

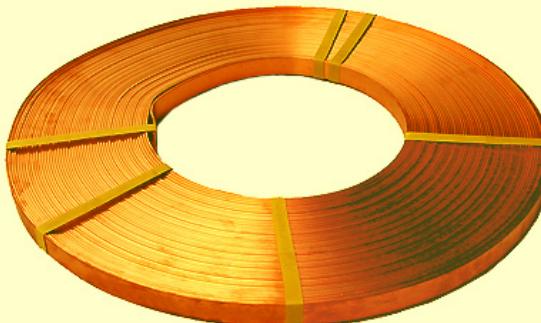


Project Title	Consultant
National Institute of Education	CPG
Cantonment Complex	CPG
PSA Terminal 3	PSA
Tuas Checkpoint	CPG
King's Centre Building	Squire Mech
Pasir Laba Camp	Parsons
Warren Golf & Country Club	P.Tan & Partners
Changi Airport Police Station	CIAS
Fullerton Square	PCR
Yishun Secondary School	CPG
Pasir Ris Secondary	CPG
Mobile One Building	Regional
Tekong Camp	DSTA
Bukit Panjang Plaza Complex	H Y M&E
Harbour Front	Meinhart
Garden at Bishan Condominium	United Projects

## EMTECH ELECTRICAL EARTHING & LIGHTNING PROTECTION PRODUCTS

**○ BARE ALUMINIUM TAPE****Bare Aluminium Tape**

Material	Aluminium
Size	25 x 3mm
Product Code	AT-1E

**○ BARE COPPER TAPE****Bare Copper Tape**

Material	Copper
Size	25 x 3mm
Product Code	CT-1E

**○ ALUMINUM TAPE-CLIP****Aluminum Tape-Clip**

Material	Aluminum
Size	1" x 1/8"
Product Code	SB-1-A

**○ BRASS TAPE-CLIP****Brass Tape-Clip**

Material	Brass
Size	1" x 1/8"
Product Code	SB-1-B

**○ HEAVY DUTY METALLIC DC TAPE-CLIP****Heavy Duty Metallic DC  
Tape-Clip**

Material	Brass
Size	1" x 1/8"
Product Code	SB-1-BH

**○ NON-METALLIC DC TAPE-CLIP (GREY)****Non-Metallic DC Tape-Clip  
(Grey)**

Material	PVC
Size	25 x 3mm
Product Code	PC1-GY

**○ NON-METALLIC DC TAPE-CLIP (BROWN)****Non-Metallic DC Tape-Clip  
(Brown)**

Material	PVC
Size	25 x 3mm
Product Code	PC1

**○ BI-METALLIC CONNECTOR****Bi-Metallic Connector**

Material	Copper/ Aluminium
Product Code	BM1

## ○ BRASS SQUARE TAPE CLAMP



Brass Square Tape Clamp

Material	Brass
Product Code	TC-S-B

## ○ LIGHTNING TEST LINK BOX



Lightning Test Link Box

Size	125mm x 125mm x 40mm
Product Code	TLB

## ○ ALUMINIUM SQUARE TAPE CLAMP



Aluminium Square Tape Clamp

Material	Aluminium
Product Code	TC-S-A

## ○ ROD TO TAPE CLAMP



Rod to Tape Clamp

Product Code	ACNB1
--------------	-------

## ○ BRASS HEAVY DUTY SQUARE TEST CLAMP



Brass Heavy Duty Square Test Clamp

Material	Brass
Product Code	TC-S-BH

## ○ GALVANIZED LID INSPECTION PIT



Galvanized Lid Inspection Pit

Material	Plastic base with hot-dipped galvanized cover
Product Code	GIP

## ○ SQUARE CONCRETE EARTH PIT



Square Concrete Earth Pit

Material	Concrete
Product Code	CIP-S

## ○ HEAVY DUTY CIRCULAR CONCRETE EARTH PIT



Circular Concrete Earth Pit

Material	Concrete
Product Code	CIP-C

## ○ HD CIRCULAR CONCRETE C/W CAST IRON COVER



Heavy Duty Circular Concrete Earth Pit c/w Cast Iron Cover

Material	Concrete/ Cast Iron Cover
Product Code	CIP-C1

## ○ COPPER ROD



Copper Rod

Size	5/8" x 6ft
Product Code	CR586E

## ○ DRIVING STUD



Driving Stud

Size	5/8"
Product Code	ST58

## ○ COUPLING



Coupling

Size	5/8" x 70mm
Product Code	CB58E

## ④ 4 HOLES EARTH POINT



4 Holes Earth Point  
Product Code | EP4H-S

## ⑤ ALUMINIUM AIR TERMINAL C/W BASE



Aluminium Air Terminal c/w Base

Material	Aluminium
Finial Point	1 ft, 1½ ft, 2 ft,
Size	2½ ft, 3 ft

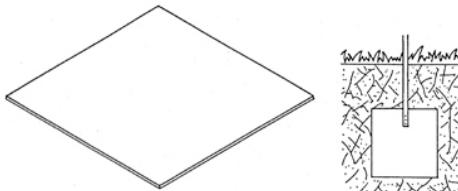
## ⑥ COPPER AIR TERMINAL C/W BASE



Copper Air Terminal c/w Base

Material	Copper/Brass
Finial Point	1 ft, 1½ ft, 2 ft,
Size	2½ ft, 3 ft

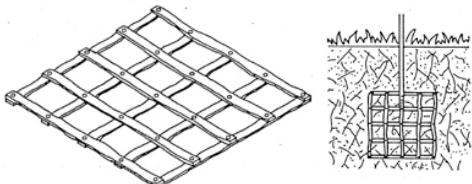
## ⑦ COPPER PLATE



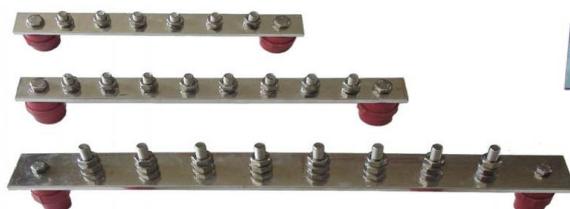
Copper Plate

Size	600 mm x 600mm x 1.5mm, 600 mm x 600mm x 3mm, 900 mm x 900mm x 1.5mm, 900 mm x 900mm x 3mm, 1200 mm x 1200mm x 1.5mm, 1200 mm x 1200mm x 3mm
------	---

## ⑧ COPPER MESH



## ⑨ EARTH BARS



Optional:  
Earth Bar  
Base Bracket

Earth Bars

Size	4 way, 6 way, 8 way, 10 way, 12 way, 14 way
Material	Copper Tinned - 25mm x 6mm, 50mm x 6mm
Note	Other sizes can also be fabricated to requirement

U CLAMP



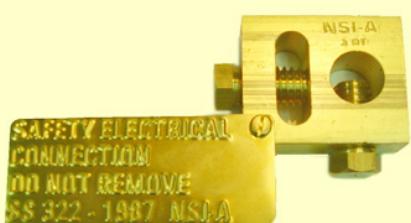
U Clamp

H CLAMP



H Clamp

ROD TO TAPE CLAMP



Rod to Tape Clamp

Product Code | AC3-E

\* NSI Brand

ROD TO CABLE CLAMP



Rod to Cable Clamp

Product Code | AC2-E

\* NSI Brand

C Type Connector



C Type Connector

Size	16mm, 25mm, 35mm, 50mm, 70mm, 95mm, 120mm, 150mm
Material	Copper Tinned

**Test Report No. 7191009763-MEC11-01-CYW**  
dated 21 JUN 2011



PSB Singapore

**Note:** This report is issued subject to TÜV SÜD PSB's "Terms and Conditions Governing Technical Services".  
The terms and conditions governing the issue of this report are set out as attached within this report.

**Choose certainty.  
Add value.**

**SUBJECT:**

Testing of copper tape submitted by Tan Teck Seng Electric Company Pte Ltd.

**TESTED FOR:**

Tan Teck Seng Electric Company Pte Ltd  
137 Kaki Bukit Avenue 1, Shun Li Industrial Park  
Singapore 416003

Attn: Mr. Kevin Tan

**TEST METHOD:**

1. BS EN ISO 6892-1 : 2009 Metallic materials-Tensile testing.
2. ISO 6507-1 : 2005 Metallic materials-Vickers hardness test.
3. BS EN 13601:2002 Copper and copper alloys-Copper rod,bar and wire for general electrical purposes.

**SAMPLE DESCRIPTION:**

One No of copper tape said to be ""EMTECH" brand of size 25mm width x 3.0mm thick was received.

**TESTS CONDUCTED:**

1. Tensile test
2. Hardness test
3. Electrical resistance
4. Chemical composition-Test report will issued separately

**ENGRAVED MARKING:**

EMTECH



**Laboratory:**  
TÜV SÜD PSB Pte. Ltd.  
Testing Services  
No.1 Science Park Drive  
Singapore 118221

Phone : +65-6885 1333  
Fax : +65-6776 8670  
E-mail: testing@tuv-sud-psb.sg  
www.tuv-sud-psb.sg  
Co. Reg : 199002667R

**Regional Head Office:**  
TÜV SÜD Asia Pacific Pte. Ltd.  
3 Science Park Drive, #04-01/05  
The Franklin, Singapore 118223  
**TUV®**

**RESULTS:**

**(1) Reduced-Section Tensile Test**

Sample Reference	"EMTECH" Brand Copper Tape
Measured width, b (mm)	12.53
Measured wall thickness, a (mm)	3.03
Cross sectional area, A = ab (mm <sup>2</sup> )	37.97
0.2% Yield strength (N/mm <sup>2</sup> )	104
Tensile strength (N/mm <sup>2</sup> )	232
Elongation based on 5.65√A gauge length (%)	52
Position of fracture	Broke between gauge marks

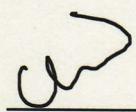
Note: The tensile test specimen was machined from the copper tape longitudinally.

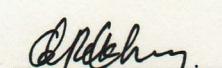
**(2) Vickers Hardness Test**

Sample Reference	"EMTECH" Brand Copper Tape	
Vickers Hardness Value HV 5	Test 1	HV 57.9
	Test 2	HV 57.9
	Test 3	HV 57.9

**(3) Electrical Resistance**

Sample Reference	"EMTECH" Brand Copper Tape	BS EN 13601:2002 Requirement
Volume resistivity ρ	0.01677 Ω.mm <sup>2</sup> /m	Max. 0.01724 Ω.mm <sup>2</sup> /m

  
Cliff Yew  
Associate Engineer

  
Chua Peck Cheong  
Product Manager  
Automotive & Industrial Group  
Mechanical Centre

**This Report is issued under the following conditions:**

1. Results of the testing/calibration in the form of a report will be issued immediately after the service has been completed or terminated.
2. Unless otherwise requested, a report shall contain only technical results. Analysis and interpretation of the results and professional opinion and recommendations expressed thereupon, if required, shall be clearly indicated and additional fee paid for, by the Client.
3. This report applies to the sample of the specific product/equipment given at the time of its testing/calibration. The results are not used to indicate or imply that they are applicable to other similar items. In addition, such results must not be used to indicate or imply that TÜV SÜD PSB approves, recommends or endorses the manufacturer, supplier or user of such product/equipment, or that TÜV SÜD PSB in any way "guarantees" the later performance of the product/equipment.
4. The sample/s mentioned in this report is/are submitted/supplied/manufactured by the Client. TÜV SÜD PSB therefore assumes no responsibility for the accuracy of information on the brand name, model number, origin of manufacture, consignment or any information supplied.
5. Additional copies of the report are available to the Client at an additional fee. No third party can obtain a copy of this report through TÜV SÜD PSB, unless the Client has authorised TÜV SÜD PSB in writing to do so.
6. TÜV SÜD PSB may at its sole discretion add to or amend the conditions of the report at the time of issue of the report and such report and such additions or amendments shall be binding on the Client.
7. All copyright in the report shall remain with TÜV SÜD PSB and the Client shall, upon payment of TÜV SÜD PSB's fees for the carrying out of the tests/calibrations, be granted a license to use or publish the report to the third parties subject to the terms and conditions herein, provided always that TÜV SÜD PSB may at its absolute discretion be entitled to impose such conditions on the license as it sees fit.
8. Nothing in this report shall be interpreted to mean that TÜV SÜD PSB has verified or ascertained any endorsement or marks from any other testing authority or bodies that may be found on that sample.
9. This report shall not be reproduced wholly or in parts and no reference shall be made by the Client to TÜV SÜD PSB or to the report or results furnished by TÜV SÜD PSB in any advertisements or sales promotion.
10. Unless otherwise stated, the tests are carried out in TÜV SÜD PSB Pte Ltd, No.1 Science Park Drive Singapore 118221.

March 2010

# TEST REPORT: 7191009763-CHM11-02-CES

Date: 23 JUN 2011

Tel: +65 68851291 Fax: +65 67784301

Client's Ref:

Email: huayi.chen@tuv-sud-psb.sg

Note: This report is issued subject to TÜV SÜD PSB's "Terms and Conditions Governing Technical Services".  
The terms and conditions governing the issue of this report are set out as attached within this report.



PSB Singapore

Choose certainty.  
Add value.

## SUBJECT

Chemical composition analysis of one sample of copper tape

## CLIENT

Tan Teck Seng Electric Company Pte Ltd  
137 Kaki Bukit Ave 1  
Shun Li Industrial Park  
Singapore 416003

Attn: Mr Kelvin Tan

## SAMPLE SUBMISSION DATE

10 Jun 2011

## DESCRIPTION OF SAMPLE

One sample of copper tape with the following details was received.

Brand: EMTECH

Size: 25mm width x 3.0mm thk

## METHOD OF TEST

1. Copper content by Electrolytic Deposition Method
2. Other elements by Inductively Coupled Plasma – Atomic Emission Spectrometry



TÜV SÜD PSB

Laboratory:  
TÜV SÜD PSB Pte. Ltd.  
No.1 Science Park Drive  
Singapore 118221

Phone : +65-6885 1333  
Fax : +65-6776 8670  
E-mail: testing@tuv-sud-psb.sg  
www.tuv-sud-psb.sg  
Co. Reg : 199002667R

Regional Head Office:  
TÜV SÜD Asia Pacific Pte. Ltd.  
3 Science Park Drive, #04-01/05  
The Franklin, Singapore 118223  
**TUV®**

**RESULTS**

Sample Marked	"EMTECH" Brand Copper Tape	BS EN 1976 : 1998 Cu-OF Specification
Copper + Silver, Cu + Ag %	99.95 min	99.95 min
Lead, Pb %	Less than 0.001	0.005 max
Iron, Fe %	Less than 0.001	-
Manganese, Mn %	Less than 0.01	-
Aluminium, Al %	Less than 0.001	-
Arsenic, As %	Less than 0.001	-
Tin, Sn %	Less than 0.001	-
Nickel, Ni %	Less than 0.001	-
Zinc, Zn %	Less than 0.001	-
Antimony, Sb %	Less than 0.001	-
Bismuth, Bi %	Less than 0.0005	0.0005 max
		Total impurities 0.03 max, excluding Ag

**REMARKS**

Chemical composition of the above sample complied with BS EN 1976 : 1998 Cu-OF specification.

MR CHUA ENG SOON  
TEAM LEADER

DR CHEN HUAYI  
ASSISTANT VICE PRESIDENT  
ELEMENTAL AND ENVIRONMENTAL ANALYSIS  
CHEMICAL & MATERIALS

This Report is issued under the following conditions:

1. Results of the testing/calibration in the form of a report will be issued immediately after the service has been completed or terminated.
2. Unless otherwise requested, this report shall contain only technical results carried out by TÜV SÜD PSB. Analysis and interpretation of the results and professional opinion and recommendations expressed thereupon, if required, shall be clearly indicated and additional fee paid for, by the Client.
3. This report applies to the sample of the specific product/equipment given at the time of its testing/calibration. The results are not used to indicate or imply that they are applicable to other similar items. In addition, such results must not be used to indicate or imply that TÜV SÜD PSB approves, recommends or endorses the manufacturer, supplier or user of such product/equipment, or that TÜV SÜD PSB in any way "guarantees" the later performance of the product/equipment. Unless otherwise stated in this report, no tests were conducted to determine long term effects of using the specific product/equipment.
4. The sample/s mentioned in this report is/are submitted/supplied/manufactured by the Client. TÜV SÜD PSB therefore assumes no responsibility for the accuracy of information on the brand name, model number, origin of manufacture, consignment or any information supplied.
5. Additional copies of the report are available to the Client at an additional fee. No third party can obtain a copy of this report through TÜV SÜD PSB, unless the Client has authorised TÜV SÜD PSB in writing to do so.
6. TÜV SÜD PSB may at its sole discretion add to or amend the conditions of the report at the time of issue of the report and such report and such additions or amendments shall be binding on the Client.
7. All copyright in the report shall remain with TÜV SÜD PSB and the Client shall, upon payment of TÜV SÜD PSB's fees for the carrying out of the tests/calibrations, be granted a license to use or publish the report to the third parties subject to the terms and conditions herein, provided always that TÜV SÜD PSB may at its absolute discretion be entitled to impose such conditions on the license as it sees fit.
8. Nothing in this report shall be interpreted to mean that TÜV SÜD PSB has verified or ascertained any endorsement or marks from any other testing authority or bodies that may be found on that sample.
9. This report shall not be reproduced wholly or in parts and no reference shall be made by the Client to TÜV SÜD PSB or to the report or results furnished by TÜV SÜD PSB in any advertisements or sales promotion.
10. Unless otherwise stated, the tests were carried out in TÜV SÜD PSB Pte Ltd, No.1 Science Park Drive Singapore 118221.

March 2010

**Test Report No. 719186588-EEC10/01-SYG**  
dated 12 OCT 2010



PSB Singapore

Choose certainty.  
Add value.

**Note:** This report is issued subject to TÜV SÜD PSB's "Terms and Conditions Governing Technical Services".  
The terms and conditions governing the issue of this report are set out as attached within this report.

**Subject**

**EVALUATION TEST OF BI-METALLIC CONNECTOR**

**Client**

**Tan Teck Seng Electric Company (Pte) Ltd**  
137 Kaki Bukit Avenue 1  
Shun Li Industrial Park  
Singapore 416003

Attn : Mr. Kevin Tan

**Sample Submission Date**

05 Oct 2010

**Date(s) of Performance of Test**

06 Oct 2010 to 12 Oct 2010

**Description of Sample**

**Bi-Metallic Connector**

Brand	:	EMTECH
Model No.	:	BM2
Quantity	:	Four (4) units
Manufacturer	:	New Starlight Industries Pte Ltd
Country of Origin	:	Singapore



**Laboratory:**  
**TÜV SÜD PSB Pte. Ltd.**  
No.1 Science Park Drive  
Singapore 118221

Phone : +65-6885 1333  
Fax : +65-6776 8670  
E-mail: testing@tuv-sud-psb.sg  
www.tuv-sud-psb.sg  
Co. Reg : 199002667R

**Regional Head Office:**  
**TÜV SÜD Asia Pacific Pte. Ltd.**  
3 Science Park Drive, #04-01/05  
The Franklin, Singapore 118223  
**TÜV®**



PSB Singapore

### **Method of Test**

The following tests were carried out in accordance with clause 56.7 of HDB Standard Specifications for Building Works & Other Installations (2005 Edition) as per client's request:-

- a) Electrical interface resistance;
- b) Tensile strength of joint and
- c) Microscopic examination of friction weld surface.

### **Results**

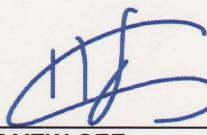
<b>Item No.</b>	<b>Title</b>	<b>Results</b>	<b>Permissible Limits</b>
1	Electrical interface resistance Measurement between (See Appendix I):- Position A Position B	0.007mΩ 0.009mΩ	Maximum 0.008mΩ Maximum 0.009mΩ
2	Tensile strength of joint Maximum load (kN)	Complied 12.61	) Joint between copper & ) aluminium not affected
3	Microscopic examination of friction weld surface	Complied (See Remark 2)	) No void or separation at ) the bi-metallic interface

**Remarks**

1. The results were based on the samples submitted by the client.
2. The test of microscopic examination of friction weld surface was conducted by Inspection and Failure Analysis Centre (TÜV SÜD PSB Test Report Reference No. : 719186588-IFA10/02-SBT dated 07 Oct 2010).
3. The samples submitted were deemed to comply with clause 56.7 of HDB Standard Specifications for Building Works & Other Installations (2005 Edition) for those tested which were conducted.



---



SIM YEW GEE  
TESTING OFFICER

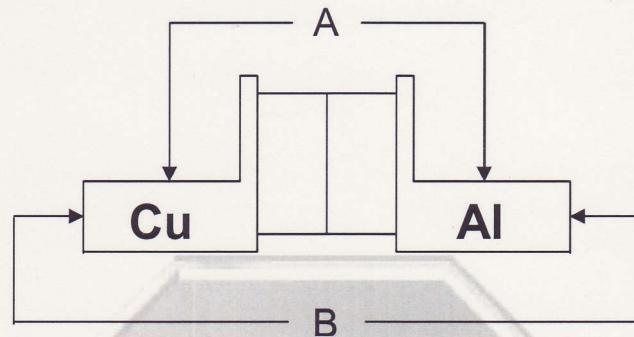
---



YEO CHIN YONG  
PRODUCT MANAGER  
ELECTRICAL & ELECTRONICS

Appendix I

Electrical Interface Resistance Measurement Between Position A and Position B

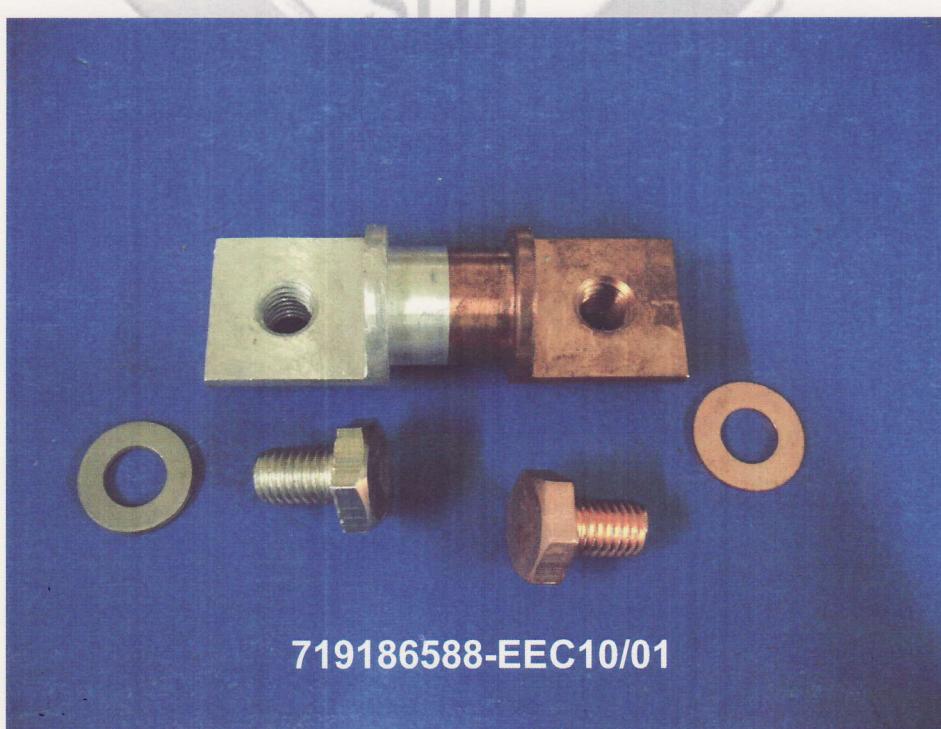
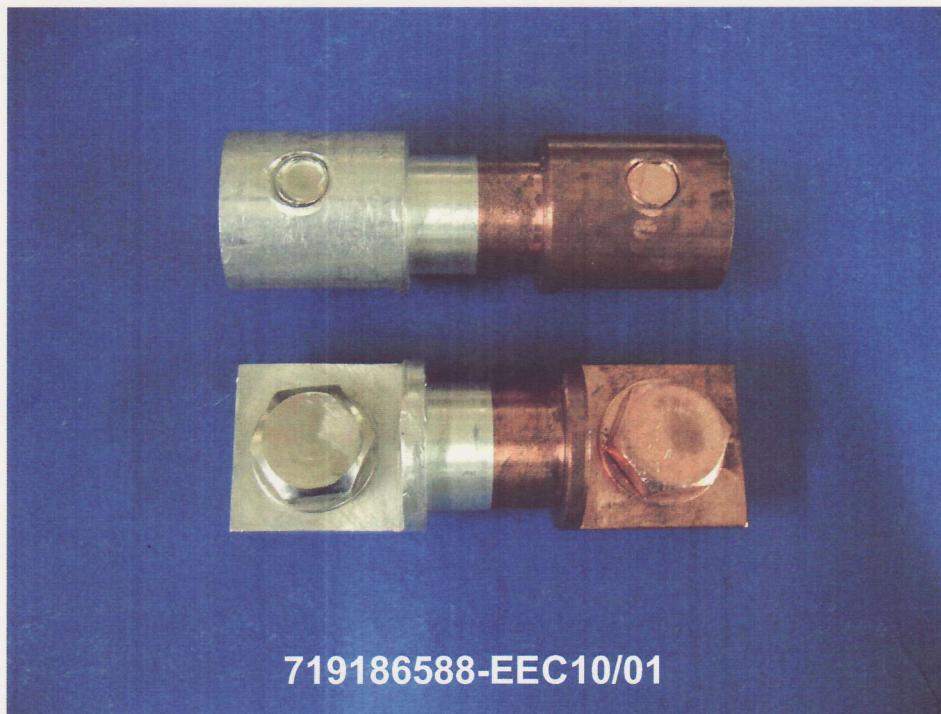




PSB Singapore

**Appendix II**

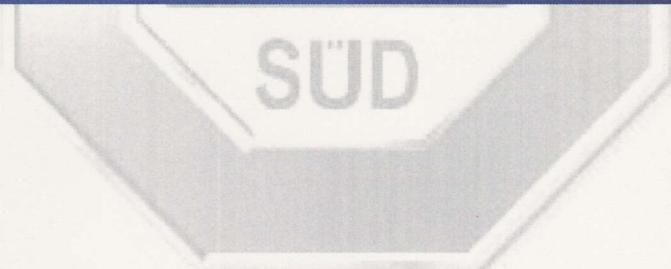
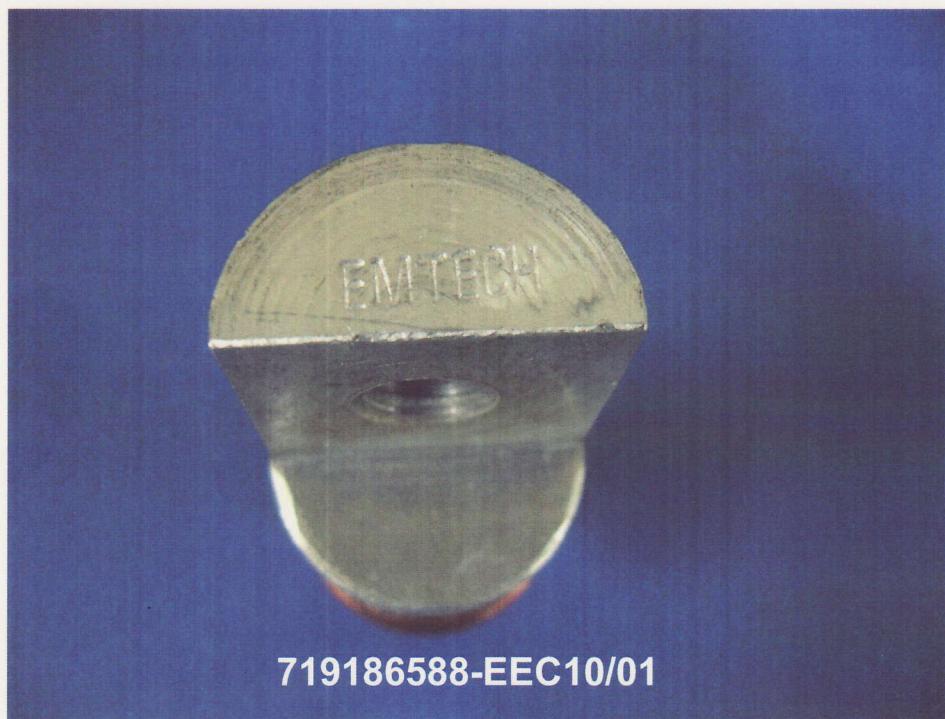
**"EMTECH" Model No. : BM2 Bi-Metallic Connector**





PSB Singapore

**Appendix II (Cont'd)**





PSB Singapore

**This Report is issued under the following conditions:**

1. Results of the testing/calibration in the form of a report will be issued immediately after the service has been completed or terminated.
2. Unless otherwise requested, this report shall contain only technical results carried out by TÜV SÜD PSB. Analysis and interpretation of the results and professional opinion and recommendations expressed thereupon, if required, shall be clearly indicated and additional fee paid for, by the Client.
3. This report applies to the sample of the specific product/equipment given at the time of its testing/calibration. The results are not used to indicate or imply that they are applicable to other similar items. In addition, such results must not be used to indicate or imply that TÜV SÜD PSB approves, recommends or endorses the manufacturer, supplier or user of such product/equipment, or that TÜV SÜD PSB in any way "guarantees" the later performance of the product/equipment. Unless otherwise stated in this report, no tests were conducted to determine long term effects of using the specific product/equipment.
4. The sample/s mentioned in this report is/are submitted/supplied/manufactured by the Client. TÜV SÜD PSB therefore assumes no responsibility for the accuracy of information on the brand name, model number, origin of manufacture, consignment or any information supplied.
5. Additional copies of the report are available to the Client at an additional fee. No third party can obtain a copy of this report through TÜV SÜD PSB, unless the Client has authorised TÜV SÜD PSB in writing to do so.
6. TÜV SÜD PSB may at its sole discretion add to or amend the conditions of the report at the time of issue of the report and such report and such additions or amendments shall be binding on the Client.
7. All copyright in the report shall remain with TÜV SÜD PSB and the Client shall, upon payment of TÜV SÜD PSB's fees for the carrying out of the tests/calibrations, be granted a license to use or publish the report to the third parties subject to the terms and conditions herein, provided always that TÜV SÜD PSB may at its absolute discretion be entitled to impose such conditions on the license as it sees fit.
8. Nothing in this report shall be interpreted to mean that TÜV SÜD PSB has verified or ascertained any endorsement or marks from any other testing authority or bodies that may be found on that sample.
9. This report shall not be reproduced wholly or in parts and no reference shall be made by the Client to TÜV SÜD PSB or to the report or results furnished by TÜV SÜD PSB in any advertisements or sales promotion.
10. Unless otherwise stated, the tests were carried out in TÜV SÜD PSB Pte Ltd, No.1 Science Park Drive Singapore 118221.

March 2010

**Test Report No. 719186588-IFA10/02-SBT**  
dated 07 OCT 2010

**Note:** This report is issued subject to TÜV SÜD PSB's "Terms and Conditions Governing Technical Services".  
The terms and conditions governing the issue of this report are set out as attached within this report.



PSB Singapore

Choose certainty.  
Add value.

### MICROSCOPIC EXAMINATION OF BI-METALLIC CONNECTOR

#### CLIENT

Tan Teck Seng Electric Company Pte Ltd  
137 Kaki Bukit Ave 1  
Shun Li Industrial Park  
Singapore 416003

Attn: Mr Kevin Tan  
(General Manager)

\*\*\*\*\*

#### DESCRIPTION

One piece of bi-metallic connector sample was submitted to Inspection & Failure Analysis Centre of TÜV SÜD PSB through Electrical and Electronic Test Centre of TÜV SÜD PSB on 06/10/2010 for microscopic examination. Following informations regarding the sample was given by the client.

Description	Bi-Metallic Connector
Brand	EMTECH
Model No.	BM2



**Laboratory:**  
TÜV SÜD PSB Pte. Ltd.  
No.1 Science Park Drive  
Singapore 118221

Phone : +65-6885 1333  
Fax : +65-6776 8670  
E-mail: testing@tuv-sud-psb.sg  
www.tuv-sud-psb.sg  
Co. Reg : 199002667R

**Regional Head Office:**  
TÜV SÜD Asia Pacific Pte. Ltd.  
3 Science Park Drive, #04-01/05  
The Franklin, Singapore 118223  
**TÜV®**



PSB Singapore

## TEST METHOD

1. Documentation by photography;
2. Microscopic examination of friction weld surface.

## TESTING RESULTS

1. Photography

General view of the bi-metallic connector sample as received is shown in Fig. 1.

2. Microscopic Examination

The microstructure of the friction weld surface is shown in Fig. 2. No significant welding defect such as oxidation, void or separation was observed.

A handwritten signature in black ink, appearing to read "Shau Beng Thai".

---

**SHAU BENG THAI**  
TECHNICAL EXECUTIVE

A handwritten signature in black ink, appearing to read "Dr. Yu Yonghe".

---

**DR YU YONGHE**  
ASSISTANT VICE PRESIDENT  
INSPECTION & FAILURE ANALYSIS CENTRE



Fig. 1. General view of the bi-metallic connector as received.

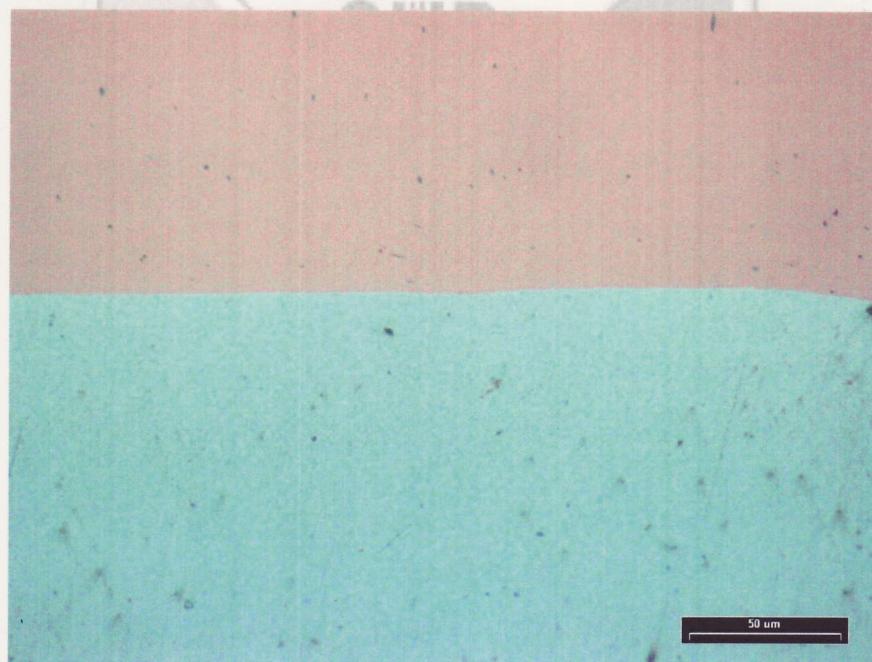


Fig. 2. Microstructure of the friction weld surface.



PSB Singapore

**This Report is issued under the following conditions:**

1. Results of the testing/calibration in the form of a report will be issued immediately after the service has been completed or terminated.
2. Unless otherwise requested, this report shall contain only technical results carried out by TÜV SÜD PSB. Analysis and interpretation of the results and professional opinion and recommendations expressed thereupon, if required, shall be clearly indicated and additional fee paid for, by the Client.
3. This report applies to the sample of the specific product/equipment given at the time of its testing/calibration. The results are not used to indicate or imply that they are applicable to other similar items. In addition, such results must not be used to indicate or imply that TÜV SÜD PSB approves, recommends or endorses the manufacturer, supplier or user of such product/equipment, or that TÜV SÜD PSB in any way "guarantees" the later performance of the product/equipment. Unless otherwise stated in this report, no tests were conducted to determine long term effects of using the specific product/equipment.
4. The sample/s mentioned in this report is/are submitted/supplied/manufactured by the Client. TÜV SÜD PSB therefore assumes no responsibility for the accuracy of information on the brand name, model number, origin of manufacture, consignment or any information supplied.
5. Additional copies of the report are available to the Client at an additional fee. No third party can obtain a copy of this report through TÜV SÜD PSB, unless the Client has authorised TÜV SÜD PSB in writing to do so.
6. TÜV SÜD PSB may at its sole discretion add to or amend the conditions of the report at the time of issue of the report and such report and such additions or amendments shall be binding on the Client.
7. All copyright in the report shall remain with TÜV SÜD PSB and the Client shall, upon payment of TÜV SÜD PSB's fees for the carrying out of the tests/calibrations, be granted a license to use or publish the report to the third parties subject to the terms and conditions herein, provided always that TÜV SÜD PSB may at its absolute discretion be entitled to impose such conditions on the license as it sees fit.
8. Nothing in this report shall be interpreted to mean that TÜV SÜD PSB has verified or ascertained any endorsement or marks from any other testing authority or bodies that may be found on that sample.
9. This report shall not be reproduced wholly or in parts and no reference shall be made by the Client to TÜV SÜD PSB or to the report or results furnished by TÜV SÜD PSB in any advertisements or sales promotion.
10. Unless otherwise stated, the tests were carried out in TÜV SÜD PSB Pte Ltd, No.1 Science Park Drive Singapore 118221.

March 2010

**Test Report No. 719185517-MEC10-01-CYW**  
dated 21 SEP 2010

**Note:** This report is issued subject to TÜV SÜD PSB's "Terms and Conditions Governing Technical Services".  
The terms and conditions governing the issue of this report are set out as attached within this report.



PSB Singapore

Choose certainty.  
Add value.

**SUBJECT:**

Testing of Ø 14.30 mm (5/8") x 1800mm "Copper-Bonded Earth Rod" submitted  
by Tan Teck Seng Electric Company Pte Ltd on 31/08/2010.

**TESTED FOR:**

Tan Teck Seng Electric Company Pte Ltd  
137 Kaki Bukit Avenue 1  
Shun Li Industrial Park  
Singapore 416003

Attn : Ms. Annie

**TEST METHOD:**

UL 467 : 2004 Standard for grounding and bonding equipment

**SAMPLE DESCRIPTION:**

One piece of Ø 14.30 mm (5/8") x 1800mm copper-bonded earth rod said to be "EMTECH" brand  
Model:CR586E was received.

**TESTS CONDUCTED:**

1. Adherence Test
2. Bending Test
3. Tensile Test
4. Copper cladding thickness - Refer to 719185517-MEC10-2-SBT

*[Handwritten signatures]*



Laboratory:  
TÜV SÜD PSB Pte. Ltd.  
Testing Services  
No.1 Science Park Drive  
Singapore 118221

Phone : +65-6885 1333  
Fax : +65-6776 8670  
E-mail: testing@tuv-sud-psb.sg  
[www.tuv-sud-psb.sg](http://www.tuv-sud-psb.sg)  
Co. Reg : 199002667R

Regional Head Office:  
TÜV SÜD Asia Pacific Pte. Ltd.  
3 Science Park Drive, #04-01/05  
The Franklin, Singapore 118223  
**TÜV®**

**RESULTS:**

**(1) Adherence Test of Copper Jacket**

Sample Reference	Ø 14.30 mm (5/8") x 1800mm copper-bonded earth rod	UL 467 : 2004 Requirement (Clause 9.2.4)
An 18" length of the rod with one end cut 45° point was driven between two steel clamping plates on the jaws of a vise set 0.04" less than the diameter of the rod, so as to shear off sufficient metal to expose the bond between the jacket and rod.	Passed	Peeling of the jacket by the steel plates or the jaws of the vise is acceptable, but there shall be no other evidence of separation of the jacket from the steel core.

**(2) Bending Test**

Sample Reference	Ø 14.30 mm (5/8") x 1800mm copper-bonded earth rod	UL 467 : 2004 Requirement (Clause 9.2.5)
A length of the rod was rigidly held in a clamp or vise and the free end bend by applying a force normal to the rod at a distance from the clamping device, equal to 40 times the rod diameter. The rod was permanently bent through a 30° angle.	Passed	Bending of the rod, there shall be no evidence of cracking of the jacket at room temperature.

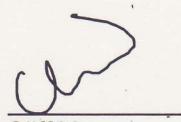
**(3) Reduced Section Tensile Test**

Sample Reference	Ø 14.30 mm (5/8") x 1800mm copper-bonded earth rod	CP 33:1996 Table 3.4 Requirements
Measured Diameter (mm)	8.78	-
Sectional area (mm <sup>2</sup> )	60.55	-
Tensile strength (N/mm <sup>2</sup> )	581	Approx. 600
Elongation (%)	14	-

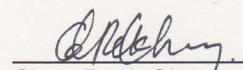
Note: The tensile test specimen was machined from the copper-bonded earth rod sample longitudinally.

**CONCLUSION:**

The above results of the tested sample meet the requirements of UL 467 : 2004 & CP 33:1996 Specification.



Cliff Yew  
Associate Engineer



Chua Peck Cheong  
Product Manager  
Automotive & Industrial Group  
Mechanical Centre



PSB Singapore

**This Report is issued under the following conditions:**

1. Results of the testing/calibration in the form of a report will be issued immediately after the service has been completed or terminated.
2. Unless otherwise requested, a report shall contain only technical results. Analysis and interpretation of the results and professional opinion and recommendations expressed thereupon, if required, shall be clearly indicated and additional fee paid for, by the Client.
3. This report applies to the sample of the specific product/equipment given at the time of its testing/calibration. The results are not used to indicate or imply that they are applicable to other similar items. In addition, such results must not be used to indicate or imply that TÜV SÜD PSB approves, recommends or endorses the manufacturer, supplier or user of such product/equipment, or that TÜV SÜD PSB in any way "guarantees" the later performance of the product/equipment.
4. The sample/s mentioned in this report is/are submitted/supplied/manufactured by the Client. TÜV SÜD PSB therefore assumes no responsibility for the accuracy of information on the brand name, model number, origin of manufacture, consignment or any information supplied.
5. Additional copies of the report are available to the Client at an additional fee. No third party can obtain a copy of this report through TÜV SÜD PSB, unless the Client has authorised TÜV SÜD PSB in writing to do so.
6. TÜV SÜD PSB may at its sole discretion add to or amend the conditions of the report at the time of issue of the report and such report and such additions or amendments shall be binding on the Client.
7. All copyright in the report shall remain with TÜV SÜD PSB and the Client shall, upon payment of TÜV SÜD PSB's fees for the carrying out of the tests/calibrations, be granted a license to use or publish the report to the third parties subject to the terms and conditions herein, provided always that TÜV SÜD PSB may at its absolute discretion be entitled to impose such conditions on the license as it sees fit.
8. Nothing in this report shall be interpreted to mean that TÜV SÜD PSB has verified or ascertained any endorsement or marks from any other testing authority or bodies that may be found on that sample.
9. This report shall not be reproduced wholly or in parts and no reference shall be made by the Client to TÜV SÜD PSB or to the report or results furnished by TÜV SÜD PSB in any advertisements or sales promotion.
10. Unless otherwise stated, the tests are carried out in TÜV SÜD PSB Pte Ltd, No.1 Science Park Drive Singapore 118221.

March 2010

**Test Report No. 719185517-MEC10-2-SBT**  
dated 24 SEP 2010

**Note:** This report is issued subject to TÜV SÜD PSB's "Terms and Conditions Governing Technical Services".  
The terms and conditions governing the issue of this report are set out as attached within this report.



PSB Singapore

Choose certainty.  
Add value.

**COPPER THICKNESS MEASUREMENT**

**CLIENT**

Tan Teck Seng Electric Company Pte Ltd  
137, Kaki Bukit Avenue 1  
Shun Li Industrial Park  
Singapore 416003

Attn: Ms Annie

\*\*\*\*\*

**DESCRIPTION**

One piece of Ø14.30mm x 1800mm copper cladding earth rod sample was submitted to Inspection & Failure Analysis Centre of TÜV SÜD PSB on 24/09/2010 for copper thickness measurement in accordance to UL 467: 2004. Following informations regarding the sample was given by the client.

Product: Copper Bonded Earth Rod  
Brand: Emtech  
Model: CR586E  
Standard: UL 467

The copper thickness shall not be less than 250µm (0.25mm) at any point.



TUV SUD PSB

Laboratory:  
TÜV SÜD PSB Pte. Ltd.  
No.1 Science Park Drive  
Singapore 118221

Phone : +65-6885 1333  
Fax : +65-6776 8670  
E-mail: testing@tuv-sud-psb.sg  
www.tuv-sud-psb.sg  
Co. Reg : 199002667R

Regional Head Office:  
TÜV SÜD Asia Pacific Pte. Ltd.  
3 Science Park Drive, #04-01/05  
The Franklin, Singapore 118223  
**TUV®**

## METHOD OF TEST

The thickness measurement was conducted according to UL 467: 2004, the testing method of ASTM B487-2007. The thickness measurement was carried out using an optical microscope under a magnification of 200X.

## RESULTS

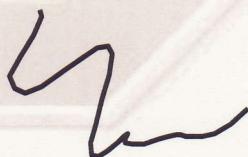
The copper thickness measurement results are given in Table 1.

Table 1: Copper thickness results of earth rod sample

Test Point	Copper Thickness ( $\mu\text{m}$ )
1	353.5
2	363.2
3	323.0
4	469.3
5	333.4
6	418.7
7	327.9
Average	369.8



**SHAU BENG THAI**  
TECHNICAL EXECUTIVE



**DR YU YONGHE**  
ASSISTANT VICE PRESIDENT  
INSPECTION & FAILURE ANALYSIS CENTRE

This Report is issued under the following conditions:

1. Results of the testing/calibration in the form of a report will be issued immediately after the service has been completed or terminated.
2. Unless otherwise requested, this report shall contain only technical results carried out by TÜV SÜD PSB. Analysis and interpretation of the results and professional opinion and recommendations expressed thereupon, if required, shall be clearly indicated and additional fee paid for, by the Client.
3. This report applies to the sample of the specific product/equipment given at the time of its testing/calibration. The results are not used to indicate or imply that they are applicable to other similar items. In addition, such results must not be used to indicate or imply that TÜV SÜD PSB approves, recommends or endorses the manufacturer, supplier or user of such product/equipment, or that TÜV SÜD PSB in any way "guarantees" the later performance of the product/equipment. Unless otherwise stated in this report, no tests were conducted to determine long term effects of using the specific product/equipment.
4. The sample/s mentioned in this report is/are submitted/supplied/manufactured by the Client. TÜV SÜD PSB therefore assumes no responsibility for the accuracy of information on the brand name, model number, origin of manufacture, consignment or any information supplied.
5. Additional copies of the report are available to the Client at an additional fee. No third party can obtain a copy of this report through TÜV SÜD PSB, unless the Client has authorised TÜV SÜD PSB in writing to do so.
6. TÜV SÜD PSB may at its sole discretion add to or amend the conditions of the report at the time of issue of the report and such report and such additions or amendments shall be binding on the Client.
7. All copyright in the report shall remain with TÜV SÜD PSB and the Client shall, upon payment of TÜV SÜD PSB's fees for the carrying out of the tests/calibrations, be granted a license to use or publish the report to the third parties subject to the terms and conditions herein, provided always that TÜV SÜD PSB may at its absolute discretion be entitled to impose such conditions on the license as it sees fit.
8. Nothing in this report shall be interpreted to mean that TÜV SÜD PSB has verified or ascertained any endorsement or marks from any other testing authority or bodies that may be found on that sample.
9. This report shall not be reproduced wholly or in parts and no reference shall be made by the Client to TÜV SÜD PSB or to the report or results furnished by TÜV SÜD PSB in any advertisements or sales promotion.
10. Unless otherwise stated, the tests were carried out in TÜV SÜD PSB Pte Ltd, No.1 Science Park Drive Singapore 118221.

March 2010

# TEST REPORT: 7191104214-CHM14-KPF

Date: 29 DEC 2014

Tel: +65 68851291 Fax: +65 67784301

Client's Ref:

Email: huayi.chen@tuv-sud-psb.sg

**Note:** This report is issued subject to the Testing and Certification Regulations of the TÜV SÜD Group and the General Terms and Conditions of Business of TÜV SÜD PSB Pte Ltd. In addition, this report is governed by the terms set out within this report.



PSB Singapore

Choose certainty.  
Add value.

## SUBJECT

Load test on an earth inspection pit

## CLIENT

TAN TECK SENG ELECTRIC COMPANY PTE LTD  
Shun Li Industrial Park  
137 Kaki Bukit Ave 1  
Singapore 416003

Attn: Annie

## SAMPLE SUBMISSION DATE

29 DEC 2014

## DESCRIPTION

One piece of earth inspection pit with hot dipped galvanised cover with rod and was submitted for the load test.

## METHOD OF TEST

The earth inspection pit test sample was placed on the testing frame of the universal testing machine. Compressive load was applied incrementally via a test block of 210 x 200 mm in dimension. Deflection on the earth pit test sample was recorded at every increment of 5kN until the maximum load of 50kN was attained. Visual inspection was conducted for any sign of deformation to the test sample.



Laboratory:  
TÜV SÜD PSB Pte. Ltd.  
No.1 Science Park Drive  
Singapore 118221

Phone : +65-6885 1333  
Fax : +65-6776 8670  
E-mail: testing@tuv-sud-psb.sg  
www.tuv-sud-psb.sg  
Co. Reg : 199002667R

Regional Head Office:  
TÜV SÜD Asia Pacific Pte. Ltd.  
3 Science Park Drive, #04-01/05  
The Franklin, Singapore 118223  
**TÜV®**

**RESULT**

Load (kN)	Measured top deflection (mm)
0	0
5	0.17
10	0.38
15	0.56
20	0.73
25	0.90
30	1.09
35	1.32
40	1.55
45	1.83
50	2.13
Permanent set after 5 min of removable load	1.22

**REMARKS**

No visible deformation was observed after the removal of load.

  
**MS KOH PEI FEN**  
 TECHICAL EXECUTIVE  
 ELEMENTAL ANALYSIS  
 CHEMICAL & MATERIALS

  
**DR CHEN HUAYI**  
 ASSISTANT VICE PRESIDENT  
 ELEMENTAL / ENVIRONMENTAL ANALYSIS  
 CHEMICAL & MATERIALS

# TEST REPORT: 7191104214-CHM14-KPF

29 DEC 2014



PSB Singapore

Please note that this Report is issued under the following terms :

This report applies to the sample of the specific product/equipment given at the time of its testing/calibration. The results are not used to indicate or imply that they are applicable to other similar items. In addition, such results must not be used to indicate or imply that TÜV SÜD PSB approves, recommends or endorses the manufacturer, supplier or user of such product/equipment, or that TÜV SÜD PSB in any way "guarantees" the later performance of the product/equipment. Unless otherwise stated in this report, no tests were conducted to determine long term effects of using the specific product/equipment.

The sample/s mentioned in this report is/are submitted/supplied/manufactured by the Client. TÜV SÜD PSB therefore assumes no responsibility for the accuracy of information on the brand name, model number, origin of manufacture, consignment or any information supplied.

Nothing in this report shall be interpreted to mean that TÜV SÜD PSB has verified or ascertained any endorsement or marks from any other testing authority or bodies that may be found on that sample.

This report shall not be reproduced wholly or in parts and no reference shall be made by the Client to TÜV SÜD PSB or to the report or results furnished by TÜV SÜD PSB in any advertisements or sales promotion.

Unless otherwise stated, the tests were carried out in TÜV SÜD PSB Pte Ltd, No.1 Science Park Drive Singapore 118221.

July 2011

