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AUSTRALIAN POWER QUALITY AND RELIABILITY CENTRE
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Evaluation of Product Information, Test Reports and Compliance with Australian Standard AS 2239 for LPI Earth Resistance Lowering Compound RESLO

Report prepared for:
Lightning Protection International Pty Ltd

Final Report – Revised v3

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9th March 2016

1 Executive Summary

Lightning Protection International Pty Ltd (LPI) has requested the University to conduct an evaluation of product information, test reports and compliance with Australian Standard AS 2239 for LPI Earth Resistance Lowering Compound (RESLO).

With regard to the product information, the technical data sheet, SDS and installation instructions provide a good coverage of the features, application and safety considerations of RESLO. The technical data sheet could be reviewed to respond to the comments in Section 4.1 of this report especially in regard to a statement concerning non-corrosiveness of the product.

The laboratory resistivity tests were well presented and detailed and clearly indicated that RESLO had a resistivity well below that of any soil it would be used in. It would have been beneficial statistically to have tested three samples rather than only one. This would have given a better average figure for the resistivity of the material but would probably not have much affected the overall relative result.

The field tests performed over a nine year period were well thought out and executed. They clearly showed the significant improvement in earth resistance that RESLO can achieve in a high resistivity soil under a range of seasonal conditions. More value could have been obtained from the experiment if another site with a different type of high resistivity soil was also examined.

RESLO complies with AS 2239-2003 as a Designation B3 backfill.

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2 Introduction

Lightning Protection International Pty Ltd (LPI) has requested the University to conduct an evaluation of product information, test reports and compliance with Australian Standard AS 2239 [1] for LPI Earth Resistance Lowering Compound (RESLO).

Earthing enhancing compound (EEC) is used where earthing effectiveness needs to be improved especially in areas such as sandy soil and rocky ground, and in situations where earth rods cannot be easily driven or there is limited land area to place the earth rods. Some of the main characteristics of an EEC is that it should significantly lower earth resistance (and minimise the impact of changing soil conditions to keep resistance uniformly low), it should be maintenance free, and it should not corrode earth bars/rods and their fittings.

This report examines the EEC from LPI, RESLO, and is structured as follows. Section 3 describes the documents evaluated in this report. Section 4 presents a review of the product information. Section 5 evaluates the laboratory and field test reports which assess the performance of the product. Section 6 evaluates compliance of the product with Australian Standard AS 2239. The report concludes with Section 7 stating conclusions and recommendations.

It is assumed that, in all documents reviewed, RESLO and RESLO-10 refer to the same material since "10" only refers to bag size (i.e. 10 kg).

3 Description of Documents Evaluated

LPI have supplied seven documents relating to RESLO:

i. Technical data sheet [2] which broadly describes the product and its applications;
ii. Safety Data Sheet (SDS) [3] which outlines the composition and safety considerations of the various component materials of RESLO;
iii. Installation instructions [4] for both trench and earth rod installations;
iv. Report on laboratory resistivity tests [5], dated 26 October 2005, for one sample of RESLO;
v. Report on laboratory resistivity tests [6], dated 3 February 2015, for one sample of RESLO (repeat of tests in [5]);
vi. Report on field resistivity tests [7], November 2005 to March 2007, for seven buried copper bars, three of which were treated with RESLO;
vii. Report on field resistivity tests [8], 28 May 2015, which extend the measurements in [7] to 27 November 2014.
viii. Report on particle size analysis of one sample of RESLO [10], dated 22 July 2015.

4 Evaluation of Product Information

The product information supplied consists of the technical data sheet [2], the SDS [3] and the installation instructions [4].

4.1 Technical Data Sheet

This document gives a good general description of the product's use and features, its measured resistivity and its practical application to bar and rod earthing electrodes. The mentioning of the

availability of a handy online earthing calculator is also a helpful aspect. The document particularly emphasises the maintenance free nature of RESLO.

Comment to consider:

- No mention is made of the degree to which the product is non-corrosive with respect to the electrode material.

4.2 Safety Data Sheet

The SDS gives the appropriate component composition and safety data for the product as required under Work Health & Safety regulations. The product is said to consist of 40% bentonite, 50% gypsum and 10% sodium sulphate, by weight.

4.3 Installation Instructions

This document gives comprehensive instruction on the application of RESLO for both trench and earth rod installations. It is well laid out and easy to follow.

5 Evaluation of Test Reports

Two sets of test reports are provided, one set for laboratory testing of a sample of RESLO and one set for field testing of an installation in which RESLO is used.

5.1 Laboratory Tests

The laboratory test reports [5] and [6] appear to use the same measurement data set, although separated by almost 10 years. Also, much of the text is the same. [6] gives slightly more detail in some places, notably the test standard used.

The laboratory reports are well presented, detailing the purpose of the tests, equipment used, calculation method, testing methodology and accuracies, results and limitations.

Comments to consider:

i. Although the Wenner four-electrode method is mentioned, no indication is given of the electrode design. The electrode design should be that of a standard soil box (e.g. [9]) for accurate measurements to be made.
ii. Only one sample was tested. For experimental work like this at least three samples should have been used and the results averaged.

Having said the above, however, from a practical point of view, the resistivity of RESLO is significantly lower than any soil that it would be used in, as noted in the laboratory test reports.

5.2 Field Tests

The field test reports [7] and [8] describe long-term resistance measurements of a test installation containing seven copper bar electrodes in trenches, three of which were treated with RESLO. Test report [7] covers the period November 2005 – March 2007 while test report [8] adds additional measurements in November 2014.

The field test reports are comprehensive and well laid out, detailing installation arrangement and configuration, measurement procedures, test results and the limitations of what could be achieved.

It is noted that the tests have only been performed for one soil type. Having test measurements from another type of high resistivity site would further assist in showing the efficacy of the use of RESLO.

Despite the previous comment, the use of RESLO is seen to significantly lower the earth resistance in a high resistivity soil situation over a range of seasonal conditions.

6 Compliance of Product with Australian Standard AS 2239

There is no Australian standard that directly deals with EEC for use with earthing electrodes for lightning protection systems or general electrical installations. However, AS 2239-2003 [1] for galvanic anodes for cathodic protection does give guidance on the purpose and composition of backfills which are placed around sacrificial anodes.

If AS 2239-2003 is applied to RESLO, the following comments can be made:

i. RESLO fulfils Clause 4.1 (b) in that it lowers the resistance of the electrode to the surrounding soil and improves electrical conductivity.
ii. RESLO would be a Designation B3 backfill since it consists of 40% bentonite, 50% gypsum and 10% sodium sulphate, by weight.
iii. The particle size distribution of RESLO complies with Table 4.1 of Clause 4.1. Figure 6.1 below indicates that particle size distribution lies on or below the maximum values specified in the Standard.
iv. RESLO fulfils the typical properties of a B3 backfill given in Table 4.2 of Clause 4.3.

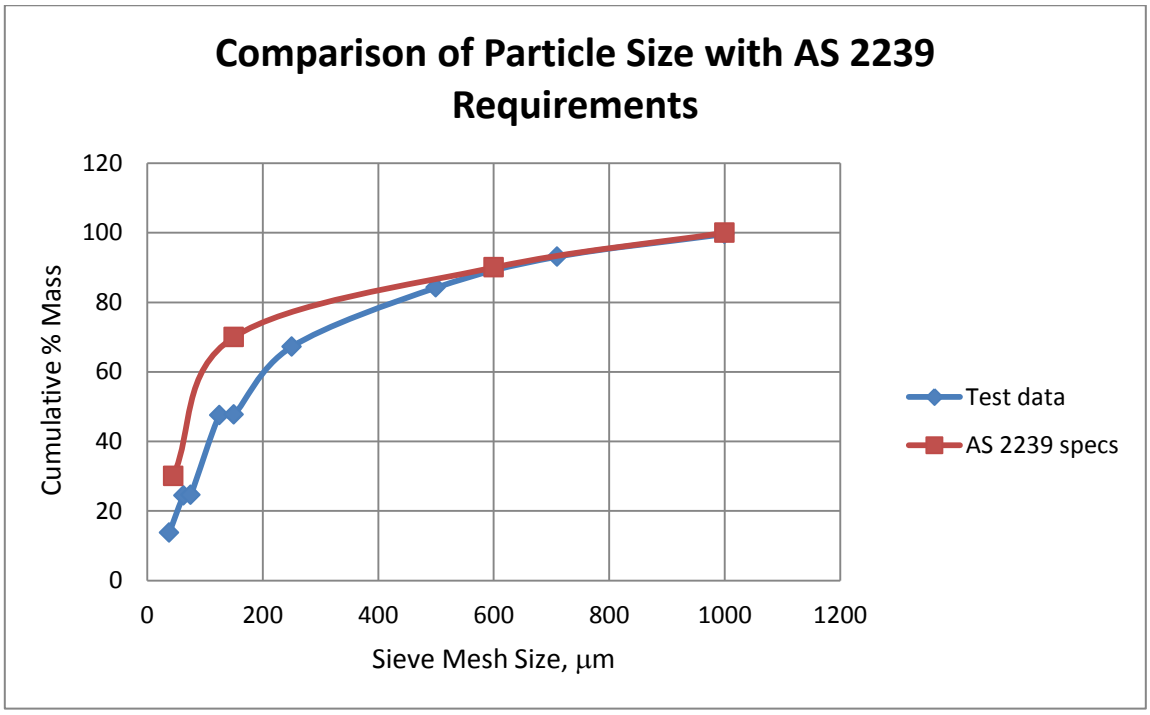

Figure 6.1: Comparison of RESLO Particle Size [10] with AS 2239 Requirements.

7 Conclusions and Recommendations

With regard to the product information, the technical data sheet, SDS and installation instructions provide a good coverage of the features, application and safety considerations of RESLO. The technical data sheet could be reviewed to respond to the comments in Section 4.1 of this report especially in regard to a statement concerning non-corrosiveness of the product.

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RESLO complies with AS 2239-2003 as a Designation B3 backfill.

8 References

[1] AS 2239-2003, “Galvanic (sacrificial) anodes for cathodic protection”, Standards Australia, 2003.

[2] Lightning Protection International, “Technical Data Sheet - LPI Resistance Lowering Compound (RESLO)”, Document ID: LPIDOC-26-1995, Version: 1.2, 04/08/2015.

[3] Lightning Protection International, “Safety Data Sheet - LPI RESLO-10”, Chemwatch Reference 4877-02, 10 October 2013.

[4] Lightning Protection International, “LPI RESLO-10 Installation Instructions”, Version 1.01.

[5] D. Edwards, “Report on Resistivity Tests on RESLO Ground Enhancement Compound for Lightning Protection International Pty Ltd, 16 Mertonvale Circuit, Kingston TAS 7050”, School of Engineering, University of Tasmania, Report Number 200502, 26 October 2005.

[6] M. Austin, “Technical Report - Resistivity Tests on RESLO Ground Enhancement Compound for Lightning Protection International Pty Ltd”, Solux, Version 1.0, 3 February 2015.

[7] D. Edwards, “Report on LPI RESLO Field Tests November 2005 – March 2007 for Lightning Protection International Pty Ltd, 16 Mertonvale Circuit, Kingston TAS 7050”, School of Engineering, University of Tasmania, Report Number 200702, 2 October 2007.

[8] M. Austin, “Technical Report - Field Tests on RESLO Ground Enhancement Compound for Lightning Protection International Pty Ltd”, Solux, Version 1.0, 28 May 2015.

[9] M. C. Miller, Large Soil Box, http://www.mcmiller.com/ProductDetails.aspx?item_no=37008&CatId=, accessed 29 May 2015.

[10] Allison Laboratories, “Results of Analysis”, Lab Reference 240374, 22 July 2015.