CPRI

TEST REPORT

Central Power Research Institute

(A Govt.of India Society,)
P.B. No.8066, Sadashivanagar Post Office
Prof. Sir.C.V. Raman Road,
Bangalore - 560 080(INDIA)

CENTRAL POWER RESEARCH INSTITUTE

CPRI

TEST REPORT

Test Report Number	: DCCD- 13339 **Dated** : 01.07.2013
Name & Address of the Customer	: M/S. KEC International Ltd.,(Cables division) Plot No. 803 ,Samlaya Savli Road ,Village-Godampura Taluka-Savli,Vadodara -Gujarat-391520
Name & Address of the Manufacturer	: M/S. KEC International Ltd.,(Cables division) Plot No. 803 ,Samlaya Savli Road ,Village-Godampura Taluka-Savli,Vadodara -Gujarat-391520
Particulars of sample tested	: 1 X 1000mm^2 38/66 kV(E) XLPE Cable,
Condition of the sample on receipt	: New.
Type	: A2XA2Y
Designation	: Conductor Material : Aluminium (water tight) No. of cores : One Size : 1000 mm^2 Insulation: XLPE Metallic Sheath : Corrugated Aluminium Outer sheath : PE Voltage Rating : 38/66 kV Declared Capacitance : 0.316 µF/km + 8 % Embossing :KEC INTERNATIONAL LTD(RPG) 38/66 KV 1X 1000 SQ.MM AL XLPE PE 2013 PROPERTY OF TATA POWER DELHI DISTRIBUTION LTD
Serial Number	: Nil
Number of Samples tested	: One
Date(s) of Test(s)	: 03.04.2013 to 28.06.2013
CPRI Sample Code no(s)	: DCCDCAB13S0022
Particulars of test conducted	: Complete Type Test
Test in accordance with Standard /Specification	:IEC 60840 -2011 and IS 7098 Part-III- 1993 , Am1 to Am4-2013
Sampling plan	: Not Applicable
Customer's requirement	: Impulse test at 350 kVP
Deviation if any	: Nil

(Thirumurthy)
TEST ENGINEER

(K.Mallikarjunapp)
Joint Director

CENTRAL POWER RESEARCH INSTITUTE

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Test Report No.:DCCD-13339

Date: 01.07.2013

Name of the witnessing persons

Customer's representatives	: None
Other than customer's representatives	: None
Test subcontracted with address of the laboratory	: Nil

Documents constituting this report (in words)

Number of sheets	: Ten + One Report of Three pages
Number of oscillogram/s	: Four(One Sheets)
Number of graphs	: Nil
Number of photos	: Nil
Number of test circuit diagrams	: Nil
Number of drawings	: One.Drg.No.:XLPE/1/EHV/AL-CORR/NDPL

(Thirumurthy)
TEST ENGINEER

(K.Mallikarjunappa)
Joint Director

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Date: 01.07.2013

TEST RESULTS

I.TESTS ON CONDUCTOR

1. Conductor Resistance Test:

a) Specified value (max) :0.0291 Ω/Km at 20 ^{0} C
b) Observed value : 0.02856 Ω/Km at 20 ^{0} C

2. Conductor examination test:

a) Specified No. of conductor Strands : 53(Min)
b) Observed No. of conductor Strands : 80

II.TESTS ON INSULATION:

1.Test for Thickness of insulation

(i) Specified Average : 11.0 mm
(ii) Observed Averge : 11.131 mm
(iii) Specified Minimum : 9.90 mm
(iv) Observed Minimum : 11.059 mm
(v) Variation of thickness $((t_{max} - t_{min})/t_{max})$
a) Specified : 0.10 (max)
b) Observed : 0.0106
(vi) Test for Ovality
a) Specified : 5 %(max)
b) Observed : 0.19 %

2.Tensile strength and Elongation at Break:

A) Before Ageing:

a) Specified Tensile Strength (Min) : 12.5 N/mm^2
b) Specified Elongation at Break (Min): 200 %
c) Observed Tensile Strength : 18.87 N/mm^2
d) Observed Elongation at break : 593.45 %

B) Ageing :

a) Sample : Dumb-bell specimens
b) Temperature : 135 ± 3 ^{0}C
c) Duration : 168 hours

C) After Ageing:

a) Observed Tensile Strength : 20.35 N/mm^2
b) Elongation at break : 527.00 %

D) Variations observed from before ageing samples:

a) Specified percentage variations (Max):± 25 %
b) Observed percentage variations:
Tensile strength : 7.89 %
Elongation at break : -11.20 %

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E) After Completed Cable Ageing:

Ageing conditions:

a) Sample : 200 mm of Completed cable
b) Duration : 168 hours
c) Temperature : 100 ± 2°C

F) After Completed Cable Ageing:

Observed Values:

a) Observed Tensile Strength : 19.96 N/mm^2
b) Elongation at break : 592.60 %

G) Variations observed from before ageing samples:

a) Specified percentage variations (Max) : ± 25 %
b) Observed percentage variations:
Tensile strength : 5.83%
Elongation at break : -0.14%

3. Shrinkage Test:

i) Sample length : 200 mm
ii) Test temperature : 130 ± 3 ^{0} C
iii) Duration of test : Six Hours
iv) Specified shrinkage allowed (Max) : 4 %
v) Observed shrinkage : 1.53%

4. Hot Set Test:

i) Test temperature : 200 ± 3 ^{0} C
ii) Load applied : 20 N/cm^2
iii) Time under load : 15 minutes
iv) Specified Hot set elongation at 200 ^{0} C (Max) :175.0%
v) Specified Permanent set elongation after cooling (Max) :15.0 %
vi) Observed Hot set elongation at 200 ^{0} C : 99.5 %
vii) Observed permanent set elongation : 0.20%

III. TEST ON SEMICONDUCTING LAYERS:

1. Thickness of Conductor Semiconducting Screen:

a) Specified Minimum : 0.80 mm
b) Observed Minimum : 1.0946 mm

2. Thickness of Insulation Semiconducting Screen:

a) Specified Minimum : 0.80 mm
b) Observed Minimum : 1.058 mm

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3. Resistivity Test for Semiconducting layers:

a) Temperature during measurement: 90 ^{0} C

b) Specified Resistivity

i) For conductor screen : 1000 Ω -metre (Max)

ii) For insulation screen : 500 Ω-metre (Max)

c) Observed values:

Sl.No	Sample	Resistivity in Ω-metre	
		Unaged	Aged at 100 ± 2 Deg.C for 168 hours
1	Conductor Screen	5.36	1.29
2	Insulation screen	5.02	8.07

IV. TESTS ON OUTER SHEATH (PE)

1. Dimension of outer sheath

a) Specified minimum thickness : 2.68 mm

b) Observed minimum thickness : 5.07 mm

c) Specified Nominal thickness : 3.60 mm

d) Observed Nominal thickness : 5.22 mm

2. TENSILE STRENGTH AND ELONGATION AT BREAK

A. BEFORE AGEING

a) Specified Tensile Strength (Min) : 12.5 N/mm^2

Elongation at Break (Min) : 300 %

b) Observed Tensile Strength : 21.68 N/mm^2

Elongation at Break :799.00 %

B. AGEING

a) Sample :Dumb-bell specimens

b) Temperature :110 ± 2 ^{0} C

c) Duration :336 Hours

C. AFTER AGEING

a) Specified Elongation at Break (Min) : 300 %

b) Observed Tensile Strength : 23.75 N/mm^2

c) Observed Elongation at Break : 756.85 %

D. AFTER COMPLETED CABLE AGEING:

i) Ageing conditions:

a) Sample : 200 mm of Completed cable

b) Duration : 168 hours

c) Temperature : 100 ± 2°C

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E) Observed Values:

a) Specified Elongation at Break (Min) : 300 %
b) Observed Tensile Strength : 19.33 N/mm^2
c) Elongation at break : 769.10 %

3. HOT DEFORMATION TEST

a) Specified Percentage depth of indentation : 50 % (Max)
b) Observed Percentage depth of indentation :3.09 %

4. CARBON BLACK CONTENT TEST:

As per DMD Test Report No. DMDPOL12G057 Dated 28/6/2012 (Enclosed)

5. Shrinkage Test:

i) Sample length : 500 mm
ii) Test temperature : 80 ± 2 ^{0} C
iii) Duration of Heating : 5 hours
iv) Number of Heating cycles: Five
v) Specified shrinkage allowed (Max) : 3 %
vi) Observed shrinkage : 1.41%

V. TESTS ON METALLIC SHEATH:

1. Test for Thickness of corrugated Aluminium sheath:

a) Specified minimum thickness : 2.30 mm
b) Observed minimum thickness : 2.78 mm

VI. Longitudinal Water Tightness Test:

a) Bending test:

An eight metre length of completed cable was subjected for bending test under the following parameters.

(i) Diameter of conductor : 37.67 mm
(ii) Diameter of Cable : 91.81 mm
(iii) Diameter of test cylinder :3300 mm
(iv) Number of bending cycles : Three

b) A six metre long cable was cut from the cable sample which has been subjected to the bending test and placed horizontally. A ring approx. 50 mm wide was removed from the centre of the length up to the Conductor. A suitable water enclosure with tube of 10 mm diameter was so arranged as to position the tube vertically above the ring. The enclosure was filled with water so that the water level in the tube was maintained at 1 metre height above the cable axis. The sample was subjected to heating cycle as given below, after allowing it to remain for 24 hours.

i) Length of cable :6 metres
ii) No. of heating cycles : 10
iii) Duration of heating : 8 hours
iv) Temperature of the Conductor during heating cycle : 95 - 100 ^{0} C
v) Duration of cooling : 16 hours
vi) Result : No traces of water were observed at the ends of the sample during the test and after the test.

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VII. ELECTRICAL TESTS:

The following tests were carried out in the order of sequence.

1. Bending Test :

(i) Diameter of conductor	: 37.67 mm
(ii) Diameter of Cable	: 91.81 mm
(iii) Diameter of test cylinder	: 3300 mm
(iv) Number of bending cycles	: Three

After bending test, the cable was provided with two Heat Shrink outdoor Terminations at both ends and subjected to the following tests.

2. Partial Discharge Test:

a) Length of the sample	: 19 metres (Including terminations)
b) Sensitivity of the detector	: 5 pC
c) Status of the sample	: Cable with Heat Shrink Terminations
d) Method of connection	: High voltage applied to conductor and metallic sheath grounded

e) Pre stressed voltage for 10 sec (1.75 Uo): 67 kV ac
f) Measuring voltage (1.5 Uo) : 57 kV ac
g) Specified discharge magnitude at 1.5 Uo (Max) : 5 pC
h) Observed Discharge magnitude: Less than 5 pC

3. Dielectric Power Factor Measurement: At ambient temperature

(i) Temperature during Measurement	: 28 Deg.C
(ii) Test Voltage	: 38 kV ac
(iii) Specified tan delta at Uo (Max) absolute	: 0.0010
(iv) Observed tan delta at Uo absolute	: 0.00058

4. Measurement of Capacitance:

(i) Ambient Temperature	: 28 ^{0}C
(ii) Test Voltage	: 38 kV ac
(iii) Declared Capacitance (Max)	: 0.316 μF/km + 8 %
(iv) Observed Capacitance at Uo	: 0.298 μF/km

5. Dielectric Power Factor Measurement at Elevated Temperature:

(i) Temperature of Conductor during Measurement	: 100 to 105 ^{0}C
(ii) Test Voltage	: 38 kV ac
(iii) Specified tan delta at Uo (Max) absolute	: 0.0010
(iv) Observed tan delta at Uo absolute	: 0.00063

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6. Heating Cycle Voltage Test:

a) The following test conditions were maintained during each heating cycle voltage test on the cable sample installed with two Heat Shrink terminations . The test sample was laid on the floor with an U- bend of 3300 mm diameter.

i) Duration of heating cycle voltage test : 24 hours
ii) Duration of heating period : 8 hours
iii) Duration of natural cooling period : 16 hours
iv) Temperature of the conductor during heating cycle : 100 to 105 ^{0}C
v) AC voltage applied through out the heating cycle voltage test : 76 kV ac
vi) Total number of heating cycle voltage test : 20

b). RESULT : No Breakdown occurred during the heating cycle test, withstood.

7. Partial Discharge Test at ambient Temperature:

a) Length of the sample : 19 metres (Including terminations)
b) Sensitivity of the detector : 5 pC
c) Status of the sample : Cable with Heat Shrink terminations
d) Method of connection : High voltage applied to conductor and metallic sheath grounded
e) Temperature of Conductor during test : 28 Deg. C
f) Pre stressed voltage for 10 sec (1.75 Uo): 67 kV ac
g) Measuring voltage (1.5 Uo) : 57 kV ac
h) Specified discharge magnitude at 1.5 Uo (Max) : 5 pC
i) Observed Discharge magnitude : Less than 5 pC

8. Impulse Withstand Test:

Test Voltage kV peak	Temperature of Conductor During Test(^{0}C)	Ambient Temperature (^{0}C)		No. of Impulses
		Dry Bulb	Wet Bulb	
350	100 to 105	28.0	25	10 Positive & 10 Negative

Test Connection	The impulse source was connected to the conductor and the screen connected to ground.

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Date: 01.07.2013 CPRI

Polarity	Shot Number	Oscillogram Number	Test Result
Positive	First	1527	Withstood
	Tenth	1538	
Negative	First	1542	
	Tenth	1552	

(OSCILLOGRAMS ENCLOSED)

9. High Voltage Test after Impulse Withstand Test:

a) Test connection : High voltage applied to conductor and metallic sheath grounded
b) Test Voltage : 95 kV ac
c) Duration of test : 15 minutes
d) Ambient Temperature : 28 ^{0}C
e) Length of the sample : 19.0 metres
f) Result : Withstood

VIII) Conclusion : The cable sample submitted meets the requirement of all type test as per IS 7098(Part-3)- 1993 with amendments 1 to 4 and IEC 60840-2011.

(Thirumurthy)
TEST ENGINEER

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NOTE

a) The Test results relate only to the item(s) tested.

b) Publication or reproduction of this test report in any form other than by complete set of the whole test report and in the language written, is not permitted without the written consent of CPRI.

c) Any Corrections/erasure invalidates this test Report.

d) NABL has Accredited this laboratory as per ISO 17025-2005, Vide Certificate No. T-0010 for the tests carried out.

e) Any anomaly/discrepancy in this test report should be brought to our notice within 45 days from the date of issue.

(Thirumurthy)
TEST ENGINEER

CENTRAL POWER RESEARCH INSTITUTE

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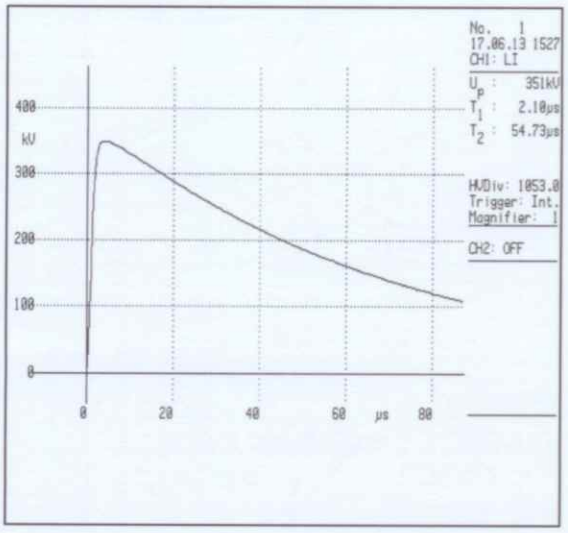
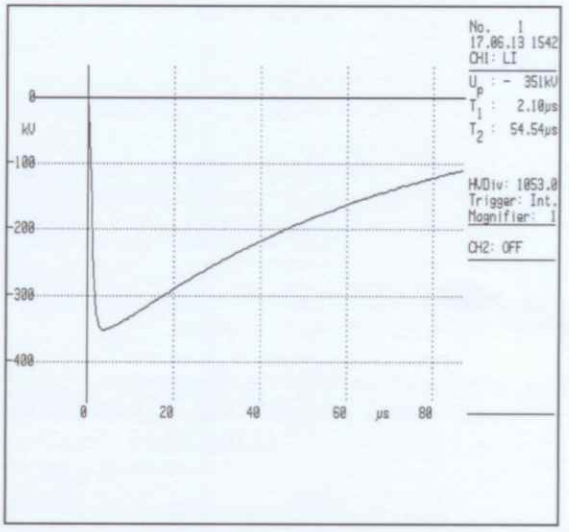
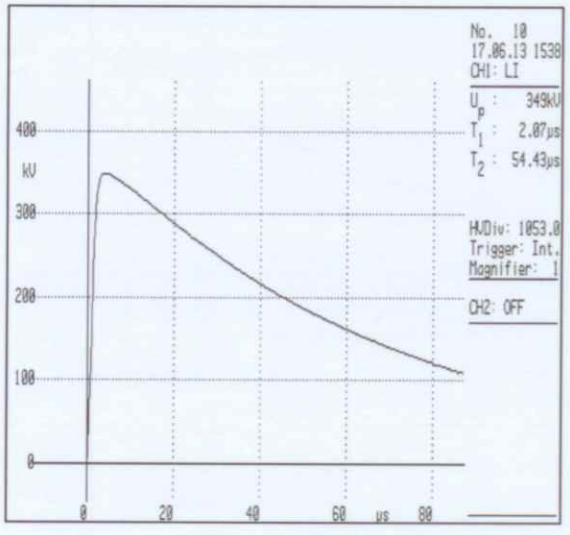
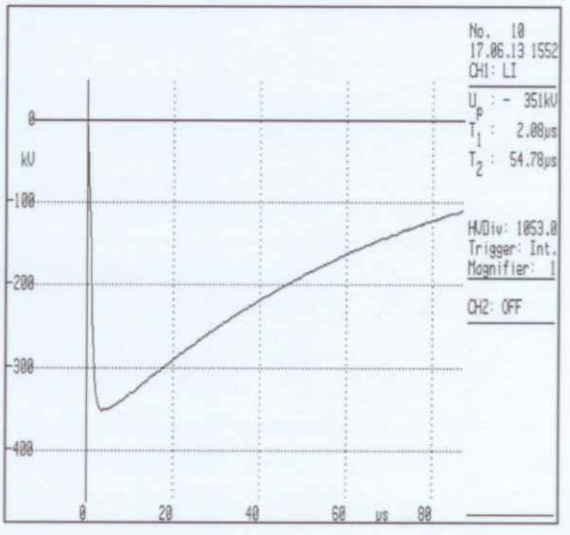
Customer : M/S. KEC International Ltd., Gujarat
Test Report No.& Date : DCCD-13339 Dated: 01.07.2013
Sample Code : DCCDCAB13S0022









(Thirumurthy)
TEST ENGINEER

DIAGNOSTIC, CABLES & CAPACITORS DIVISION
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CENTRAL POWER RESEARCH INSTITUTE

CPRI

TEST REPORT

Test Report Number	: DMDPOL13G0050.
Dated	: 28.06.2013.
Name & Address of the Customer	: M/s. KEC International Ltd., (Cables Div), Vadodara, Gujarat.
Customer Reference & Date	: 2/2/DCCD(Cab)/2013-14, dtd. 24.05.2013.
Name & Address of the Manufacturer	: M/s. KEC International Ltd., (Cables Div), Vadodara, Gujarat.
Particulars of Sample tested	: HDPE outer sheath of 1 x 1000 sq.mm Aluminium Conductor, XLPE Insulated, Corrugated Aluminium Sheathed, PE sheathed 38/66 kV Cable.
Condition of Sample on Receipt	: New
Type	: Nil
Designation	: HDPE outer sheath
Serial No.	: Nil
No. of Samples tested	: One only
Sample(s) received on	: 24.05.2013
Date(s) of Test(s)	: 27.06.2013 & 28.06.2013
CPRI Sample Code No.	: DCCDCAB13S0022
Particulars of tests conducted	: Carbon black content test
Tests in accordance with standard/Specification	: As per TGA method (IEC:60811- 4-1)
Sampling Plan	: - - - - -
Customer's requirement	: As per above standard
Deviation if any	: Nil
Name of the witnessing persons	
Customer's Representatives	: None
Other than customer's representatives	: None
Test Subcontracted with address of the laboratory	: None
Documents constituting this report (in words)	:
Number of sheets	: Three only.
Number of Oscillogram/s	: Nil
Number of graphs	: Two only.
Number of photos	: Nil
Number of Test Circuit Diagrams	: Nil
Number of Drawings	: Nil

(Dr. P. Thomas)
Test Engineer

(V. V.Pattanshetti)
Joint Director

DIELECTRIC MATERIALS DIVISION
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CENTRAL POWER RESEARCH INSTITUTE

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TEST REPORT

Test report No. & Date : DMDPOL13G0050, dtd 28.06.2013.

Identification of the sample : Received the samples in plastic cover labeled as

HDPE outer sheath of 1 x 1000 sq.mm Aluminium Conductor,
XLPE Insulated, Corrugated Aluminium Sheathed,
PE sheathed 38/66 kV Cable.-
DCCDCAB13S0022 = DMDPOL13G0050.

Sl. No.	Particulars of the Test	Carbon Black Content, Wt. %		
		Trial 1	Trial 2	Average
1.	HDPE outer sheath DMDPOL13G0050	2.082	2.034	2.06

[Instrument Used : Thermogravimetric Analyser, Model : Q 500, Make : TA Instruments, Test Temperature : up to 850^{0}C under N_2 atmosphere & 20 deg/min Heating Rate and then from 850^{0}C to 950 ^{0}C under Synthetic Air atmosphere & 20 deg/min Heating Rate, Flow Rate: 60 ml/min]

(Dr. P. Thomas)
Test Engineer

DIELECTRIC MATERIALS DIVISION
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(Dr. P. Thomas)
Test Engineer

DIELECTRIC MATERIALS DIVISION
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PROF. SIR. C. V. RAMAN ROAD, BANGALORE - 560 080, INDIA
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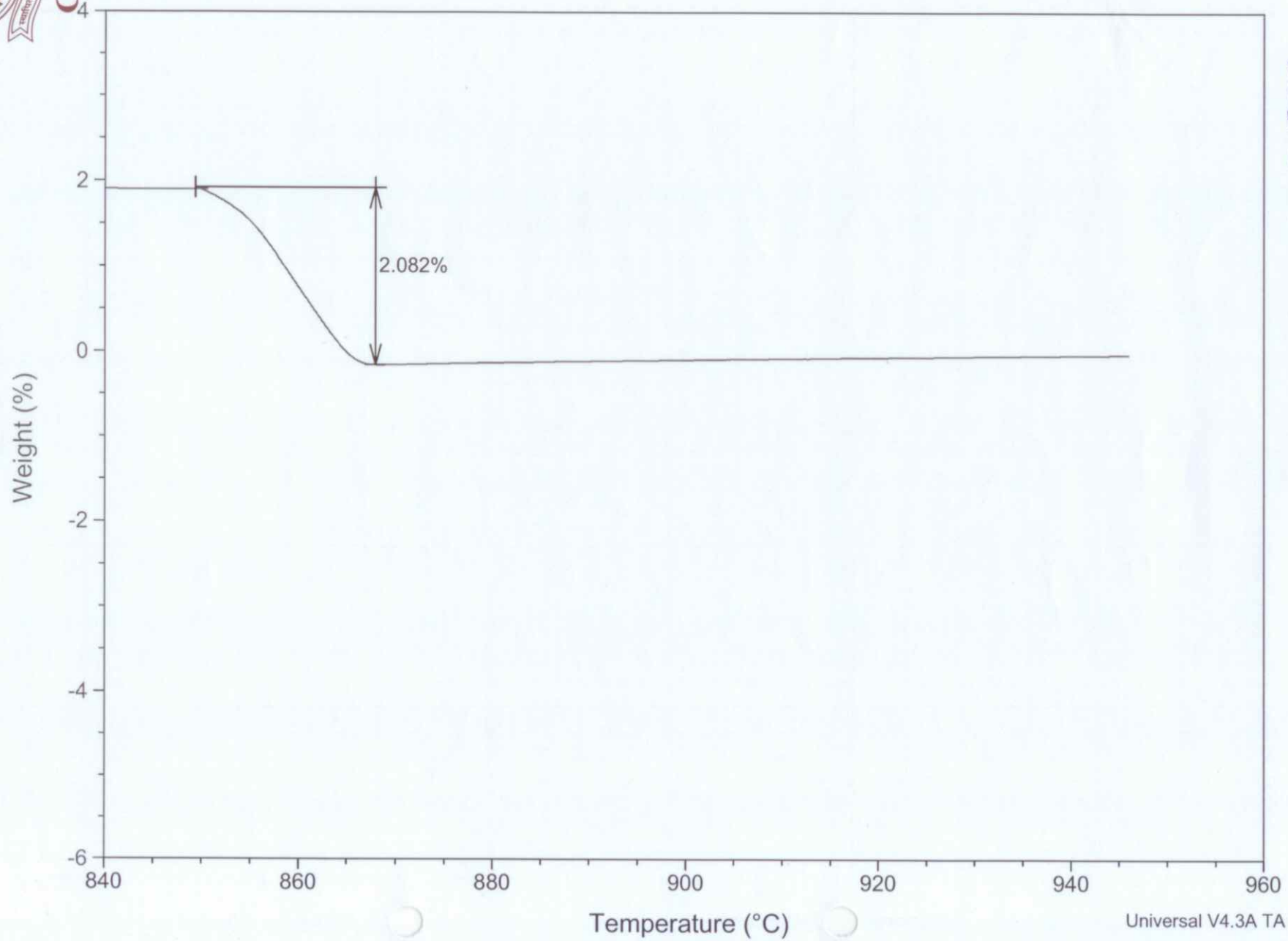
Sample: G0050
Size: 14.8080 mg
Method: CARBON BLACK IEC 60811

TGA

File: C:...\Administrator\Desktop\G0050-5
Operator: TA
Run Date: 27-Jun-2013 14:11
Instrument: TGA Q500 V20.2 Build 27

CPRI



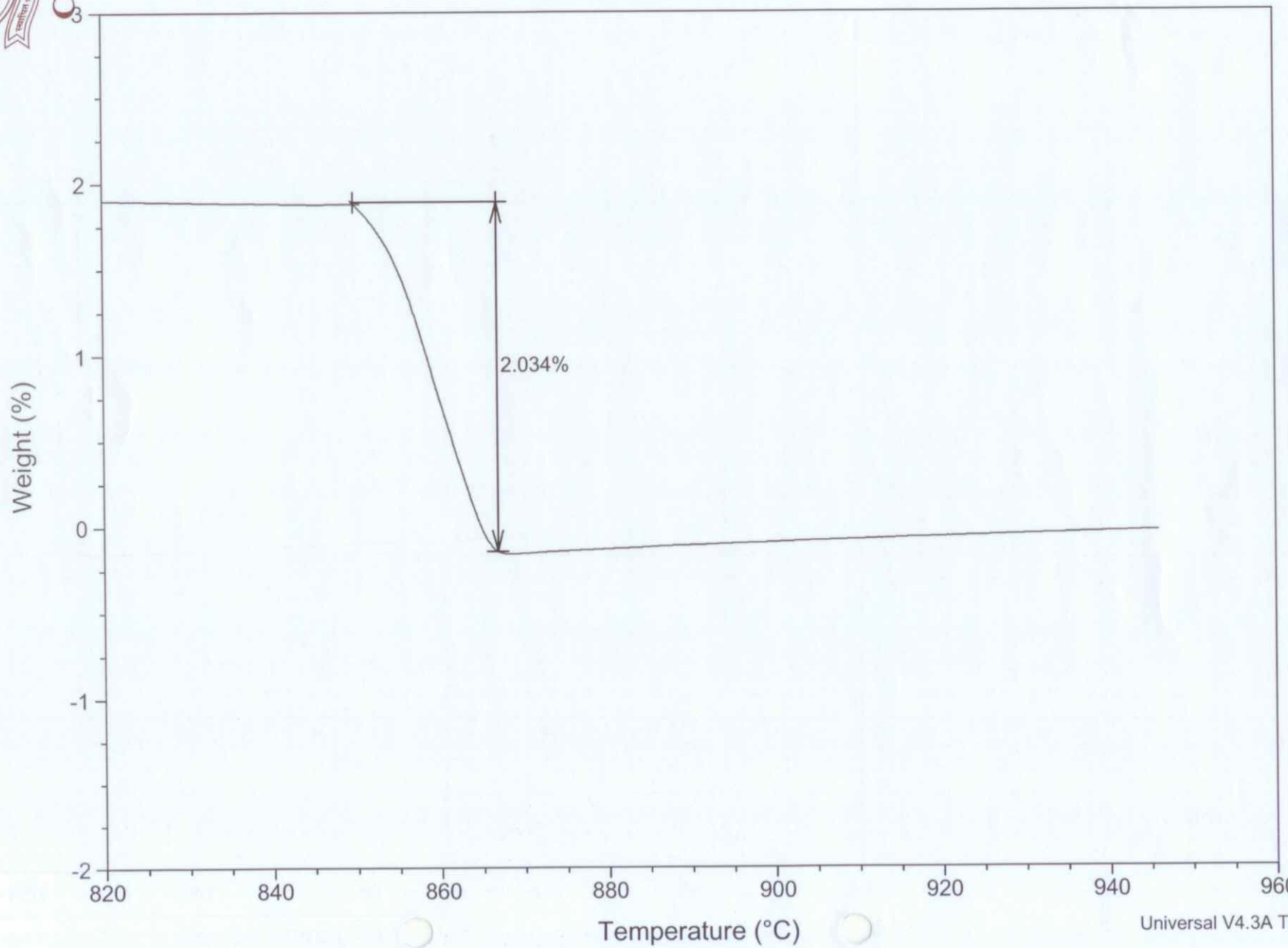
This Graph pertains to Test Report
DMDPOLI3G0050 Dt. 27-06-13

Universal V4.3A TA Instrum

Sample: G0050-910
Size: 14.9708 mg
Method: CARBON BLACK IEC 60811

TGA

File: D:\Data\TGA\DCCD\28.06.2013\G0050-10
Operator: TA
Run Date: 28-Jun-2013 17:11
Instrument: TGA Q500 V20.2 Build 27

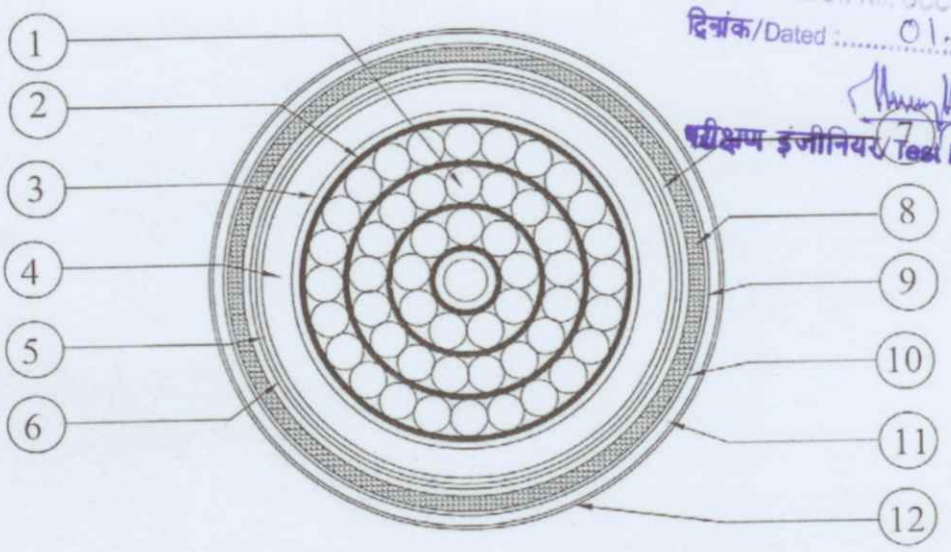


This Graph pertains to Test Report No. DMDPOL/13/0030 Dt. 28.06.13

Universal V4.3A TA Instrum

CROSS-SECTIONAL SKETCH OF 1 CORE XLPE EHV CABLE

यह ड्राइंग सीपीआरई की परीक्षण रिपोर्ट से संबंधित है।
THIS DRAWING PERTAINS TO CPRI TEST REPORT
सं. डीसीसीडी/No. DCCD: 13339
दिनांक/Dated : 01.07.2013
परीक्षण इंजीनियर/Test Engineer



1. Water Tight Aluminium Conductor ((Approx.) Ø 37.4 mm)
2. Semiconducting Tape ((Approx.) Ø 37.9 mm)
3. Semiconducting Compound ((Approx.) Ø 39.9 mm)
4. TR XLPE Insulation ((Approx.) Ø 62.3 mm)
5. Semiconducting Compound ((Approx.) Ø 64.3 mm)
6. Semicondcuting Water Blocking Tape ((Approx.) Ø 65.5 mm)
7. Semi conducting Cu Woven Water Blocking Tape ((Approx.) Ø 65.9 mm)
8. Corrugated Aluminium Sheath ((Approx.) Ø 81.4 mm)
9. Bitumen Compound
10. Compounded Textile Tape ((Approx.) Ø 82.2 mm)
11. PE Sheath Type ST 7 ((Approx.) Ø 89.4 mm)
12. PE Semicon Sheath ((Approx.) Ø 91 mm)

Voltage Grade : 38/66 KV **Cable Type :** **A2XA2Y(SEMICON PE)** **1 x 1000 mm2**	SCALE: N. T. S. DATE : 01.09.2012 DRAWN BY : PGD CHECKED BY : BS	**KEC INTERNATIONAL LTD** SKETCH NO : XLPE/1/EHV/AL-CORR/NDPL