

Product test report -  
5/8" Copperbond rods  
to BS EN 50164-2:2008

Report No. RB205-FU\_TR\_01\_0

### Revision record

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## 1 Introduction

This report details the type testing of a Furse Copperbond (steel coated Copper) earth rod (nominal diameter 5/8") made by FURSE (catalogue number RB205-FU) for use in earth termination network of an external Lightning Protection Systems (LPS) buried in the ground.

The Copperbond earth rod was tested according to British Standard BS EN 50164-2:2008.

One sample of each component was provided for analysis.

## 2 Abbreviations

CENELEC - European Committee for Electrotechnical Standardisation

LPS - Lightning Protection Systems

BS EN - British Standard European Norm

## 3 Test requirements and acceptance criteria

### 3.1 General

Tests shall be carried out with initially three (3) specimens according to BS EN 50164-2:2008 *Clause 5.1.3*. After the completion of the relevant tests, if all three (3) specimens have been found to fulfil the standard acceptance criteria, it is assumed that the specific type of tested component is valid to be used in a LPS. In the event that one (1) of the three (3) tested specimens does not satisfy a test criterion due an assembly or manufacturing fault, that test and any preceding one which may have influenced the results of the test shall be repeated and also the tests which follow shall be carried out in the required sequence on another full set of three (3) specimens, all of which shall comply with the requirements. If this second set of three (3) specimens satisfy the acceptance criteria, then the specific type of tested component is considered appropriate to be used in a LPS. If however one (1) of the second set of three (3) specimens does not satisfy a test, the specific component under test is not deemed valid to be used in a LPS.

## 3.2 Required tests

The Copperbond earth rod was subjected to the minimum dimension measurements and mechanical tests as summarized in BS EN 50164-2:2008 *Annex C*.

- Specimen measurement
- Test 5.3.1 - Tests for thickness of coating
- Test 5.3.2 - Adhesion test
- Test 5.3.3 - Bend test
- Test 5.3.4 - Environmental test
- Test 5.3.5 - Tensile strength tests
- Test 5.3.6 - Electrical resistivity tests
- Test 5.3.7 - Test for yield tensile ratio

These tests are referenced in detail in the present test report.

## 3.3 Preparation

The samples were prepared as follows:

- Cutting of earth rods at the required length.
- Cleaning of the earth rods with alcohol.
- Marking of the specimens, with the use of a marking tool, with the serial number of the test.

## 4 Performed tests

### 4.1 Specimen visual examination

#### 4.1.1 Requirements

The threads on the rods if any shall be smooth and fully formed. For coated rods, the coating shall extend over the threads. A lead in chamfer or point is recommended to facilitate driving.

NOTE For electroplated rods such as copper coated rods, it is desirable to thread roll the thread profile to ensure no copper is removed from the steel.

#### 4.1.2 Acceptance criteria

Compliance is checked by inspection.

#### 4.1.3 Results obtained

Visual examination of the sample rods shows that:

- The threads are formed by thread rolling.
- The Copper coating extends over the full length of the rolled thread.
- The samples show good adherence between the parent metal (steel) and coating (Copper) over the length of the threads.

## 4.2 Specimen measurement

### 4.2.1 Requirements

The diameter and the coating of each specimen are measured in accordance with BS EN 50164-2:2008 *Clause 4.3* and *Table 3*.

### 4.2.2 Acceptance criteria

A minimum diameter of 14 mm is specified in BS EN 50164-2:2008 *Table 3*.

### 4.2.3 Results obtained

The earth rod diameter (complete with coating) was measured. Measurements were made at three positions along the length of each specimen; one close to each end and one at the centre.

Measurements of the diameter were made with a Clarke 0 - 25 mm External Micrometer. The results are presented in Table 1.

Sample	Recorded measurement (mm)			Average (mm)	Pass/Fail
	Top	Middle	Bottom		
A	14.11	14.25	14.15	14.17	Pass
B	14.14	14.21	14.13	14.16	Pass
C	14.19	14.28	14.12	14.19	Pass

Table 1

## 4.3 Tests for thickness of coating (5.3.1)

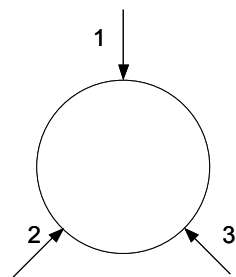
### 4.3.1 Requirements

In accordance with BS EN 50164-2:2008 *Clause 5.3.1* the Copper or the Zinc coating on a steel cored earth rod should be measured using a magnetic method instrument complying with ISO 2178.

Measurements should be taken at three positions along the length of the rod;

one 50 mm in from the top of the rod, one 50 mm in from the bottom of the rod and one at the mid point of the rod.

At each position detailed above, two additional measurements should be taken around the circumference of the rod at approximately 120 degrees separation (see Figure 1).



1,2,3 = measurements

Figure 1

**4.3.2 Acceptance criteria**

A minimum radial thickness of 250 micron is specified in BS EN 50164-2:2008 *Table 3*.

**4.3.3 Results obtained**

The earth rod coating thickness was measured with the use of an Elcometer model 345, calibrated thickness gauge. The results are presented in *Table 2*.

Sample	Test no.	Recorded measurement (µm)			Average (µm)	Pass/Fail
		Top	Middle	Bottom		
A	1	282	344	268	310	Pass
	2	291	357	304		
	3	294	356	294		
B	1	299	316	290	299.1	Pass
	2	287	311	281		
	3	284	331	293		
C	1	267	356	312	318.1	Pass
	2	283	353	320		
	3	279	361	332		

Table 2

#### 4.4 Adhesion test (5.3.2)

##### 4.4.1 Requirements

in accordance with BS EN 50164-2:2008 *Clause 5.3.2* the specimens are driven through two steel clamping plates or the jaws of a vice set  $1^{+0,00}_{-0,25}$  mm less than the diameter of the specimens, so as to shear off sufficient metal to expose the bond between the coating and the parent metal.

##### 4.4.2 Acceptance criteria

After the test, the coating of the specimens shall show adherence to the parent metal. Separation of the copper from the steel is not acceptable.

##### 4.4.3 Results obtained

With reference to Figure 2 it can be seen that the sample shows good adherence between the parent metal (steel) and coating (Copper).



Figure 2

#### 4.5 Bend test (5.3.3)

##### 4.5.1 Requirements

in accordance with BS EN 50164-2:2008 *Clause 5.3.3* the copper coated steel earth rods specimens used in and complying with *Clause 5.3.2* shall be bent through a radius equal to 5 times (+/-1mm) of its diameter to an angle of 90° (+/- 5°)



#### 4.5.2 Acceptance criteria

After the test, the specimens shall show no sharp edges, cracks or peeling around the bending area.

#### 4.5.3 Results obtained

With reference to Figure 3 it can be seen that the sample shows no sharp edges, cracks or peeling around the bending area.

#### 4.6 Environmental test (5.3.4)

##### 4.6.1 Requirements

in accordance with BS EN 50164-2:2008 *Clause 5.3.4* the copper coated steel earth rods specimens used in and complying with *Clause 5.3.3* shall be subjected to an environmental test as specified in BS EN 50164-2:2008 *Annex A*.

##### 4.6.2 Acceptance criteria

After the test the specimens shall satisfy the following criteria:

- the specimens shall be of good visual appearance and have no rough edges or burrs throughout their length
- the base metal of the specimens shall not exhibit any visual corrosive deterioration

NOTE 1 White rust is not considered as corrosive deterioration.

NOTE 2 100 mm from both ends of the specimens are excluded from inspection

##### 4.6.3 Results obtained

With reference to Figure 3 it can be seen that the sample shows no rough edges or burrs and the base metal of the specimens do not exhibit any visual corrosive deterioration.



Figure 3

**4.7 Tensile strength tests (5.3.5)**

**4.7.1 Requirements**

In accordance with BS EN 50164-2:2008 *Clause 5.3.5* the tensile strength of the copper coated steel rods ( $R_m$ ) shall be determined in line with EN 10002-1.

For the testing of earth rods the test specimen should be tested un-machined as per C1.

**4.7.2 Acceptance criteria**

A tensile strength of 600 – 770 N/mm<sup>2</sup> is specified in BS EN 50164-2:2008 *Table 4*.

**4.7.3 Results obtained**

With reference to Figure 4 it can be seen that a tensile strength of 770 N/mm<sup>2</sup> was recorded for the sample.

## 4.8 Electrical resistivity tests (5.3.6)

### 4.8.1 Requirements

In accordance with BS EN 50164-2:2008 *Clause 5.3.6* a sample length of earth rod, approximately 1.2 m long should be used for the test. The resistance measurement should be taken over a 1 m (+/- 1 mm) distance, using a proprietary microhmeter, and the reading corrected to 20 °C using appropriate correction factors.

The resistivity of the sample length of conductor can then be found by the formula

$$(\rho) = \frac{R \times A}{\ell}$$

Where:      R      =      resistance in microhms ( $\mu\Omega$ ) over 1 m length  
                  A      =      cross sectional area ( $m^2$ )  
                   $\ell$      =      unit length (m)

### 4.8.2 Acceptance criteria

A maximum electrical resistance of 0.25  $\mu\Omega m$  is specified in BS EN 50164-2:2008 *Table 4*.

### 4.8.3 Results obtained

Measurements of the resistance of each sample were made with a Megger DLRO 10. The results of the resistance measurements for each sample along with the calculated resistivity are presented in Table 3.

Sample	Resistance ( $\mu\Omega$ )	C.S.A. ( $mm^2$ )	Resistivity ( $\mu\Omega m$ )	Pass/Fail
A	608.5	157.6992	0.0960	Pass
B	583.9	157.4767	0.0920	Pass
C	578.9	158.1447	0.0915	Pass

Table 3

## 4.9 Test for yield tensile ratio (5.3.7)

### 4.9.1 Requirements

In accordance with BS EN 50164-2:2008 *Clause 5.3.7* the yield/tensile ratio is determined by ascertaining the upper yield strength [ $R_{eH}$ ] and dividing the result by the tensile strength [ $R_m$ ].

### 4.9.2 Acceptance criteria

A yield/tensile ratio of 0.8 – 0.95 is specified in BS EN 50164-2:2008 *Table 4*.

### 4.9.3 Results obtained

With reference to Figure 4 it can be seen that a yield strength of 705 N/mm<sup>2</sup> was recorded for the sample.

Therefore the yield/tensile ratio is determined as follows:

$$\text{yield tensile ratio} = \frac{R_{eH}}{R_m}$$

$$\text{yield tensile ratio} = \frac{705}{770}$$

$$\text{yield tensile ratio} = 0.92$$

## 5 Conclusions

The three Copperbond earth rods (catalogue number RB205-FU) with a diameter of 5/8" (shank Ø14.2 mm) for use in an external Lightning Protection Systems (LPS) buried in ground were tested according to British Standard BS EN 50164-2:2008.

The Copperbond earth rods were subjected to and have successfully passed the criteria according to BS EN 50164-2:2008.

## 6 Variant part numbers

This report is valid for variant part numbers; RB205-FUR, RB205M, RB210, RB215, RB220-FU, RB225 and RB235.

This report is valid (with the exception of any reference to rod threads) for variant part numbers RB203, RB213, RB216, RB217, RB223, RB226, RB236

## Figures



# ndt services limited

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### CERTIFICATE OF TEST

**Client:** W J FURSE + CO LIMITED  
 Wilford Road  
 Nottingham  
 NG2 1EB

**Report No:** V013693E1/09

**Issue No:** 1

**Date received:** 16-Apr-09

**Date of test:** 20-Apr-09

**Date of issue:** 20-Apr-09

**FAO:** Andrew Bromhead

**Order No :** 163389

**Description :** Copper Bond Rod

**Quantity:** 1

**Other Info:** 14.2mm Diameter

**Identification :** Thunder

**Material:** Steel Core / Copper Coated

**Batch:**

**Specification:** Clients Order Requirements

BS EN 10002-1:2001		Tensile Test		Round sample			Comments
Dia (mm)	Area (mm <sup>2</sup> )	Proof Stress (N/mm <sup>2</sup> )	Tensile Strength (N/mm <sup>2</sup> )	Elongation on 50mm G.L (%)	Reduction of Area (%)		
9.94	77.61	705	770	8.5	41.0	n/a	

**Comments:** Test results conform to : Clients order requirements

*Yield / Proof determined by Offset method.*

End.

For **NDT** Services Limited

Leigh Hobson

*Metallurgical Services*



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Figure 4

Document class:

**COMMERCIAL IN CONFIDENCE**

Filename:

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