keep records for the life of the crane can result in a $60,000 fine. So not only is there a good incentive to delay the actual Major Inspection date, but also the added incentive of avoiding substantial penalties if you don’t conform to the record keeping.

It is never too late to institute good record keeping for mobile cranes. Some examples that is required:

- CraneSafe Operator Log Books – including previous years and the current year
- Copies of all annual CraneSafe Assessments or equivalent
- Servicing and Maintenance Records
- Scheduled oil samplings (if utilized)
- All replacement parts used and dates of installation
- All repairs and modifications by date

After careful consideration of all of the information, it will give the Competent Person a greater appreciation of what detailed inspections and strip-downs are necessary. An example is the case where a Winch has been replaced 18 months prior to the scheduled Major Inspection. This clearly indicates that the Competent Person will not need to consider a strip-down of the Winch which would normally have been mandatory at 10 years. The Winch still must pass the line-pull test and brake holding tests, but no strip-down is required if these items are OK.

Simply by keeping records, many unnecessary checks and expenses can be avoided. Quite apart from anything else, record keeping is a mandatory requirement by most State OH&S Regulatory Authorities.

3. **Used Crane Imports**

Any decommissioned crane, or used crane with no records, has to have a mandatory Major Inspection as per Australian Standard AS2550.1 before it can commence work.
4. **Crack Testing**

Even though the 10 Year Major Inspection is predominantly a mechanical inspection it is considered mandatory to thoroughly NDT crack test the mobile crane for any evidence of cracking. A guide to crack testing has been developed by CraneSafe and combined with the Competent Person’s direction; all areas of the crane will be covered.

The Guide for this crack testing is included in “Attachment B”.

It is suggested that this crack inspection be carried out concurrently with the records research so that the Competent Person can formulate a plan of attack prior to any physical inspection of the crane itself.

5. **Crane Maintenance**

CICA believes that it makes a lot of sense to have the Competent Person supervise the changing of all oils and filters prior to the commencement of the 10 Year Major Inspection.

By having the Competent Person supervise the oil and filter changes concurrent with the Major Inspection, it is possible for them to check the oil and the inside of filters which will assist in determining any potential failures.

Note: If regular scheduled oil samplings have been done over several years previously, it is good practise to do them again prior to the Major Inspection. If however, no previous oil sampling has been carried out, it maybe considered to be a waste of money commencing just prior to the Major Inspection. This is simply not enough comparison data available to highlight any major deterioration of the crane components.
6. **Crane Inspection**

The actual Crane Inspection is simply another action in determining the total action required to bring the crane into a safe condition that can continue to be used for a specified period into the future. It goes without saying that the crane should be presented to the Competent Person in the cleanest possible manner. It is far cheaper for you to carry out this action than paying a Competent Person to clean it to a stage where it can be worked on in a proper manner.

There are many components that must be inspected and verified against the Manufacturer’s Specifications. Selecting a Competent Person who has access to the manufacturer of your particular crane and is conversant with the functions will be a great advantage.

At all times, it is the Manufacturer’s Specifications that must be adhered to. If the manufacturer no longer exists, then it maybe necessary to employ a qualified CICA Endorsed Engineer to reverse engineer the component or assembly to ensure that it is the equivalent or better than the original designs.

An annual inspection regime like that used by CraneSafe will establish whether many of the non-wearing components such as LMI, Anti-Two Blocks, Monitoring Systems, etc., are working correctly and require little or no further investigation. Upon request, CraneSafe will list the specific areas that require more attention than would be the case with a normal 12 Month Inspection regime.

6.1. **Winches**

All winches, whether they are main, auxiliary, boom raising, luffing or any others not mentioned, play an important part in lifting and lowering the load and are high in importance as far as wear, and the possibility to drop a load through mechanical failure or brake failure is concerned.

Different manufacturers have different points of view as to the actual life, but it must be conceded that the modern All Terrain cranes offer a far more definitive life expectancy than any other form of life monitoring in mobile cranes. Even though it is possible to predict what life is remaining, the manufacturers still stipulate that a rebuild is required at 10 years regardless of any theoretical life remaining.

It is recommended that unless there is evidence of any major work having been carried out on any of the winches prior to the Major Inspection that regardless of condition, all brake linings need to replaced, and a complete overhaul of the winch and its individual components be carried out in accordance with the manufacturer’s recommendations. Asbestos linings should be replaced immediately with non-asbestos linings regardless of any life left.
After the crane has completed its Major Inspection and is back in working order, the 10% overload test and brake holding capabilities should be tested in accordance with Australian Standards and the manufacturer’s recommendations.

All winches except for reeving winches need to be overhauled and tested.

A typical example of an All Terrain crane winch life expectancy calculator is in “Attachment A”.

6.2. **Hydraulic System**

The hydraulic system is often complex and extensive in its functions, so to cover this subject in detail would be a major exercise in its own right. We will however touch on some of the issues that we consider appropriate.

6.2.1. **Hydraulic Pump**

The flow can be checked either by a flow meter or more simply, a time check on some of the function times that can be supplied by the manufacturer. An example of this is the actual extension time of the Boom. If the time is longer than the specified time, then there is a probable lower pump output which will require further investigation such as stripping. Careful analysis of the discarded filters or scheduled oil sampling will also alert possible potential hydraulic system faults. Careful monitoring the noise of the pump under load will also assist in determining the on-going life of the pump.

The pressure also needs to be checked and this should be done in accordance with the Manufacturer’s recommendations.

6.2.2. **Hydraulic Cylinders**

A careful external examination will ascertain if there are any cylinder gland leaks. A simple check for internal leaks is to do a creep test on all of the cylinders in accordance with the Manufacturer’s instructions. Great care needs to be taken in isolating the check valves when testing the by-pass of hydraulic fluids. At all times ensure that the Manufacturer’s instructions are followed.

If there are any doubts, then the cylinder should be dismantled and fully overhauled using original seal kits if they are available.
6.2.3. **Hydraulic Hoses**

Each manufacturer has different requirements and their recommendations must be followed at all times. Information received from a variety of manufacturers indicates that critical hoses for steering, braking and winch controls require replacing every two years. It is highly likely that most manufacturers will require total replacement.

A typical example of general hose replacement policy by a leading Manufacturer follows:
6.2.4. **Hydraulic Swivel**

Attention should be paid to this component as it is a warning sign that the main slew ring maybe worn. It is a vital component in its own right and it is important that it is not leaking.

6.3. **Slew System**

This area of the crane is vital for the safety of the crane and like other critical areas needs attention to the fine details. The key areas are as follows:

6.3.1. **Slew Bearing**

Slew Bearings wear out and generally speaking are not suitable for reconditioning as the roller or ball bearing path is worn beyond the original heat treatment. Simply replacing the balls or rollers with larger diameter ones or taking a skim of the mating surfaces only extends the life for a short period of time.

The checking of wear is to be carried out as per the original Manufacturer’s recommendations and it is good practice to check the ring in four equally spaced locations around the circumference of the ring.

6.3.2. **Slew Bolts**

Many different manufacturers have different standards and there is very little common ground for us to give any meaningful guidance. The best approach is to follow the manufacturer’s advice and if this is not available, the Competent Person needs to assess what degree of inspection is required. If in doubt, the Slew Bolts should be replaced.

6.3.3. **Slew Motor**

Careful attention needs to be paid to the condition and of particles present in the oil, noise levels and smoothness of operation. If any doubt exists then an overhaul needs to be carried out.

6.3.4. **Slew Brake**

If no records exist of any repairs or maintenance on the Slew Brake, it should be dismantled and repaired, or replaced.
6.4. **Booms**

This area of the crane is covered by the 25 Year Major inspections but in some respect the 10 Year inspection has almost the same requirement and this fact would be taken into account by the Competent Person when assessing the amount of inspection is required for the 25 Year major inspection.

6.4.1. **Hydraulic Booms**

All boom should be fully dismantled to correctly assess the condition of all components if the records indicate that no prior strip-down has ever been carried out.

Most of these checks are carried out by the regular monthly CraneSafe Assessment regime, but for the Major Inspection, greater attention needs to be paid to the Manufacturers recommendations. For example, we know that many manufacturers stipulate a finite life on the extension and retraction ropes (or chains) where these are fitted. The records need to be carefully studied to see if any replacement has been carried out in accordance with these recommendations.

It is the decision of the Competent Person whether to carry out a full strip down of hydraulic boom cranes, but there is enough compelling evidence now to suggest that it is good practice to fully strip these booms. Not all areas can be covered by not having a full strip down.

A great deal of attention needs to be paid to all of the wearing items to ensure that all of the original tolerances for pin to bush/bearings are maintained; slider pads are within tolerances; boom locking pins (where fitted) are correctly functioning; cylinders are not leaking externally or internally; lock valves are functioning; anti-2 blocks are functioning; sheaves are serviceable and correct for the ropes installed; there are no cracks and no corrosion evident; jib or superlift attachment points are serviceable; and that all of the individual boom sections are within tolerance for straightness.

6.4.2. **Lattice Booms (including fixed and luffing jibs)**

Like the hydraulic booms, many of the inspections are mandated by the manufacturers and the CraneSafe assessment program, the one difference being, that crack testing is not a mandatory requirement in all States even though it is recommended by CraneSafe and Australian Standards. Lattice booms by their very construction are more susceptible to corrosion, so a more extensive examination may be required. Even though the 10 Year Major Inspection is by nature a
CICA Guideline to Major Inspections

mechanical inspection, structural examinations like we suggest here will no doubt help ensure the safe operation of the crane and assist the Competent Person when the 25 Year structural inspection is required.

More attention than the normal CraneSafe assessment needs to be done on all of the listed items to ensure that all of the original tolerances for pin to bush/bearings are maintained, boom connectors and pins are serviceable, anti-2 blocks are functioning, sheaves are serviceable and correct for the ropes installed, there are no bent or damaged lacings or cords, there are no cracks and no corrosion evident, and that all of the individual boom sections are within tolerance for straightness.

Many manufacturers stipulate a maximum life for their Rope Pendants. If no life has been stipulated, a careful inspection needs to be carried out to verify that the Pendant still has life.

6.5. Revolving Frame

All cracks evident should be detected through the NDT crack testing. The intent of the 10 Year Major Inspection is to find, and rectify, all mechanical defects but structural areas also need to be checked prior to the 25 year mandated inspection. All pins, bushes, bearings, bolted assemblies need to be checked against Manufacturer’s recommendations and repaired where necessary.

6.6. Chassis

This is both a mechanical and structural check. NDT crack testing will highlight any major structural defects, but all areas should be visually inspected to ensure there are no potential problems and that there is no evidence of corrosion that could affect the structural integrity of the crane. Any pin, bush, bearings, bolted assemblies need to be checked against Manufacturer’s recommendations and repaired where necessary.

6.7. Outriggers (including Pads)

Each crane is different but the intent is to ensure that if there are slider pads fitted, these must be within tolerance. Where none are fitted, there must be no excessive wear evident. All pins, holes and bushes must be within Manufacturer’s tolerances and the beams must be straight. All pad attachments need to be serviceable as well as the pads themselves.

6.8. Operator Aids

All operator aids need to be functioning as they were designed to and all must
comply with the Australian Standards. This extends to Load Charts, Operator Manuals and anything else that is required by the operator to use the unit in accordance with manufacturer’s specifications and Australian standards. Wherever possible, the aids should be in accordance with the Australian Standards that are current at time of the major inspection. If this is not possible, then a risk assessment needs to be carried out as to how the crane can provide a similar level of safety equivalent to the latest Australian Standards.

6.9. **Wire Ropes**

Before any inspections take place, it is important to ascertain that the Wire Ropes fitted to the crane being inspected are the same, or equivalent, to that originally specified by the manufacturer.

Unless the machine records indicate no action is required, all Wire Ropes are to be inspected along their complete length to detect all abnormalities.

Wedges and sockets also need to be carefully inspected to verify the correct wedges are being used and that there is no wear.

6.10. **Hook Blocks**

It needs to be established that the Hook Blocks are those that were originally supplied with the crane or were supplied later but were specifically suited to the crane and the Hook Blocks need to be clearly and permanently marked with the identification, tare weight, and capacity in accordance with the Australian Standards. Pins, bushes/bearings all need to be verified that they conform to the original design. The Hook Blocks need to be NDT tested and the throat dimensions need to be checked for any elongation. All safety latches need to be present and be serviceable.

It is not the intention of this Guide to provide a step by step instruction as to what level of inspection is required. A Competent Person shall be well equipped to perform this function. The whole purpose of this Guide is to try to demystify the Major Inspection process, and the intent of achieving a crane that may indeed have reached the end of its design life, is safe to continue to be used in the lifting industry with no risk to all of those associated with the crane industry.

It is also worthwhile to note that where Manufacturer’s specifications are not available, new specifications should be developed by a Competent Person where necessary. Even if Manufacturer’s specifications are available, they should be assessed by a Competent Person to see if they are still relevant in today’s environment.
5.4 Measures required for winch monitoring

Also observe the information on the general inspection of the hoists; p. 8 - 7.

These measures for monitoring the winches (hoisting gear) were compiled by VDMA and are to be used for all vehicle cranes according to the Accident Prevention regulations Winches, Hoisting and Tractor Machines BCV D 6 (VGB 9) and BCV D 8 (VBG 8).

5.4.1 Theoretical service life

The theoretical service life is the result of certain operating conditions and a theoretical operating time assumed by the design engineer when calculating and dimensioning the winches of your crane.

The winches of your crane are classified as follows (ISO 4301/1, FEM 1.001, DIN calculation rules for power units):

- Power unit group: M ......
- Load spectrum: Q ...... (L......)
- Collective load factor: Km =......
- Theoretical service life: D = ......

The power unit group M 3 and the collective load L1 (Km = 0.125) are generally given for truck cranes in erection mode, resulting in a theoretical service life of 3200 h.

The theoretical service life is not the same as the real (actual) service life of a winch.
5.4 Measures required for winch monitoring

The real service life of a winch is affected by a number of additional external factors, such as:

1. Overloading caused by improper use of the crane.
2. Insufficient maintenance: oil is not changed at the specified intervals.
3. Operating errors: extreme acceleration or deceleration of the load, load drops and stops suddenly while suspended.
4. Improper maintenance: wrong oil used, incorrect filling quantity, contamination during oil change.
5. Improper assembly during maintenance and repair work.
6. Leaks which were ignored.
7. Improper adjustment of safety devices.
8. Concealed damage caused by accidents.
9. Extreme environmental conditions: low or high temperatures, aggressive atmosphere, dust and dirt.

Proportion of the theoretical service life used

The crane operator must perform a crane inspection at least once a year (ISO 9827-1 and BGV D 8 (VGB 9) / BGV D 8 (VGB 8)).

This includes establishing the proportion of the theoretical service life that has been used. If required, the crane operator is to appoint an expert for this assessment.

The actual operating conditions (load spectrum) and the operating hours of the hoists are to be determined for each inspection interval when establishing the proportion of the theoretical service life that has been used. The operator is responsible for proper documentation in the crane logbook.
Determining the operating conditions (collective load)

The collective load of the crane is divided into groups:
(also refer to ISO 4301/1, FEM 1.001)

When establishing the load spectrum, the existing wire cable is used as a standard, i.e. under certain circumstances, the crane can be supporting a small load, whereby the winch is actually supporting a heavy load, e.g. due to insufficient reeving. Therefore, the following graphic representation of the load spectrum refers to the winch’s wire cables.

<table>
<thead>
<tr>
<th>Collective load Class</th>
<th>Term designation</th>
<th>Working time proportion</th>
<th>Collective load factor Km</th>
<th>Graphic representation</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>light</strong> O 1 L 1</td>
<td>Power units or their parts, which are subjected to highest load as an exception, continuously however only very less load</td>
<td>10% of the operating time with highest load (dead load + 1/1 payload) 43% of the operating time with dead load + 1/3 payload 50% of the operating time only with dead load</td>
<td>0.125</td>
<td><img src="image1" alt="Diagram" /></td>
</tr>
<tr>
<td><strong>medium</strong> O 2 L 2</td>
<td>Power units or their parts, which are very often subjected to highest load, however continuously less load subjected to load</td>
<td>1/6 of the operating time with highest load (dead load + 1/1 payload) 1/6 of the operating time with dead load + 2/3 payload 1/6 of the operating time with dead load + 1/3 payload 50% of the operating time only with dead load</td>
<td>0.25</td>
<td><img src="image2" alt="Diagram" /></td>
</tr>
<tr>
<td><strong>heavy</strong> O 3 L 3</td>
<td>Power units or their parts, which are frequently subjected to highest load and continuously to medium load</td>
<td>50% of the operating time with highest load (dead load + 1/1 payload) 50% of the operating time only with dead load</td>
<td>0.5</td>
<td><img src="image3" alt="Diagram" /></td>
</tr>
<tr>
<td><strong>very heavy</strong> O 4 L 4</td>
<td>Power units or their parts, which are regularly subjected to loads close to maximum loads.</td>
<td>90% of the operating time with highest load (dead load + 1/1 payload) 10% of the operating time only with dead load</td>
<td>1</td>
<td><img src="image4" alt="Diagram" /></td>
</tr>
</tbody>
</table>

One of the load spectrums listed above is to be selected on the basis of the actual operating conditions and entered in the crane logbook for the respective testing interval.

Note for truck cranes:
In case of truck cranes in erection mode, as a rule, the collective load L 1 is to be given with the collective load factor Km = 0.125.
Maintenance overview
5.4 Measures required for winch monitoring

Determining the proportion of the theoretical service life used

For a testing interval \( i \) (max. 1 year according to ISO 9927-1 or BGV D 6 (VBG 9)/BGV D 8 (VBG 8)) the used proportion of the theoretical service life \( S_i \) is calculated using the formula:

\[
S_i = \frac{K_m}{K_m} \times T_i
\]

\( K_m \) = Load spectrum factor established during winch calculation. This factor is given in the operating instructions.

\( K_m \) = Load spectrum factor in inspection interval \( i \) in accordance with the section "Determining the operating conditions (collective load)"

\( T_i \) = Effective operating hours in the testing interval \( i \) according to section "Determining the actual operating hours \( T_i \)"

This used proportion is subtracted from the remaining theoretical service life \( D_i \) after every testing interval (see example in the appendix to this chapter).

A general overhaul must be performed on the winch if the remaining theoretical service life is not likely to be sufficient for the next operating period.

If the theoretical service life \( D \) has been reached (\( \Rightarrow \) Theoretical service life, p. 5 - 21), the winch must not be operated until after a general overhaul has been performed.

A general overhaul must be performed at least once every 10 years after commissioning of the crane.

The general overhaul is to be arranged by the operator and performed by the manufacturer or his representative. The results are to be entered in the crane logbook.

The manufacturer or his representative will specify a new theoretical service life \( D \) upon completion of the general overhaul.

The next general overhaul must be performed within 10 years.
5.4.3 Example

A truck crane with a separate operating hour counter for driving and crane operation is classified by the manufacturer according to the Operating Instructions as follows:

Power unit group: M 3
Load spectrum: light L 1, Km = 0.125
Theoretical service life: D = 3200 h

The used proportion $S$ of the theoretical service life is calculated over the individual inspection intervals as follows:

1. Inspection (first year)

The crane was used for assembly work during the previous year: Collective load L 1, i.e. $Km1 = 0.125$.

The superstructure operating hour counter reads 800 h. The winch was operated 20% of the time, i.e. $T1 = 160$ h.

The used proportion $S_1$ of the theoretical service life after the first inspection is therefore:

$$S_1 = \frac{0.125}{0.125} \times 160 = 160 \text{ h}$$

Remaining theoretical service life:

$$D1 = 3200 \text{ h} - 160 \text{ h} = 3040 \text{ h}.$$  

The aforementioned values are entered in the table (see example table p. 5 - 29).

2. Inspection (second year)

The crane was used for unloading work on docks: Load spectrum: L 3, i.e. $Km2 = 0.5$.

The superstructure operating hour counter reads 2000 h, i.e. during this period: $2000 \text{ h} - 800 \text{ h} = 1200 \text{ h}$ (800 h were used during the first year).

The winch was operated 40% of the time, i.e. $T2 = 480 \text{ h}$.
5.4 Measures required for winch monitoring

The used proportion $S_2$ of the theoretical service life after the second inspection interval is therefore:

$$S_1 = \frac{0.5}{0.125} \times 480 \text{ h} = 1120 \text{ h}$$

Remaining theoretical service life:

$$D_2 = 3040 \text{ h} - 1920 \text{ h} = 1120 \text{ h}.$$  

The aforementioned values are entered in the table (see example table p. 5 - 29).

3. Inspection (third year)

The crane was used for assembly work and occasional unloading work on docks: Load spectrum: L 2, i.e. Km3 = 0.25.

Three thousand hours are read at the superstructure working hour meter; i.e., during this period:

$$3000 \text{ h} - 2000 \text{ h} - 1000 \text{ h} \quad (2000 \text{ h} \text{ are used in the first two years of operation}).$$

The winch was operated 30% of the time, i.e. $T_3 = 300$ h.

The used proportion $S_3$ of the theoretical service life after the third inspection interval is therefore:

$$S_1 = \frac{0.25}{0.125} \times 300 \text{ h} = 600 \text{ h}$$

Remaining theoretical service life:

$$D_3 = 1120 \text{ h} - 600 \text{ h} = 520 \text{ h}.$$  

The aforementioned values are entered in the table (see example table p. 5 - 29).

The remaining theoretical service life is to be documented in a separate table for each winch.

This table is to be attached to the crane logbook. This table is found in the Maintenance Manual appendix for truck cranes that do not require a crane logbook or similar documentation according to the regulations of the respective country.
Table example to determine the remaining theoretical service life on winch no. 1 (main hoist winch)

<table>
<thead>
<tr>
<th>Crane model:</th>
<th>GMK 3045</th>
</tr>
</thead>
<tbody>
<tr>
<td>Work number:</td>
<td>3045 42 95</td>
</tr>
<tr>
<td>Commissioned on:</td>
<td>10.06.1990</td>
</tr>
<tr>
<td>Serial number of the winch in accordance with the model plate:</td>
<td>13 301</td>
</tr>
<tr>
<td>Last general overhaul performed on:</td>
<td>..........................</td>
</tr>
<tr>
<td>Winch design data (see Operating Instructions):</td>
<td>..........................</td>
</tr>
<tr>
<td>Drive gear group:</td>
<td>M 3</td>
</tr>
<tr>
<td>Load spectrum:</td>
<td>Q 1 (L1)</td>
</tr>
<tr>
<td>Factor of the load spectrum:</td>
<td>K_m = 0.125</td>
</tr>
<tr>
<td>Theoretical service life:</td>
<td>D = 3 200 h</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Testing interval</th>
<th>Date of last inspection</th>
<th>Operating hours of main hoist</th>
<th>Operating hours of load hoist</th>
<th>Operating hours of load hoist for the last inspection</th>
<th>Load spectrum factor established during load calculation</th>
<th>Remaining theoretical service life</th>
<th>Signature</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>1</strong></td>
<td>15.5.91</td>
<td>-</td>
<td>800</td>
<td>-</td>
<td>10% (30% of 800)</td>
<td>85%</td>
<td>Mollá</td>
</tr>
<tr>
<td>1</td>
<td>20.5.92</td>
<td>-</td>
<td>1300</td>
<td>-</td>
<td>15% (40% of 1300)</td>
<td>1300</td>
<td>1100</td>
</tr>
<tr>
<td>2</td>
<td>16.4.93</td>
<td>0.3</td>
<td>1000</td>
<td>1000</td>
<td>30% (30% of 1000)</td>
<td>1000</td>
<td>1000</td>
</tr>
</tbody>
</table>

CAUTION:
A general overhaul is to be performed every 10 years!

Alternative provision, refer to section 5.4.2, p. 50 - 22.

Last general overhaul performed: ..........................
GUIDELINES FOR THE CRACK INSPECTION
OF MOBILE CRANES
FOR
CRANESAFE ASSESSMENT

Prepared by:
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September 2006

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1. **PURPOSE**

The purpose of this procedure is to provide the crane owner and non-destructive testing companies with a guideline of the components and areas that should be inspected on a mobile crane to meet the requirement of the ‘Green Sticker’ program. The non-destructive testing procedure is for the detection of cracks in welding and components on a generic crane to be inspected as a minimum. This procedure does not replace the crane manufacturer’s inspection requirements or any crane inspection requirements specified by the Australian Standards.

2. **SCOPE**

This procedure is used to detect any surface breaking cracks in the structural components of the crane that may have occurred during in-service usage. The NDT method to be used will be at the discretion of the inspector based on the condition of the crane presented for testing. The testing method used must be in accordance with the relevant Australian Standard. Personnel holding appropriate certification from the Australian Institute of Non-Destructive Testing or the CIB-NZ shall be deemed qualified to carry out the inspection.

3. **PROCEDURE**

The areas to be examined shall be as per the following as a minimum. Any additional areas as specified by the CraneSafe Assessor must also be examined and recorded in the report.

3.1. **Hydraulic Telescope Booms – refer figures 1(a) & 1(b):**

<table>
<thead>
<tr>
<th>Area</th>
<th>Checks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Boom base section:</td>
<td>Hydraulic Luff Ram Mounts</td>
</tr>
<tr>
<td></td>
<td>Foot pin area</td>
</tr>
<tr>
<td></td>
<td>Butt joins in main plate sections</td>
</tr>
<tr>
<td></td>
<td>Jib attachment and storage brackets</td>
</tr>
<tr>
<td></td>
<td>Boom pinning areas</td>
</tr>
<tr>
<td></td>
<td>Winch mounts – where applicable</td>
</tr>
<tr>
<td></td>
<td>Load bearing pinholes</td>
</tr>
<tr>
<td></td>
<td>Doubler, stiffener plates</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Boom intermediate sections:</th>
<th>Boom pinning areas</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Load bearing pinholes</td>
</tr>
<tr>
<td></td>
<td>Doubler, stiffener plates</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Boom tip section:</th>
<th>Head attachment Welds</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Doubler, stiffener plates</td>
</tr>
<tr>
<td></td>
<td>Load bearing pinholes</td>
</tr>
</tbody>
</table>
(Boom tip section cont’d) Butt joins in main plate sections
Jib attachment brackets
Boom pinning areas
Rooster sheave mounts

3.2. Lattice (pin type) Boom & Jib – refer figures 2(a) & 2(b):

Boom/Jib base section: All welding on connectors
All chord butt welds
All load lift lugs or guy rope suspension brackets
10% of lacing node points on each chord, if any defects found then check all nodes
Base plate to chord welds

Intermediate boom/jib section: All welding on connectors
All chord butt welds
All load lift lugs or guy rope suspension brackets
10% of lacing node points on each chord, if any defects found then check all nodes

Boom/Jib tip section: All welding on connectors
All chord butt welds
All load lift lugs, attachments or guy rope suspension brackets
10% of lacing node points on each chord, if any defects found then check all nodes
Head plate to chord welds
Dead end rope anchor

Jib Suspension Bars: End attachment brackets to rod
Bracing between bars

3.3. Upper/Turret Frame – refer figure 3:

Winch attachment frame
Side frame welding to base plate (front & rear)
Lifting lugs and counterweight attachments
Luffing ram mounts
3.4. **Carrier & Outriggers - refer figure 4:**
- Slew ring mount
- Wheel rims
- Outrigger box & mounting
- Jack cylinder mounts
- Welds at full extension of beam
- Stiffener plate on bottom of outrigger box
- Any butt joins on plates

3.5. **Crawler Carbody – refer figure 5:**
- Base weld on turret or slew mount
- Weld on roller path
- Attachment welds for track mounts and extensions

3.6. **Slew Ring Bolts:**

Due to variations in manufacturers’ requirements CraneSafe assessments require the inspection of Slew Ring Bolts to be in accordance with the Manufacturer’s stipulated requirements. If none exists, then the correct method is as follows:

A minimum of 10% of the Slew Ring Bolts is to be inspected on the Upper and carrier. Front & rear of upper bolts must be included in the 10% selected.

**Note:** It is recommended that all accessible slew ring bolts be subjected to ultrasonic testing when testing is carried out in situ and that the front & rear bolts must be included in the inspection.

3.7. **Any additional areas as instructed by the CraneSafe Assessor.**

**Note:** It is advisable to carry out testing in conjunction with or after the CraneSafe assessment in case additional areas are nominated by the Assessor.

The attachment reference drawings – *figures 1 to 5* – show examples of areas to be examined. These are generic crane drawings to show typical components as described above for guidance to the technician.

4. **DEFECT ASSESSMENT**

The intent of the inspection is to locate only cracks in load bearing members that may have developed in service of the crane. The quality, shape & size of welding such as minor surface porosity, weld undercut, irregular weld cap, weld roll over, and minor lack of fusion shall not be considered for the purpose of this inspection requirement.

The technician performing the test shall determine the extent of testing procedure to ensure area inspected is free of cracks. Any defect interpreted to be a crack – irrespective of length – will deem the component rejectable.
5. DOCUMENTATION

A record of results shall be made to provide the following information:
- Name & address of crane owner
- Make & model of crane
- Serial number of crane
- Registration number of crane (if applicable)
- Plant number of crane (if applicable)
- For Pin type (lattice) Boom & Jib section – identification number & serial number of all sections
- Serial number or identification number of all Hooks
- Name of Testing Authority
- Report number
- Date of test
- Name of technician
- Type of material
- Type of test
- Condition of surface
- Non-destructive testing procedure used and relevant Australian Standard
- Type of instrument used
- Any abnormal conditions or restrictions
- Coating thickness (if applicable)
- The results of test
- Signature of the technician
- The results of the examination
- Signature of non-destructive testing technician
Figure 2 (b): Jibs & Suspension Rods
Figure 3: Upper/Turret Frame
Figure 5: Crawler Carbody