
NATIONAL TRANSPORTATION SAFETY BOARD

Office of Research and Engineering
Materials Laboratory Division
Washington, D.C. 20594



9/21/2015

MATERIALS LABORATORY FACTUAL REPORTReport No. 15-101

A. ACCIDENT INFORMATION

Place : Washington, DC
Date : January 12, 2015 3:15 p.m. EST
Vehicle : WMATA train #302 Yellow Line
NTSB No. : DCA15FR004
Investigator : Robert Gordon

B. COMPONENTS EXAMINED

- 1) Sample of water taken from the leak through the tunnel liner.
- 2) Sample of water collected from the tunnel floor opposite the arcing location.
- 3) Sample of cable insulation from the incident cables.

C. DETAILS OF THE EXAMINATION

The water samples collected were tested for pH in the NTSB laboratory. Sample #1 measured 7.4 on the pH scale and sample #2 measured 7.6 on the pH scale. Further tests on the water samples, including ion chromatography¹, conductivity and resistivity² were performed by IMR and the results are attached to this report.

The sample of insulation was collected from one of the cables removed from the incident site. This sample was sent to IMR for thermogravimetric analysis (TGA) of the component layers. The results of that analysis are attached to this report.

Joseph Panagiotou
Fire & Explosion Investigator

¹ Method: CAP-017P (ICP-AES)

² Method: ASTM D 1125-14 Method A

IMR TEST LABS

A Curtiss-Wright Business Unit
www.imrtest.com

131 Woodsedge Drive
Lansing, NY 14882
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TEST REPORT

IMR Report Number 201506245A

May 27, 2015

Nancy McAtee
National Transportation
Safety Board
490 L'Enfant Plaza
Washington, DC 20594

SUMMARY

Two samples were received for Ion Chromatography analysis

The results are below.

PO Number
Credit Card

Date Received
May 14, 2015

Sample#
1-Water sample (flow thru
tunnel)
2 - Water sample (opposite
arcing location)

Sample ID
DCA15FR004

CHEMISTRY

Analyte	Sample #1	Sample #2
Bromide	0.1	0.2
Chloride	273	213
Fluoride	0.3	0.3
Nitrate	<0.1	2.0
Nitrite	<0.1	<0.1
Phosphate	<0.1	<0.1
Sulfate	14.2	10.5

Results in parts per million unless otherwise indicated.
Method(s): Modified ASTM D 4327-11 (IC)



Reviewed by



Lisa Wackowicz
Technical Operations Coordinator

Reviewed by



Brian Wackowicz
Senior Chemist

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TEST REPORT

Original Date
September 10, 2015

IMR Report Number 201510929 – Revision 1 (Additional Testing)

Revision Date
September 11, 2015

Nancy McAtee
National Transportation
Safety Board
490 L'Enfant Plaza
Washington, DC 20594

SUMMARY

Two samples were received for chemical analysis, conductivity and resistivity testing.

A 5 mL aliquot was taken of each sample and placed in individual beakers. The samples were taken to dryness on a hotplate. The resulting residue was digested with mixed acids and then brought up to a volume of 100 mL. The solutions were then analyzed by ICP-AES.

PO Number
Credit Card

Conductivity and resistivity were determined on the "as received" sample using ASTM D 1125-14. The conductivity measurement was made at 25.0° C. The resistivity was calculated from the sample's conductivity reading.

Date Received
August 28, 2015

Sample#
1, 2

The results are on the following page(s).



Reviewed by



Andy Ensign for Lisa Wackowicz
Technical Operations Coordinator

Reviewed by



Brian Wackowicz
Senior Chemist



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CHEMISTRY

Element	1	2
Ca	0.0078	0.0088
Fe	0.0021	0.0120
Mg	0.0017	0.0021
Na	0.0130	0.0110
Si	0.0018	0.0053

Other elements tested (<0.0005%): Ag, Al, As, Au, B, Ba, Be, Bi, Cd, Ce, Co, Cr, Cu, In, K, Li, Mn, Mo, Nb, Ni, P, Pb, Pd, Pt, Sb, Se, Sn, Sr, Ta, Te, Ti, Tl, V, W, Zn, & Zr.

Results in weight percent unless otherwise indicated.

Method(s): CAP-017P (ICP-AES)

CONDUCTIVITY AND RESISTIVITY

Parameter	1	2
Conductivity	1,154 $\mu\text{mho/cm}$	1,160 $\mu\text{mho/cm}$
Resistivity	866.6 $\Omega\cdot\text{cm}$	862.1 $\Omega\cdot\text{cm}$

Conductivity result in $\mu\text{mho/cm}$ (micromhos/centimeter) and resistivity result in $\Omega\cdot\text{cm}$ (ohm centimeters).

Note that $\mu\text{mho/cm}$ and $\mu\text{S/cm}$ (microsiemens/centimeter) are equivalent.

Method(s): ASTM D 1125-14 Method A

May 27, 2015

Nancy McAtee
National Transportation
Safety Board
490 L'Enfant Plaza
Washington, DC 20594

TEST REPORT

IMR Report Number 201506245B

PO Number
Credit Card

Date Received
May 14, 2015

Sample#
3 – Electrical cable insulation
assembly piece

Sample ID
DCA15FR004

SUMMARY

One cable insulation assembly was received for TGA analysis of the component layers. The insulation assembly (Figure 1) consists of an inner upjacket (which would have cover the conductors), a middle insulation layer and an outer jacket layer.

TGA results are reported for each layer.

The results are on the following page(s).



Reviewed by



Peter Damian for
Mike Bimbo
Senior Chemist

Reviewed by



Rob Demaree, Manager
Chemistry Department

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THERMOGRAVIMETRIC ANALYSIS (TGA)

TGA analysis was performed per ASTM E 1131-08. A sample was heated at a rate of 10°C/min from 30°C to 850°C in air. Each sample decomposed according to a profile. The initial decomposition was characterized by noting the temperatures at which the samples lost 1%, 2%, 5% and 10% of their initial mass. At the conclusion of the run the sample's noncombustible filler content is also noted.

Individual results are presented in Figures 2-4.

Sample	1% mass loss Temperature	2% mass loss Temperature	5% mass loss Temperature	10% mass loss Temperature	Noncombustible Filler (%)
Inner Upjacket	261°C	313°C	342°C	359°C	47.5
Middle Insulation	270°C	310°C	381°C	414°C	37.0
Outer Jacket	182°C	262°C	314°C	339°C	5.4

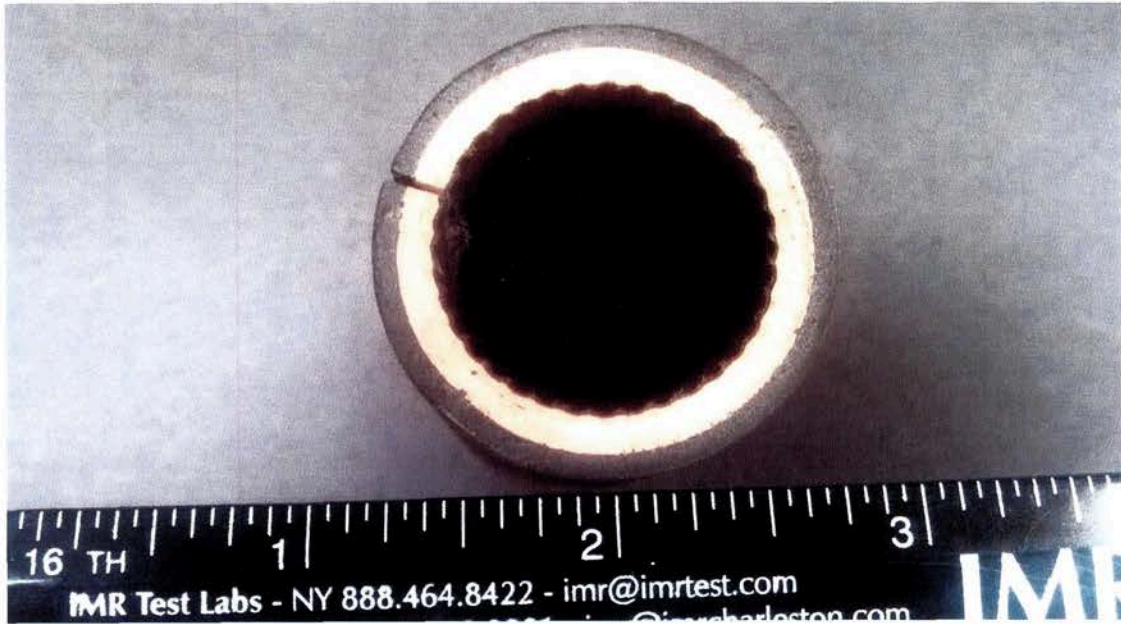
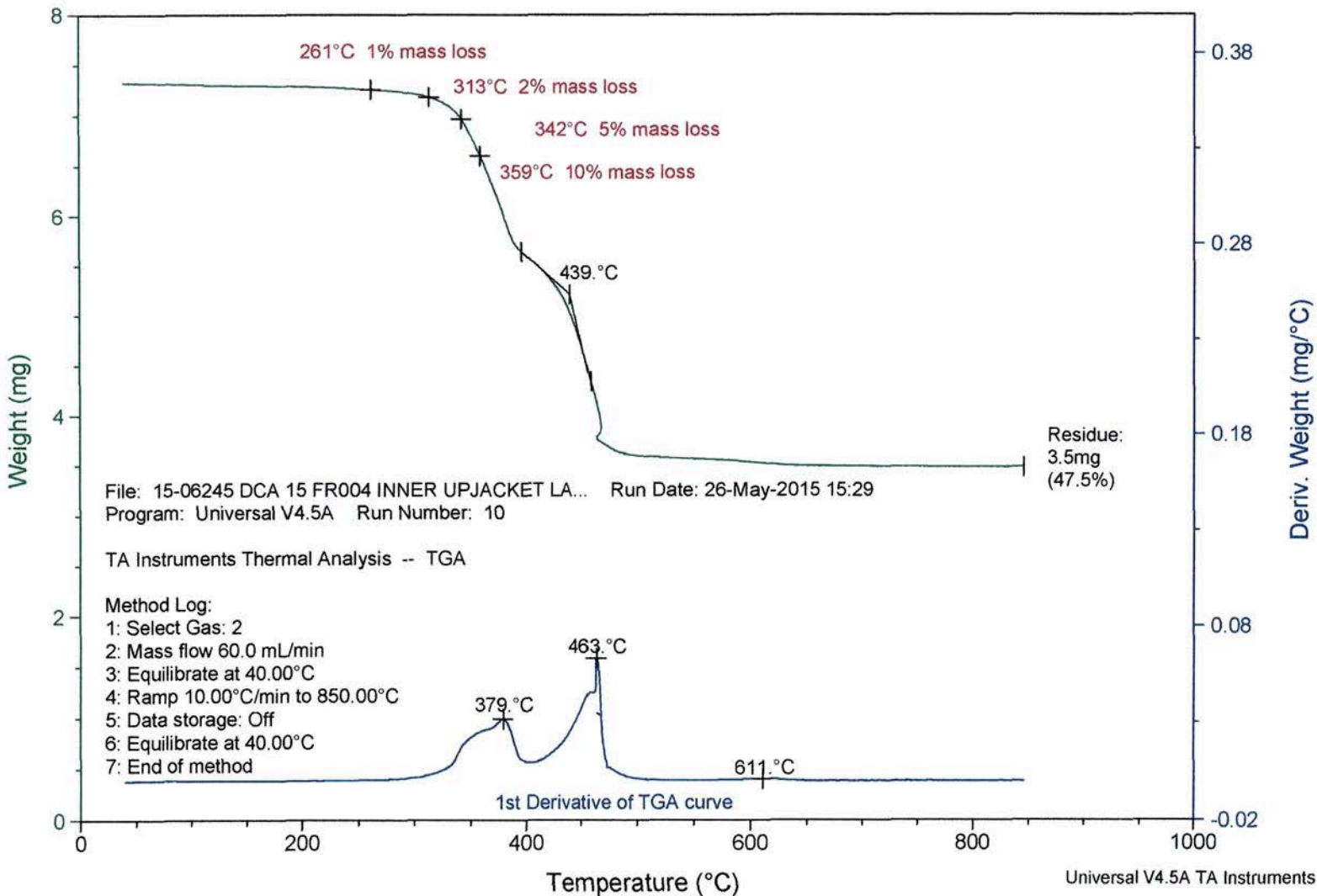


Figure 1: Image of the cable insulation assembly, showing the three layer materials.

TGA

Sample: DCA15 FR004 Upjacket
Size: 7.3320 mg
Method: ASTM E1131 in air to 850C
Comment: DCA 15 FR004, upjacket inner layer, air to 850, pan 3

File: 15-06245 DCA 15 FR004 INNER UPJACKET ...
Operator: RJD CSDR 7485
Run Date: 26-May-2015 15:29
Instrument: TGA Q500 V6.7 Build 203



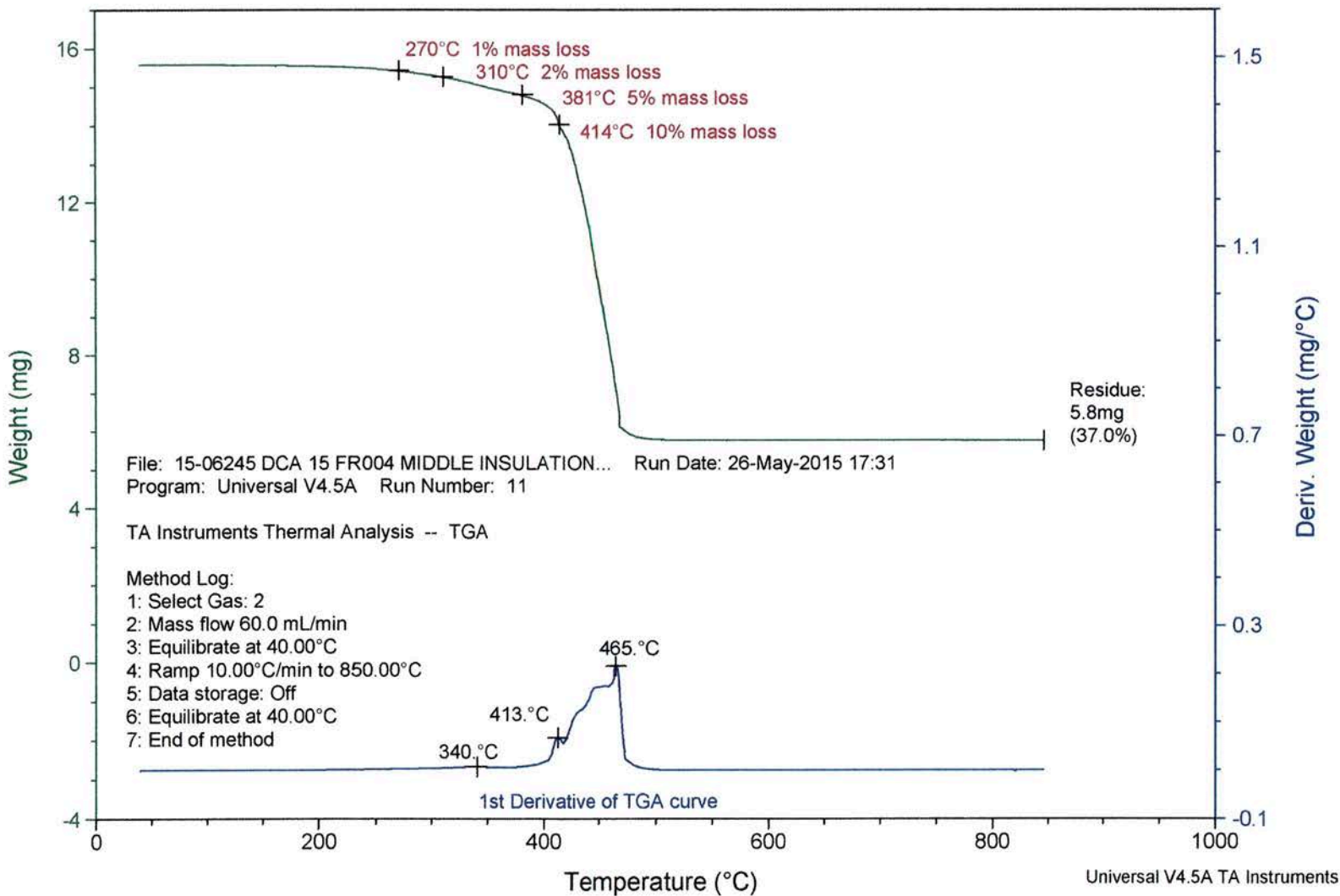
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Figure 2: TGA results for the inner upjacket material of the cable insulation assembly.

TGA

Sample: DCA15 FR004 Insulation
Size: 15.5890 mg
Method: ASTM E1131 in air to 850C
Comment: DCA 15 FR004, middle Insulation layer, air to 850, pan 4

File: 15-06245 DCA 15 FR004 MIDDLE INSULATI...
Operator: RJD CSDR 7485
Run Date: 26-May-2015 17:31
Instrument: TGA Q500 V6.7 Build 203



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Figure 3: TGA results for the middle insulation material of the cable insulation assembly.

TGA

Sample: DCA15 FR004 Outer Jacket
Size: 4.5390 mg
Method: ASTM E1131 in air to 850C
Comment: DCA 15 FR004, outer jacket layer, air to 850, pan 5

File: 15-06245 DCA 15 FR004 OUTER JACKET.001
Operator: RJD CSDR 7485
Run Date: 26-May-2015 19:31
Instrument: TGA Q500 V6.7 Build 203

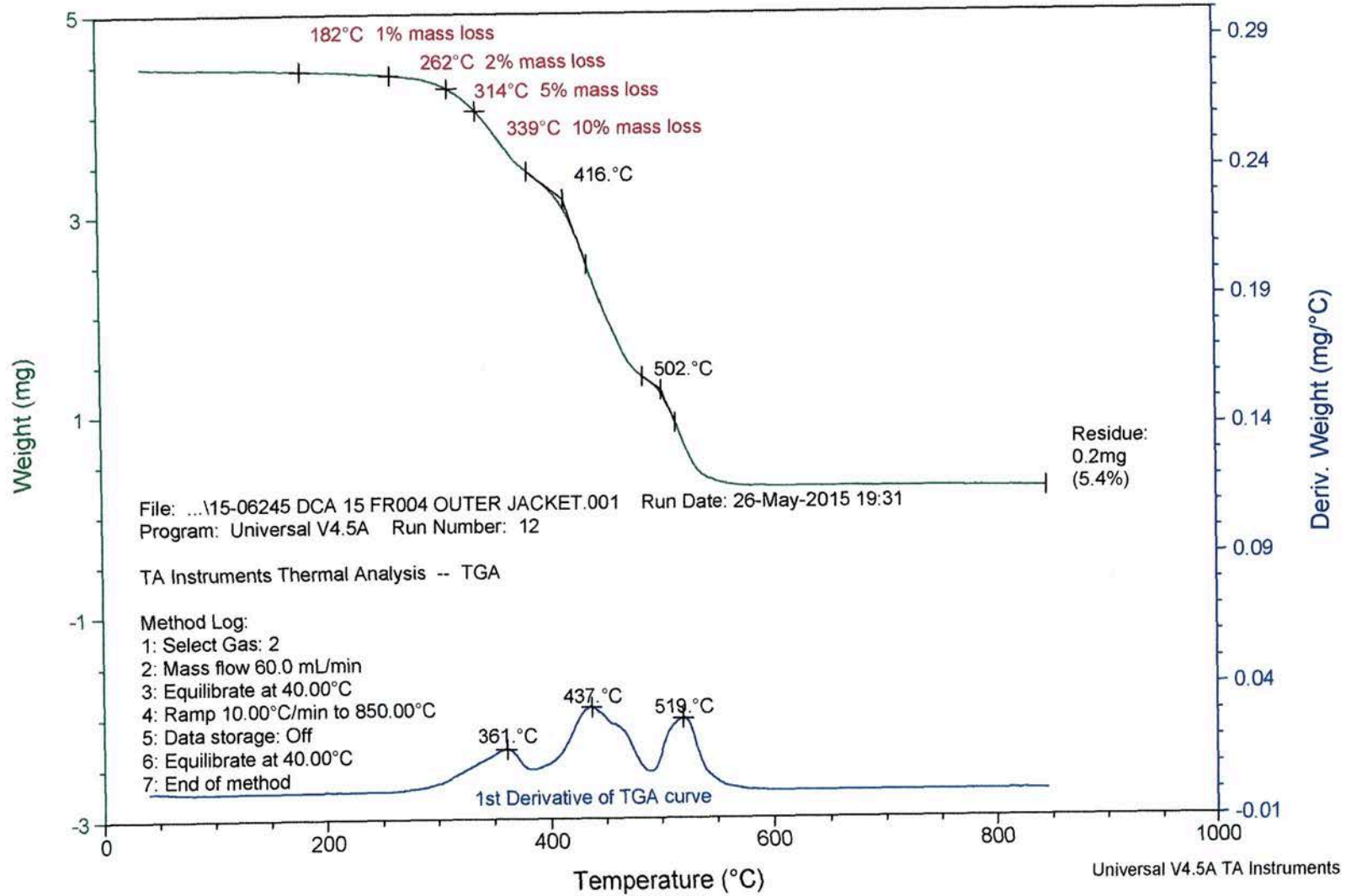


Figure 4: TGA results for the outer jacket material of the cable insulation assembly.