

SPECIFICATION FOR STEELWORK INSPECTION AND CONDITION ASSESSMENT OF OVERHEAD LINE TOWERS

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PURPOSE AND SCOPE

This document is an objective specification for visual inspection and condition assessment of lattice steelwork on transmission towers on the National Grid Transmission System.

This specification outlines the requirements for data collection and reporting associated with tower steelwork condition assessment. This will achieve consistent data gathering across OHL Alliances and align with National Grid Maintenance Delivery Teams. The output will inform the ENI Asset Health Manager to enable appropriate refurbishment investment decisions.

PART 1 - PROCEDURAL

1 GENERAL REQUIREMENTS

Tower condition will vary depending on its age, geographic location, installed environment, historical maintenance and refurbishment record (e.g. strengthening or coating). Variation may also occur across a single tower as it is affected by prevailing corrosivity in a localised manner. This will be a consequence of the climate and its physical location (for example, where a tower is partially shaded due to local vegetation or topographical features).

The initial method of inspection will be by high definition photographic survey (helicopter). The aerial survey and the assessment report will be of sufficient quality to identify and quantify all grades of steel. Validation of the photographic survey will be carried out by climbing inspection targeted on towers which have bars graded 4, 5 & 6.

Aerial condition surveys will usually be carried out and compiled internally by the MDE Condition Monitoring Team.

Where local restrictions are in place that prevent the use of helicopter inspections, visual inspections will be carried out by climbing the tower.

Towers with extensive grade 5 will require an additional climbing survey. Where necessary, additional steel thickness measurement equipment will be used. Climbing Inspection reports will include the use of photography as a permanent record. The data gathered must be sufficient to facilitate the full range of strategic implications that might be considered

The current National Grid Contract Spec No.: OH/L1/Z3/AA states:

"In saline or marine atmospheres, all traces of salt must also be removed."

In saline or marine atmospheres, surfaces must be tested to ensure compliance with the above specification.

The number of towers to be inspected by climbing will be scheme /route dependent.

1.1 Technical Requirements for Visual Inspection and Condition Assessment

1.1.1 Inspection Methods, Instruments and Measurements

All the tower steelwork shall be assessed with reference to the photographs and visual grading system (Table 3) detailed in Appendix A

For photography, ultrasonic thickness and pit depth measurement the following requirements are to be adhered to:

- a) It is considered that a Grade 4 bar still offers its full design strength, however, a Grade 5 bar is considered to offer reduced strength due to its visual section loss.
- b) All members ranked Grade 5 shall be measured for nominal section thickness or maximum pit depth during a climbing survey using ultrasonic testing or appropriate tool to an accuracy of $\pm 0.1\text{mm}$. This may mean it is necessary to physically remove a minimum amount of paint to obtain a reliable metal thickness close to the corroded area.
- c) A photographic record shall be made showing the full extent (physical area) of corrosion on each member ranked Grade 5 with an additional photograph to confirm the detail of the location where the pit depth measurement is made.
- d) On a tower with no Grade 5 members it is necessary to photograph up to ten Grade 4 to confirm the ranking.
- e) Where back-to-back bars are identified as Grade 4 or above both members shall be reported.
- f) Members that are non-accessible (e.g. due to outage constraints) and are ranked Grade 5 or above shall have photographs taken to record their condition.
- g) Members that can not be safely accessed for thickness measurements should trigger extra measurements on adjacent, more accessible Grade 5 bars, if present. A minimum of one measurement shall be made.
- h) In saline or marine atmospheres record salt levels. Three tests per tower required on at least ten percent of towers in the affected area.

1.1.2 Assessment of Bolt Condition

Bolt condition will be recorded against a visual inspection standard of bolt grades. The three classifications are B1 to B3 and summarised in Table 1.

B2 is similar in definition to Grade 4 on steelwork and B3, for a corroded or missing bolt is similar to Grade 5.

Only bolts in the B3 classification shall be reported in accordance with Table 2.

Where nut disintegration has occurred a representative photograph shall be taken (maximum of five photographs per tower).

Missing bolts to be recorded separately

Classification	Description
B 1	No evidence of corrosion or damage
B 2	Minor corrosion/ no loss of section
B 3	Significant corrosion/ loss of section/ nut disintegration

Table 1 – Classification of Bolt Condition

1.1.3 Assessment of Coating Condition

Coating condition shall be assessed in accordance with the grading system detailed in Appendix A

Where a tower is climbed to inspect or validate grade 4 conditions, a cross-cut adhesion tests shall be conducted to demonstrate the adequate adhesion of the sound coating adjacent to grade 4 areas. Adhesion of remaining sound coating should exceed classification 3A to ASTM D3359. Coatings with this level of adhesion have a low risk of failure when overcoated. A photographic record shall be made of any areas that do not meet the requirements.

1.2 Requirements for the Inspection Process and Data Reporting

1.2.1 General Requirements

The number of towers to be inspected shall be scheme/route dependent and will be agreed with National Grid.

In addition to the requirements outlined in this specification the inspection activity shall include identification of any missing, damaged or distorted bars, bolts and any other irregularities associated with the tower or equipment.

1.2.2 Quality Assurance

The following guidelines should be complementary to (and not replace) existing Quality Procedures used by the companies supplying the steel work inspection and are not applicable to internal surveys.

- Team members will be identified and shall operate together consistently as a traceable coordinated group on an agreed series of tower inspections. The names of the inspectors and the team leader in each team shall be recorded and reported against the data for each tower that a particular group has inspected.

- b) As a routine validation and quality control procedure at least one in every twenty towers inspected by a particular team will be re-inspected. If less than twenty towers are to be inspected, at least one tower will be climbed and inspected again as a quality cross check.
- c) The validation inspection will be completed to the same level of detail as the first inspection by a completely separate inspection team i.e. operating with different members from the first team. Any existing data from a previous tower inspection may not be examined or be made available to the re-inspecting team.
- d) The two data sets may be compared only after a record of the results of that tower inspection are checked and signed by the team leader in each inspection team. No changes may be made. Any misalignment of reported data shall require a cross check quality assurance report.

1.2.3 Forming part of the Quality Assurance (QA) work, a Cross Check QA report shall be produced and shall follow the guidelines listed below:

- a) A list of differences between the two assessments shall be reported in a cross check quality assurance report which will include relevant details of the location of the bars where different steelwork Grades are reported or where the thickness measurements do not agree within 0.4mm. The number of bars allocated different Grades or the number of thickness measurements that do not agree will be quantified as a percentage of the total number of bars inspected. This data can be compared to quantify the difference in interpretation between groups on the tower and to define an acceptable margin of error for potential future schemes.
- b) It is the local MDE engineer who has on-site responsibility to determine if the inspection can continue based on the differences reported in the on-site cross checking quality report. Approval of the results of the cross checking inspection result should be recorded every twenty (20) towers. At the discretion of the engineer, additional tower inspection cross checks may be sanctioned.
- c) Both sets of inspection results for the cross check tower(s) and the consistency analysis (quality) report must be copied in full to the MDE condition assessment engineer at the earliest opportunity for their on-going assessment of the reproducibility of the reported results.

1.2.4 Inspection Report

The inspection data report shall be in a standard format and shall comply with the following requirements:

- a) Include an Executive Summary.
- b) All reports should be available in electronic and paper format.
- c) The information included in the report should be compiled in a spreadsheet format as detailed in Table 2.
- d) Links to electronic copies of photographs should also be included in the spreadsheet where these were recorded if required it may also include additional information such as coating condition.
- e) The detailed inspection report should contain key quantities including the size and weight of the identified bar.

- f) All site data should show the names of the inspection team and be signed by the team leader. The names of the associated individuals should be reproduced in the electronic copy.
- g) The Grading (grades 4 to 6 only) on each tower should be summarised in a colour coded drawing. It is sufficient to represent this part of the report as multiple 2D line drawings for each tower although 3D is preferred. An example of 2D colour coded line diagrams are shown in the Appendices.
- h) For the avoidance of doubt, this report must be labelled **NOT FOR FABRICATION** on each page.

Tower		Date of Inspection		Team Number	Names of Inspection Team Members				Signature Team leader in Inspection Team	
Bar Identity	Material Grade	Section Details	Section Weight	Bar Length	Grade	Minimum Thickness	Pit Depth	Nominal Thickness	Bolt Condition	Additional Information Paint Ranking and/or Link to Photograph

Table 2 - Inspection Report Format

1.3 Training and Qualification of Steelwork Inspectors

1.3.1 General

All inspections and condition assessments will be completed by suitably qualified staff that will have met all Health and Safety and competency requirements detailed below such that the result of their work is considered reliable:

- a) All persons involved in steelwork inspections shall have all current authorisations for access to National Grid's Transmission System.
- b) In addition, all persons shall undertake specific training in accordance with this specification.

The training shall include:

- a) Assessment of tower steelwork, paint condition and condition of bolts
- b) Measurement of steelwork thickness and pit depth using ultrasonic thickness and pit depth gauges
- c) Measurement of salt contamination in accordance with ISO 8502-6
- d) Measurement of coating adhesion to ASTM D3359
- e) Data capture processes – use of cameras, hand held computers, IT for data logging and recording/processing photographs
- f) All trained personnel shall maintain a professional log book of experience.

2 FORMS AND RECORDS

Not applicable.

PART 2 - DEFINITIONS AND DOCUMENT HISTORY

3 DEFINITIONS

Not applicable.

4 AMENDMENTS RECORD

Issue	Date	Summary of Changes / Reasons	Author(s)	Approved By (Inc. Job Title)
1	April 2013	First issue	David Clutterbuck	EEPIG

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5 IMPLEMENTATION

5.1 Audience Awareness

Audience	Purpose Compliance (C) / Awareness (A)	Notification Method Memo / letter / fax / email / team brief / other (specify)
ETAM Network Engineering	C	Email
ETAM Investment Management	C	Email
ETAM Operations	C	Email
Capital Delivery	C	Email
Alliances	C	Email

5.2 Training Requirements

Training Needs N/A / Informal / Workshop / Formal Course	Training Target Date	Implementation Manager
N/A	N/A	N/A

5.3 Compliance

By ETAM Operations.

5.4 Procedure Review Date

5 years from publication date.