



UNIVERSITY  
OF WOLLONGONG  
AUSTRALIA

# Evaluation of Independent Test Reports for Compliance of LPI's SRIMPLUS-20 with IEC 62561-7:2018

Report prepared for:

Lightning Protection International Pty Ltd

**Final Report**

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## Executive Summary

Lightning Protection International Pty Ltd (LPI) has requested the Australian Power Quality and Reliability Centre (APQRC) at the University of Wollongong to conduct an evaluation of independent test reports on LPI's earth enhancing compound (EEC), generically called "SRIM Plus" but with a market name of "SRIMPLUS-20", for compliance with the testing requirements specified in IEC 62561-7:2018.

The results of the evaluation are summarised in the table below.

IEC 62561-7:2018 Test Clause	Results	Compliance with IEC 62561-7
5.2: Leaching Test	All heavy metals are below environmental limits	Yes
5.3: Sulphur Determination	$\leq 0.3\%$ , i.e., well below 2% limit	Yes
5.4: Determination of Resistivity	$\rho < 0.1 \Omega\text{m}$ stated in data sheet	Yes
5.5: Corrosion Tests	$R_p > 8 \Omega\text{m}^2$ on curing	Yes (for both non-aggressive and aggressive environments)

In summary, the independent tests carried out on LPI's SRIM Plus EEC verify compliance with IEC 62561-7:2018.

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## 1. Introduction

Lightning Protection International Pty Ltd (LPI) has requested the University of Wollongong (UOW) to conduct an evaluation of independent test reports on LPI's earth enhancing compound (EEC), generically called "SRIM Plus" but with a market name of "SRIMPLUS-20", for compliance with the testing requirements of IEC 62561-7:2018 [1].

An 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 SRIM Plus in the following sections of the report:

- Section 2 summarises the testing requirements in IEC 62561-7:2018.
- Section 3 lists the documents supplied and the independent test reports evaluated in this report.
- Section 4 evaluates the independent test reports, i.e., performance of SRIM Plus according to the testing requirements of IEC 62561-7:2018.
- Section 5 summarises the findings and presents conclusions.

## 2. Testing Requirements of IEC 62561-7:2018

Compliance with the test requirements of IEC 62561-7:2018 is specified in sections 5.2, 5.3, 5.4 and 5.5 of the Standard.

A brief summary of the requirements is as follows:

### Clause 5.2: Leaching Test

- Procedure per EN 12457-2 and EN 12506, i.e., using TCLP methods (also described in EPA 1311) and instrumentation such as ICP-MS.
- Test for leachable levels of Fe (iron), Cu (copper), Zn (zinc), Ni (nickel), Cd (cadmium), Co (cobalt) and Pb (lead).
- *The EEC is deemed to have passed the test if all measured values are below environmental limits (national or international guidelines).*

### Clause 5.3: Sulphur Determination

- Procedure per ISO 4689-3 or ISO 14869-1, i.e., using instrumentation ICP methods such as ICP-OES, ICP-AES, etc.).
- *The EEC is deemed to have passed the test if all measured values of sulphur content comprise less than 2% of the total material.*

### Clause 5.4: Determination of Resistivity

- The four-electrode method shall be used to measure the resistivity of the EEC as described in ASTM G57-06.
- *The EEC is deemed to have passed the test if the resistivity value obtained from the three samples are equal or less than the resistivity value claimed by the manufacturer (see extract from SRIM Plus Technical Data Sheet presented in Annex A).*

### Clause 5.5: Corrosion Tests

- The corrosion rate shall be determined by using potentiodynamic polarisation resistance methods as outlined in ASTM G59-97 (subsequent conversion to corrosion rates via ASTM G102-89). The polarisation curves collected as per ASTM G59-97 are used to determine the polarisation resistance,  $R_p$ .
- *For copper-plated earth electrodes, the polarisation resistance shall be  $> 4 \Omega m^2$  for non-aggressive environments and  $> 8 \Omega m^2$  for aggressive environments.*

### 3. Document List

The following documents were supplied by LPI to UOW for evaluation of SRIM Plus.

- A. Standard IEC 62561-7:2018 [1].
- B. Technical Data Sheet [2].
- C. Safety Data Sheet [3].
- D. Installation instructions [4].
- E. Eurofins Environment Testing Certificate of Analysis – Leaching (Cadmium, Cobalt, Copper, Iron, Lead, Nickel and Zinc) [5].
- F. Eurofins Environment Testing Certificate of Analysis – Sulphur Content [6].
- G. Enerven - Test Report on Earth Enhancing Compound SRIMPLUS-20: Resistance Measurement of 3 Samples - Rep. No. 179/21/1789N [7].
- H. Monash University LPR Testing – Final Report (SRIM Plus) [8].
- I. Monash University Summary Report: Corrosion Performance Testing – LPI SRIM Plus [9].

## 4. Evaluation of Independent Test Reports

This section presents the results of an evaluation of the independent test reports supplied by LPI for the purpose of certification of SRIM Plus.

### 4.1. Environment Testing (Leaching and Sulphur)

Environmental testing for leaching of heavy metals and for sulphur content was performed on 3 samples of SRIM Plus by Eurofins Environment Testing Australia. This testing laboratory is NATA certified and has ILAC-MRA accreditation.

The Eurofins Environment Testing Certificate of Analysis – Leaching [5] indicates that heavy metals leaching is below the limit of reporting for all metals except Zinc which at worst is 0.10 mg/L. All heavy metals leaching is below environmental limits and hence is compliant with IEC 62561-7.

The Eurofins Environment Testing Certificate of Analysis – Sulphur Content [6] indicates that sulphur content  $\leq 0.3\%$ , i.e., well below the 2% limit and hence is compliant with IEC 62561-7.

### 4.2. Resistivity Testing

Resistivity was determined from resistance measurements of 3 samples of SRIM Plus performed by Enerven Calibration and Testing Services. This testing laboratory is NATA certified and has ILAC-MRA accreditation.

The Enerven Calibration and Testing Services Test Report [7] indicates that resistivity was determined over several days and at a number of frequencies: 50 Hz, 95 Hz, 115 Hz, 128 Hz, 1 kHz, 5 kHz, 10 kHz and 20 kHz. Resistivity gradually decreased with curing of the SRIM Plus material. Also, after curing, the high frequency measurements give lower resistivity compared to those determined from the low frequency measurements (as shown on pages 6 and 7 of the Report).

All resistivities determined from the measurements are less than the 0.1  $\Omega\text{m}$  value which is specified in the SRIM Plus Technical Data Sheet [2] and hence are compliant with IEC 62561-7.

### 4.3. Corrosion Testing

The corrosion performance of SRIM Plus was assessed by Monash University using the linear polarisation resistance (LPR) method to obtain polarisation resistance values,  $R_p$ , as a function of time. The Department of Materials Science and Engineering at Monash University is one of only two organisations in Australia that do LPR testing. There are no NATA certified laboratories in Australia with this capability.

The Monash University Summary Report: Corrosion Performance Testing – LPI SRIM Plus [9] shows that LPR testing was carried out on duplicate samples of Cu-plated steel rods embedded in two batches of SRIM Plus (hence 4 samples in total). An increasing trend of  $R_p$  with time was observed. After 34 days (the typical curing time), the  $R_p$  values had increased in all cases to  $> 8 \Omega\text{m}^2$ , indicating that the polarisation resistance values of SRIM Plus exceed the minimum requirements of IEC 62561-7 for both non-aggressive and aggressive environments for copper-coated steel electrodes.

## 5. Summary and Conclusions

Lightning Protection International (LPI) requested the University of Wollongong's APQRC to conduct an evaluation of independent test reports on LPI's earth enhancing compound (EEC), SRIM Plus, for compliance with the testing requirements of IEC 62561-7:2018. The results of the evaluation are summarised in **Table 5-1** below.

**Table 5-1: Results of Evaluation**

<b>IEC 62561-7:2018 Test Clause</b>	<b>Results</b>	<b>Compliance with IEC 62561-7</b>
5.2: Leaching Test	All heavy metals are below environmental limits	Yes
5.3: Sulphur Determination	$\leq 0.3\%$ , i.e., well below 2% limit	Yes
5.4: Determination of Resistivity	$\rho < 0.1 \Omega\text{m}$ stated in data sheet	Yes
5.5: Corrosion Tests	$R_p > 8 \Omega\text{m}^2$ on curing	Yes (for both non-aggressive and aggressive environments)

In summary, the independent tests carried out on LPI's SRIM Plus EEC verify compliance with IEC 62561-7:2018.



## 6. References

- [1] IEC 62561-7:2018, *Lightning protection system components (LPSC) – Part 7: Requirements for earthing enhancing compounds*, International Electrotechnical Commission (IEC), 2018.
- [2] Lightning Protection International, *Technical Data Sheet: LPI Soil Resistance Improvement Material (SRIM PLUS)*, Document ID: LPIDOC-26-3007 Version: 1.2 16/03/2021.
- [3] Lightning Protection International, *Safety Data Sheet: SRIMPLUS-20*, Chemwatch: 5381-32, Version No: 2.1.1.1, Issue Date: 02/04/2020.
- [4] Lightning Protection International, *Installation Instructions: LPI SRIMPLUS-20*, Document ID: LPIDOC-26-2016 Version: 1.2 07/12/2020.
- [5] Eurofins Environment Testing, *Certificate of Analysis: SRIM PLUS – Heavy Metals & USA Leaching Procedure*, Report Number: 769278-L, February 2, 2021.
- [6] Eurofins Environment Testing, *Certificate of Analysis: SRIM PLUS – Sulphur & % Moisture*, Report Number: 769278-S, February 2, 2021.
- [7] Enerven Calibration and Testing Services, *Test Report on Earth Enhancing Compound LPI SRIMPLUS-20: Resistance Measurement of 3 Samples*, Report No. 179/21/1789N, 19 March, 2021.
- [8] Monash University, *LPR Testing – Final Report (SRIM PLUS)*, 24 February 2020.
- [9] Monash University, *Summary Report: Corrosion Performance Testing – LPI SRIM PLUS*, 24 February 2020.

## Annex A: SRIMPLUS-20 Key Information from TDS

<b>Ordering Code</b>	<b>SRIMPLUS-20</b>
Product description:	High-performance, standards-compliant earth enhancing compound
Application:	To lower earth electrode resistance and impedance
<b>Electrical resistivity:</b>	<b>Less than 0.1 <math>\Omega</math>m (tested to ASTM G57-06)</b>
Weight:	20 kg
Packaging:	LDPE-lined woven polypropylene bag
Pallet quantity:	48 bags per pallet

