

Two Test Methodologies for Evaluating the Resistance to Electrical Arcing Properties of Polymeric Materials for use in Automotive 42 V Applications

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Funding

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- ***USCAR (United States Council For Automotive Research - Daimler-Chrysler, Ford and General Motors)***
- ***MVFRI (Motor Vehicle Fire Research Institute)***
- ***UL (Underwriters Laboratories Inc.)***

Introduction

- ***The Auto Industry is moving toward a 36 Volt Battery (nominal 42 V Charging)***

- ***Increased Electrical Loads***

 - Shift from mechanical and hydraulic systems to electrical operated systems***

- ***Enhanced Automotive Design***

 - Electronic steering, braking***

42 V DC Considerations

Shock Hazard

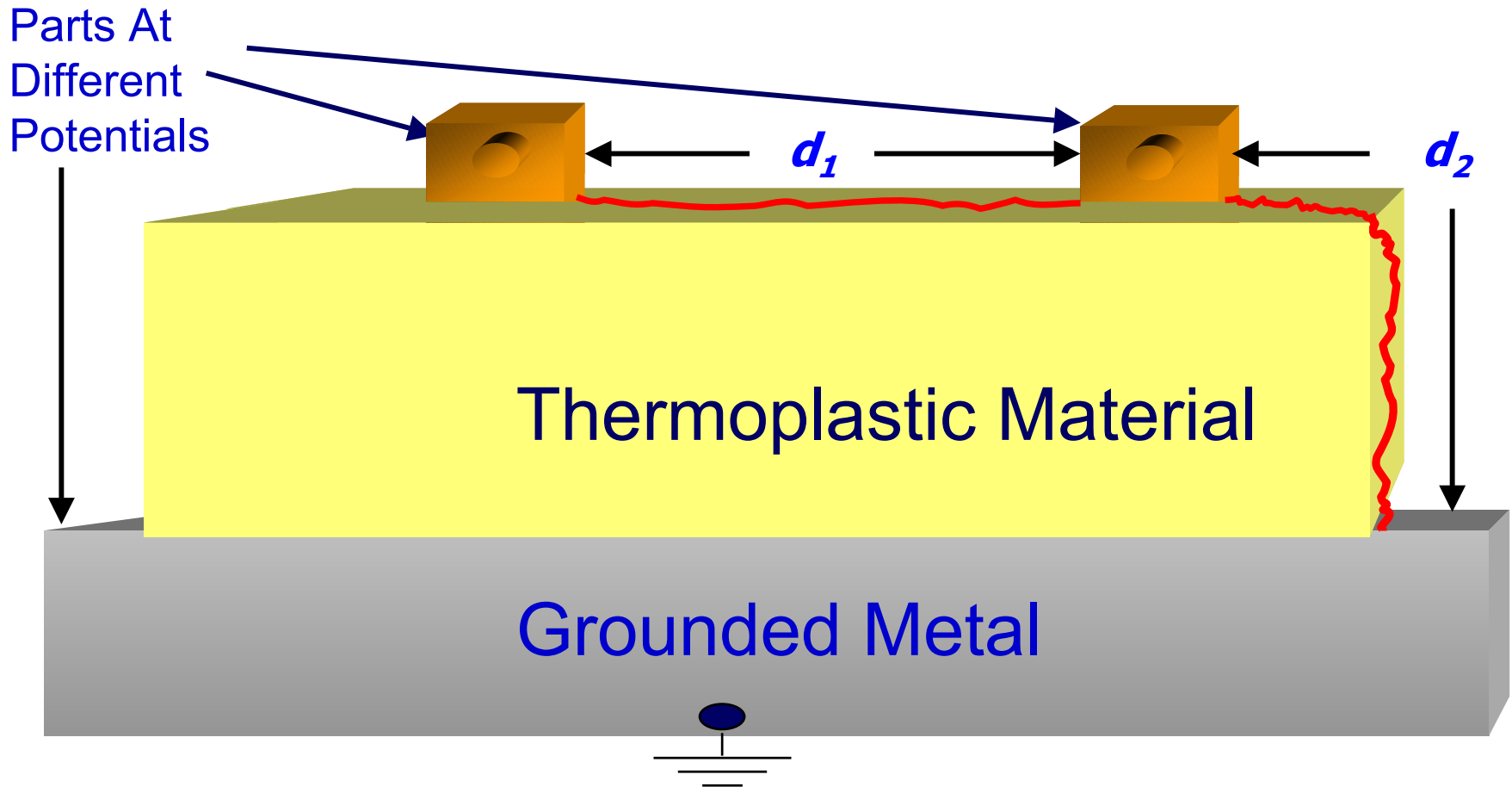
Burn Hazard

Casualty Hazard

Arc and Tracking Hazard

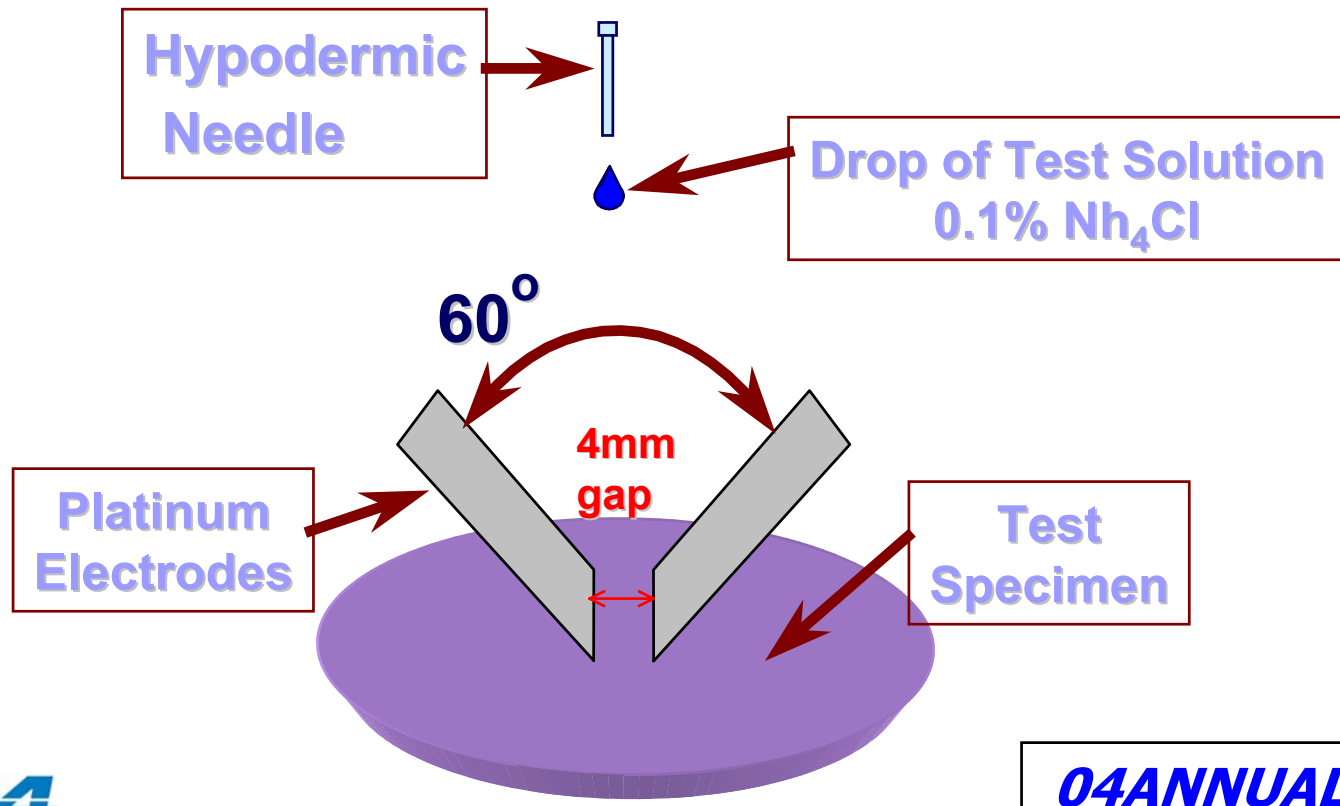


Tracking Path Example



CTI

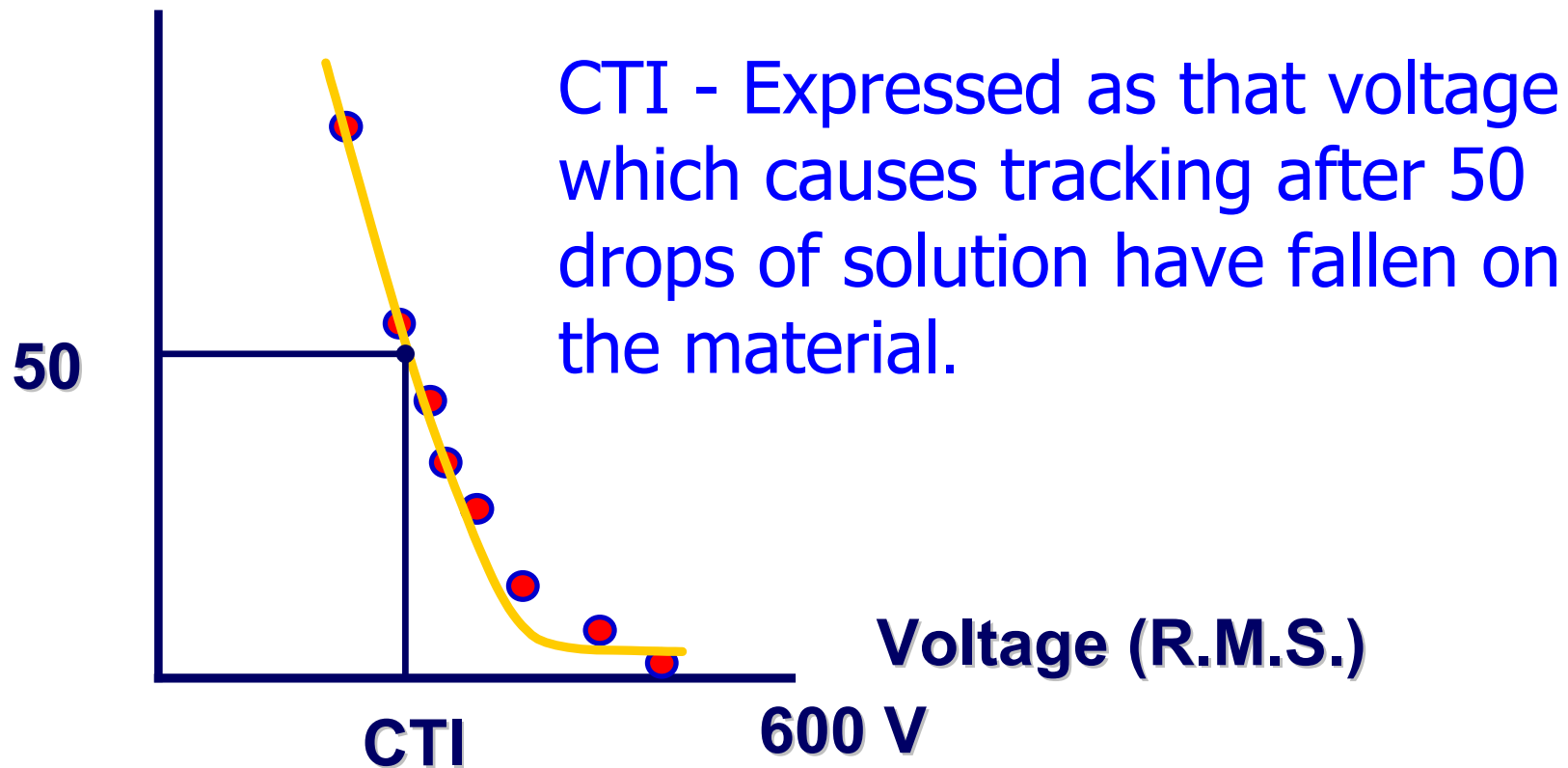
AC Test Set-Up



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CTI

Number of Drops



Comparative Tracking Index

References

UL746A - Polymeric Materials – Short Term Property Evaluations

ASTM D 3638 - Standard Test Method for Comparative Tracking Index of Electrical Insulation Materials

IEC 60112 - Method for the determination of the comparative and the proof tracking indices of solid insulating materials

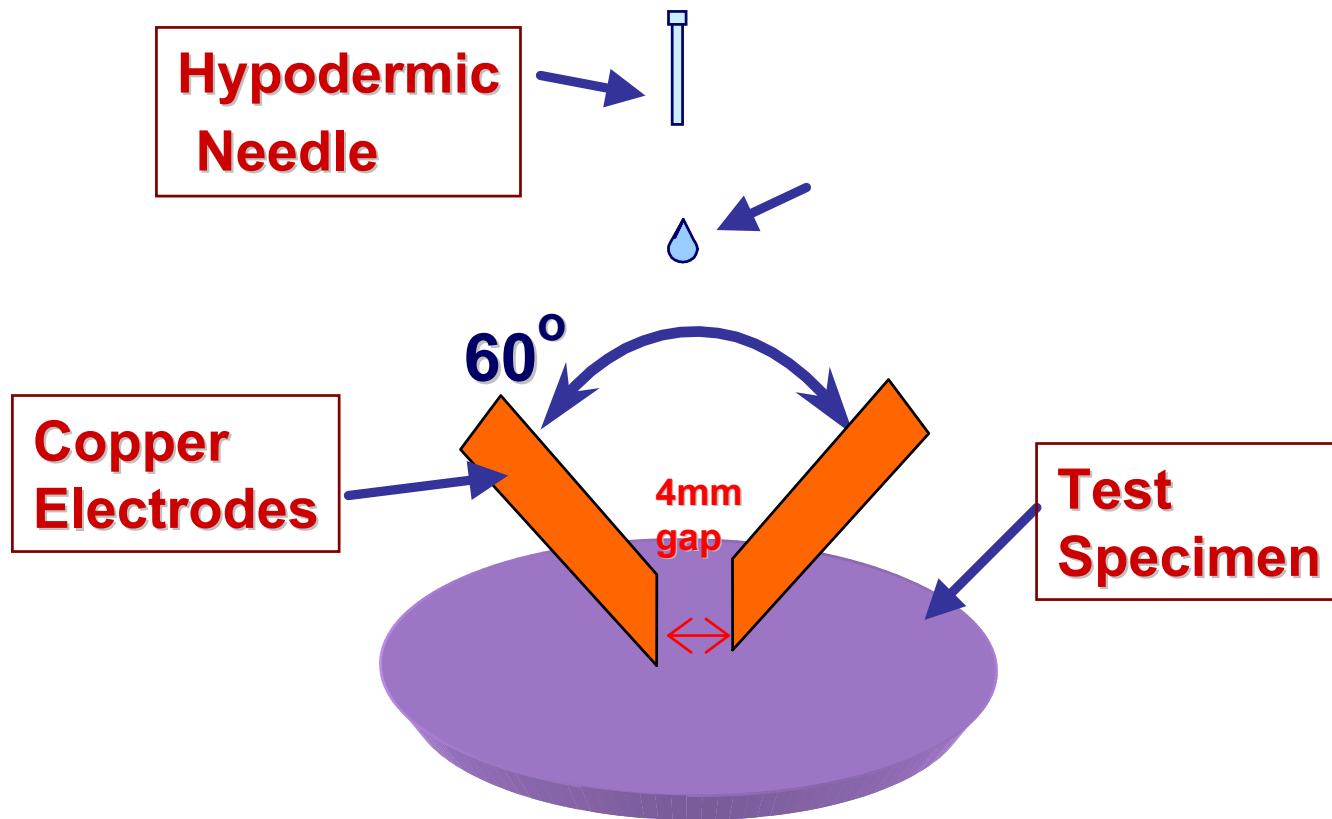
CTI – DC Modifications

The AC voltage supply to the electrodes is replaced with a DC supply

The current is limited to 20 A by a ballast resistor

CTI – DC Modifications

Test Set-Up



Copper Electrodes

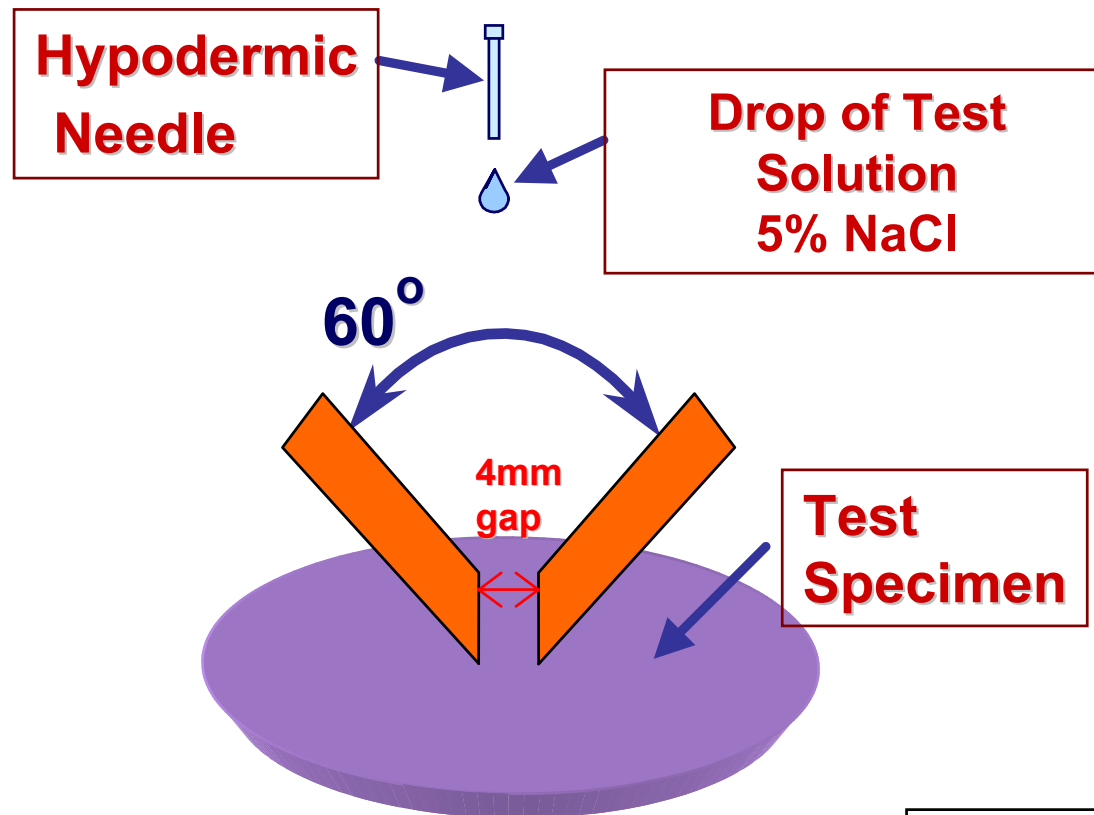
Representative of the electrical conductors found in an automotive application.

ASTM D 5288 Standard Test Method for Determining the Tracking Index of Electrical Insulating Materials Using Various Electrode Materials (Excluding Platinum) validates the use of copper electrodes as an alternative material.

The relative "soft" nature of the copper electrodes may require more frequent cleaning and regrinding of the electrode faces in order to produce consistent test results.

CTI – DC Modifications

Test Set-Up



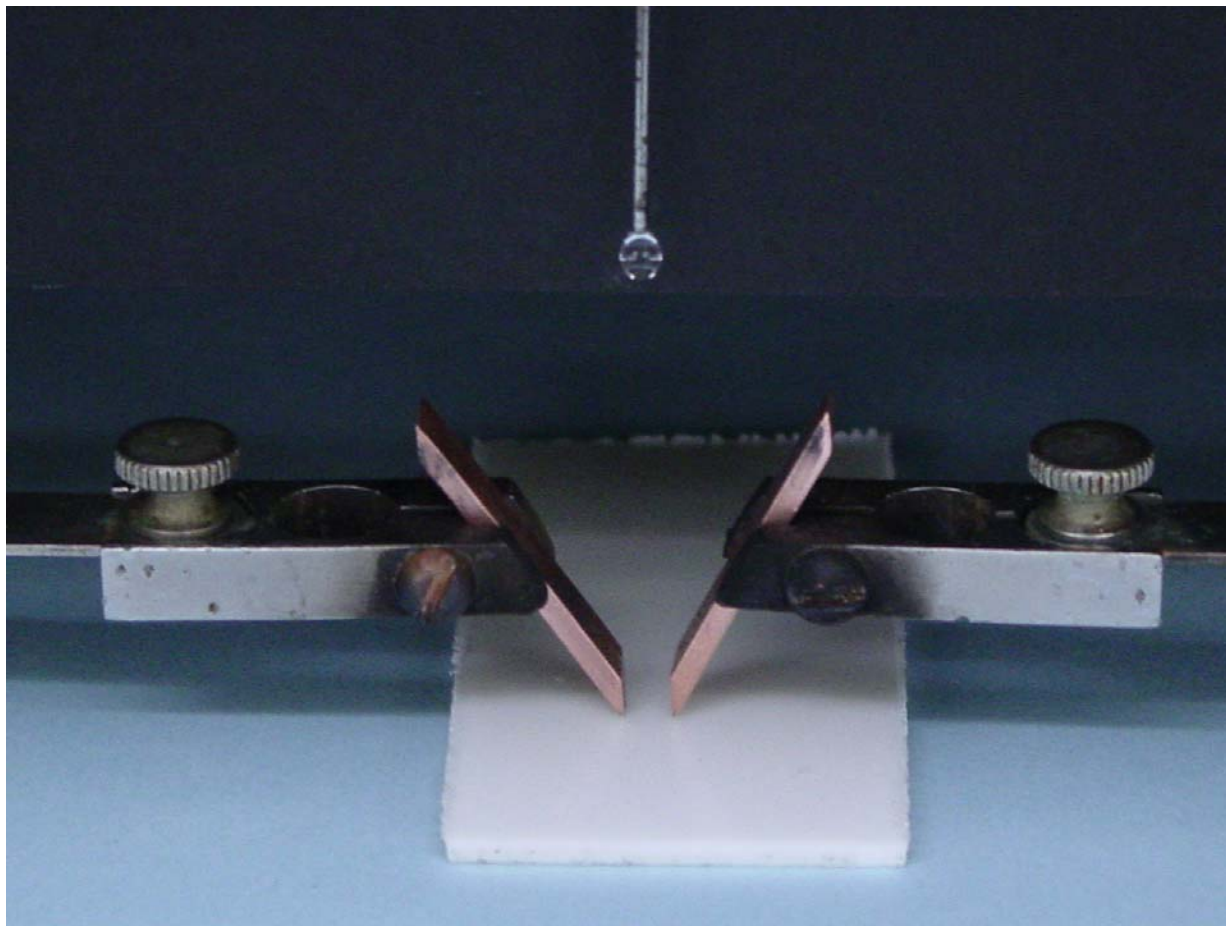
CTI – DC Modifications

ASTM B117

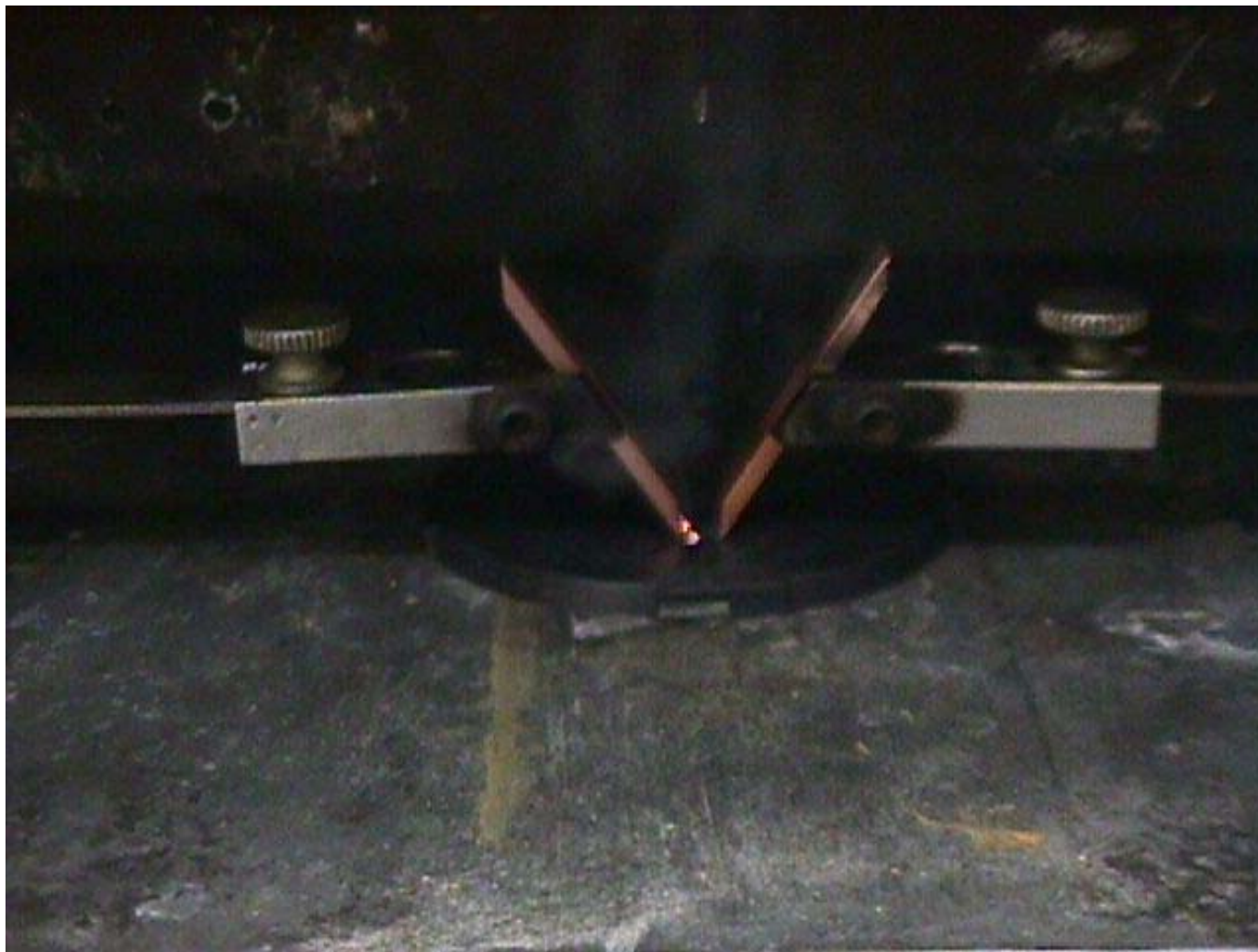
Standard Method of Salt Spray
(Fog) Testing

Specifies the use of a 5% salt
concentration by weight.

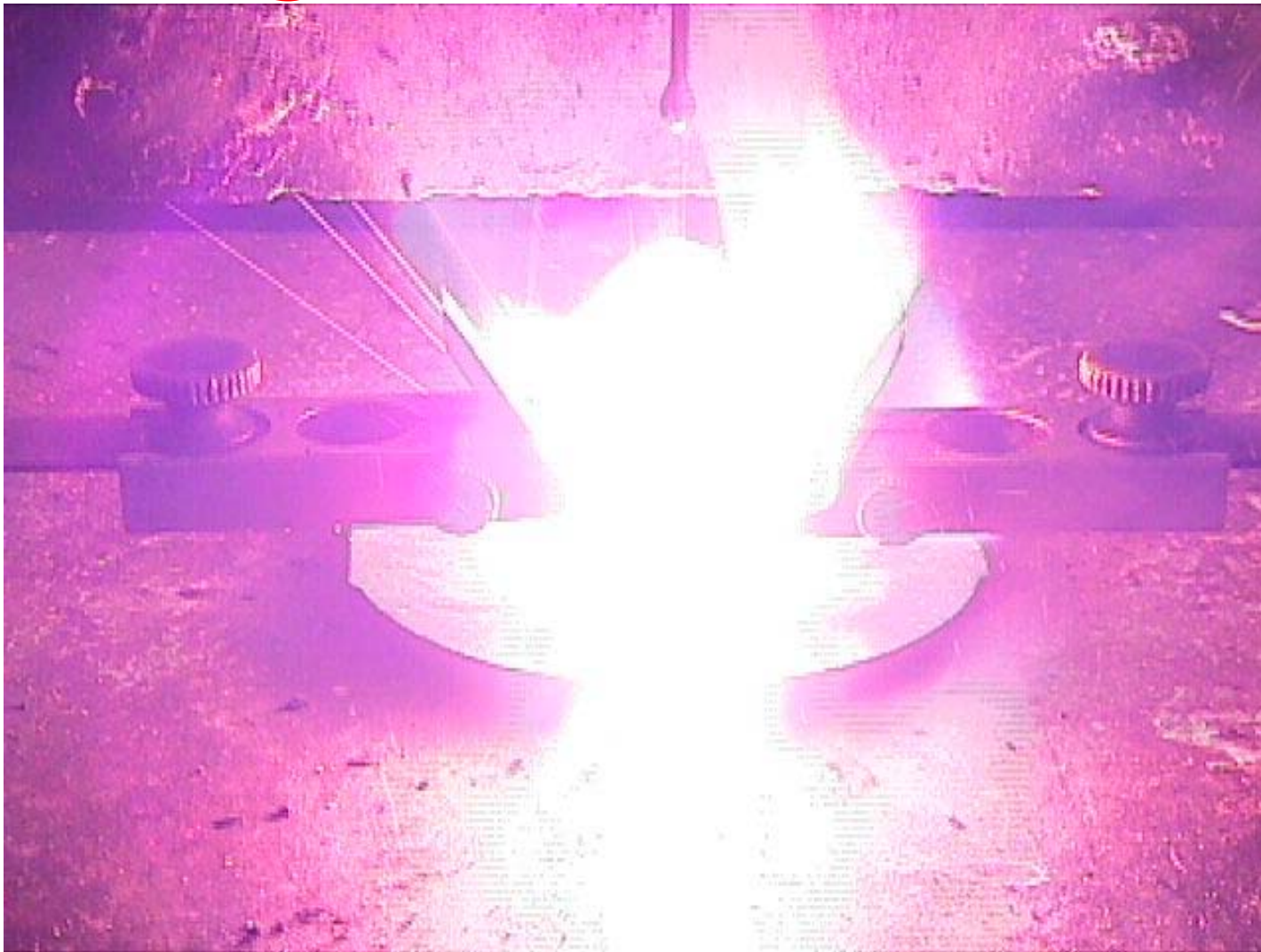
DC-CTI Test Set Up



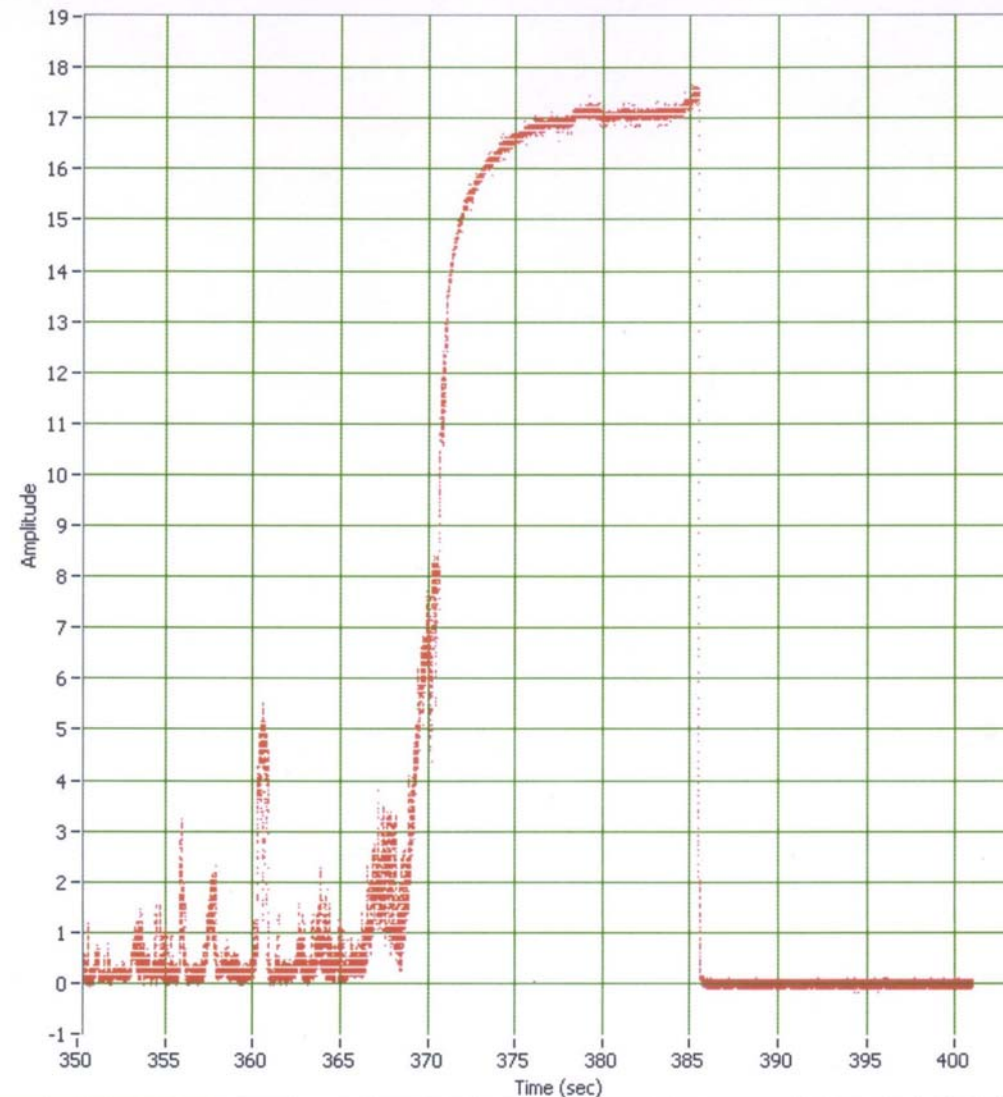
DC CTI - Initial Scintillations



DC CTI - Ignition

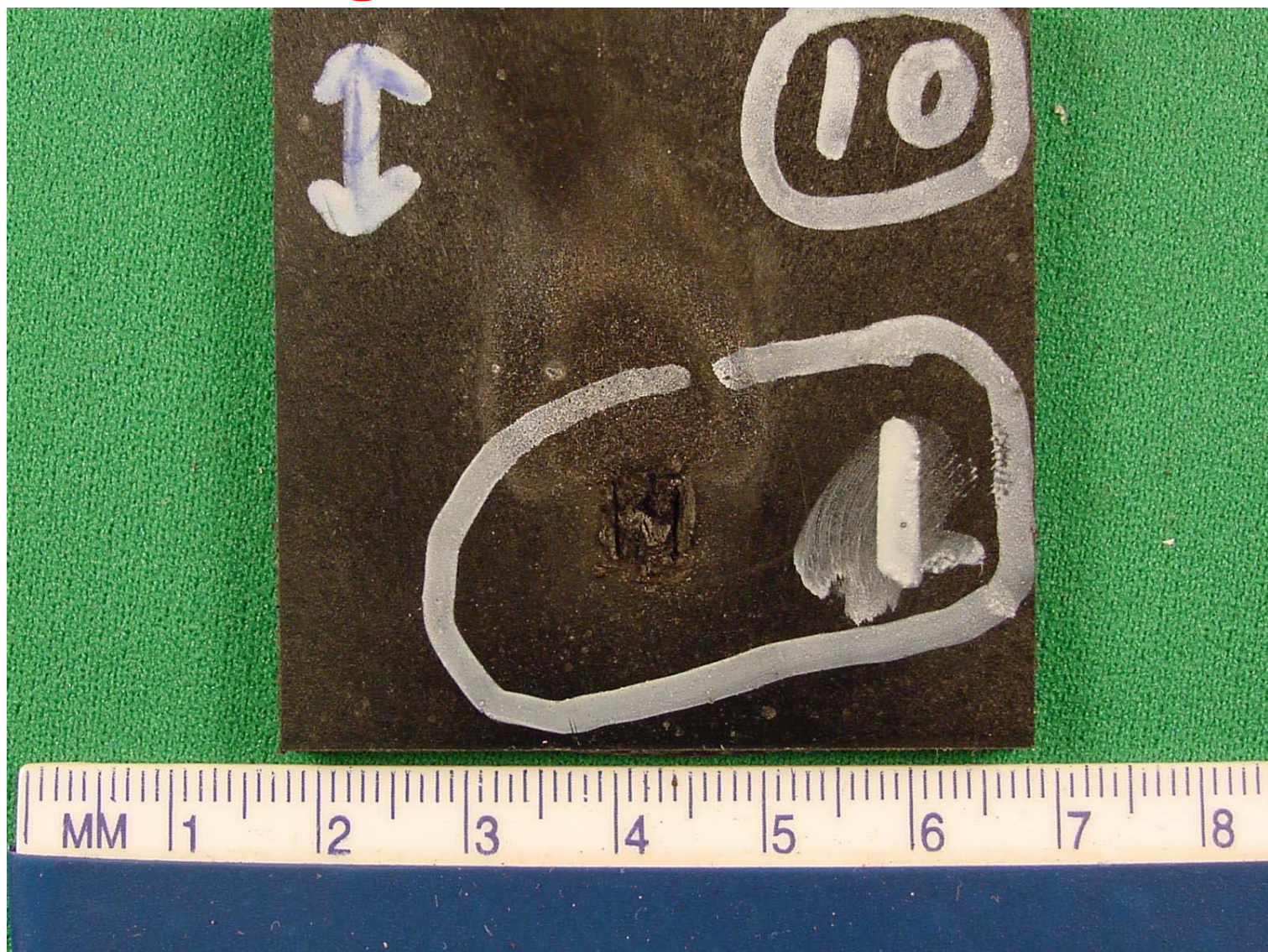


Current at End of Test

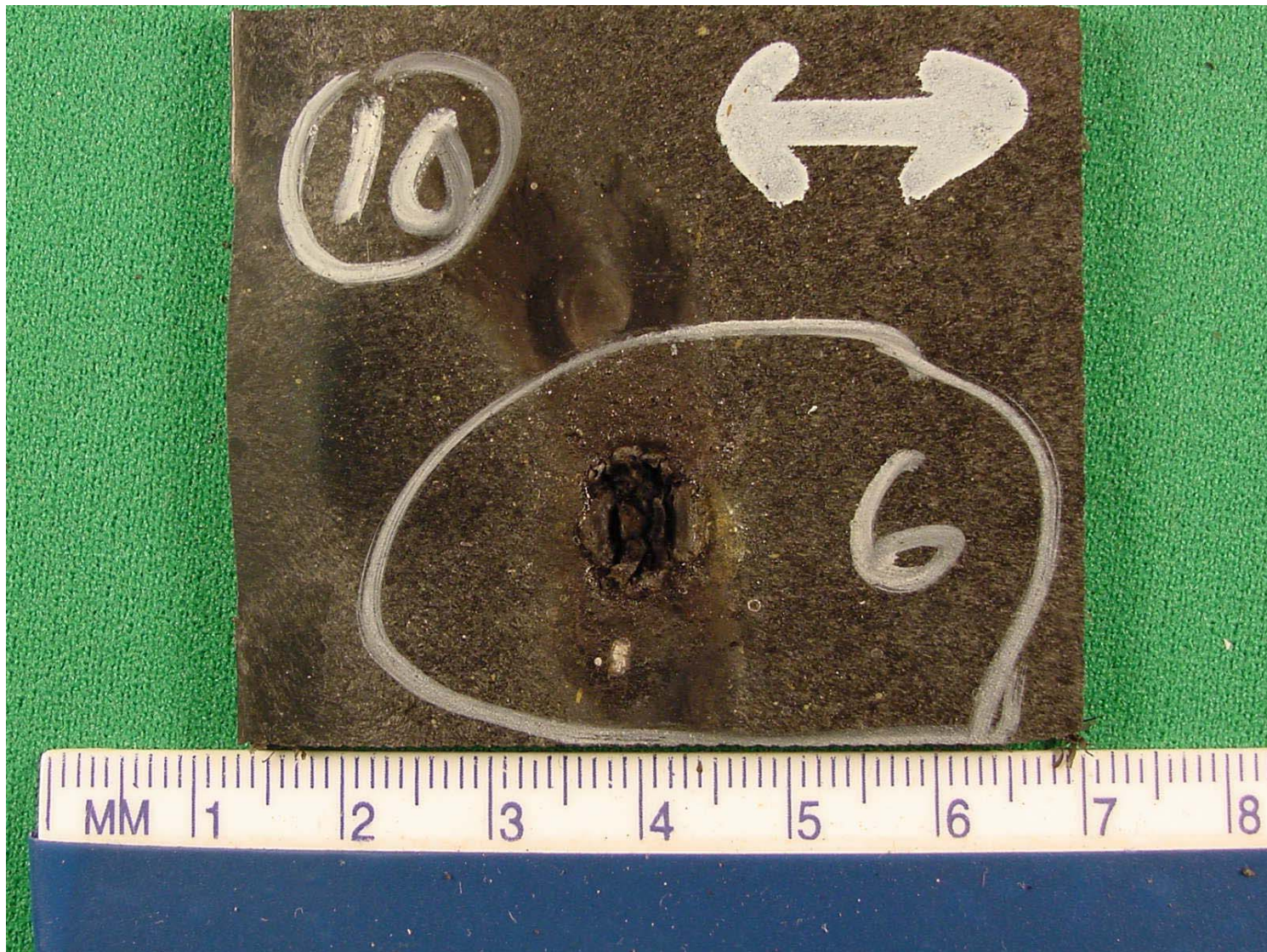


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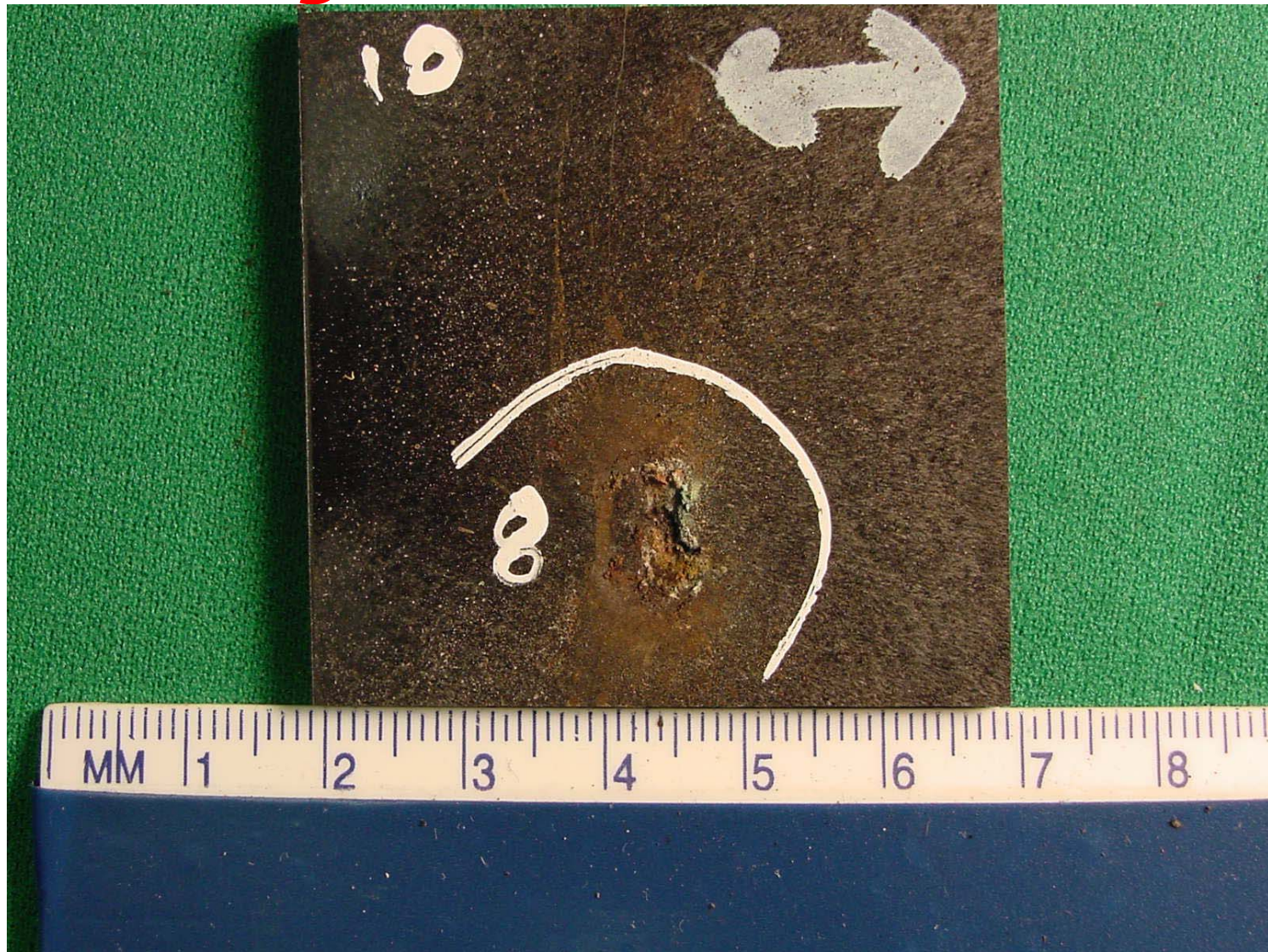
Material Designation 10 @ 150V DC



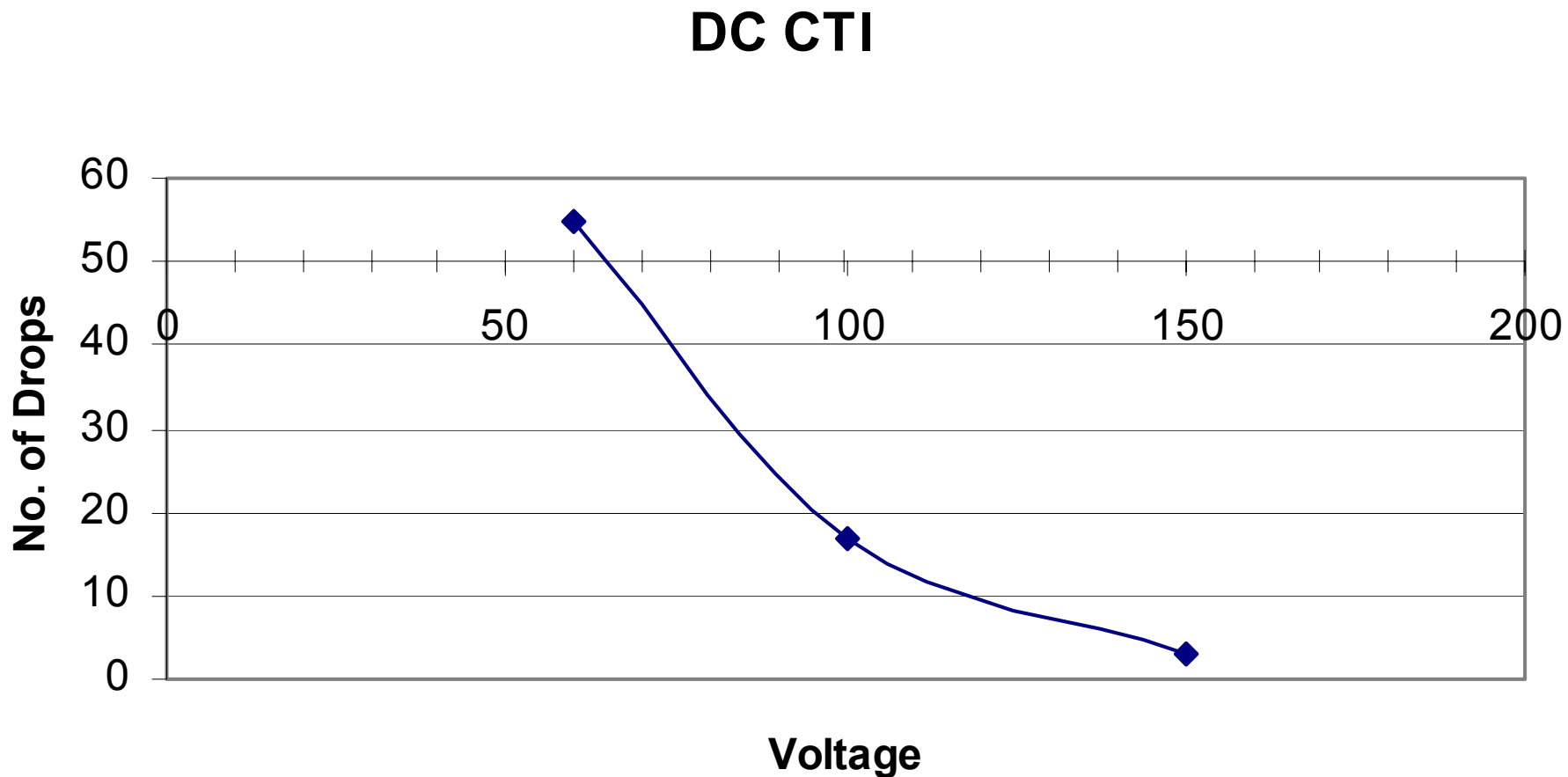
Material Designation 10 @ 100V DC



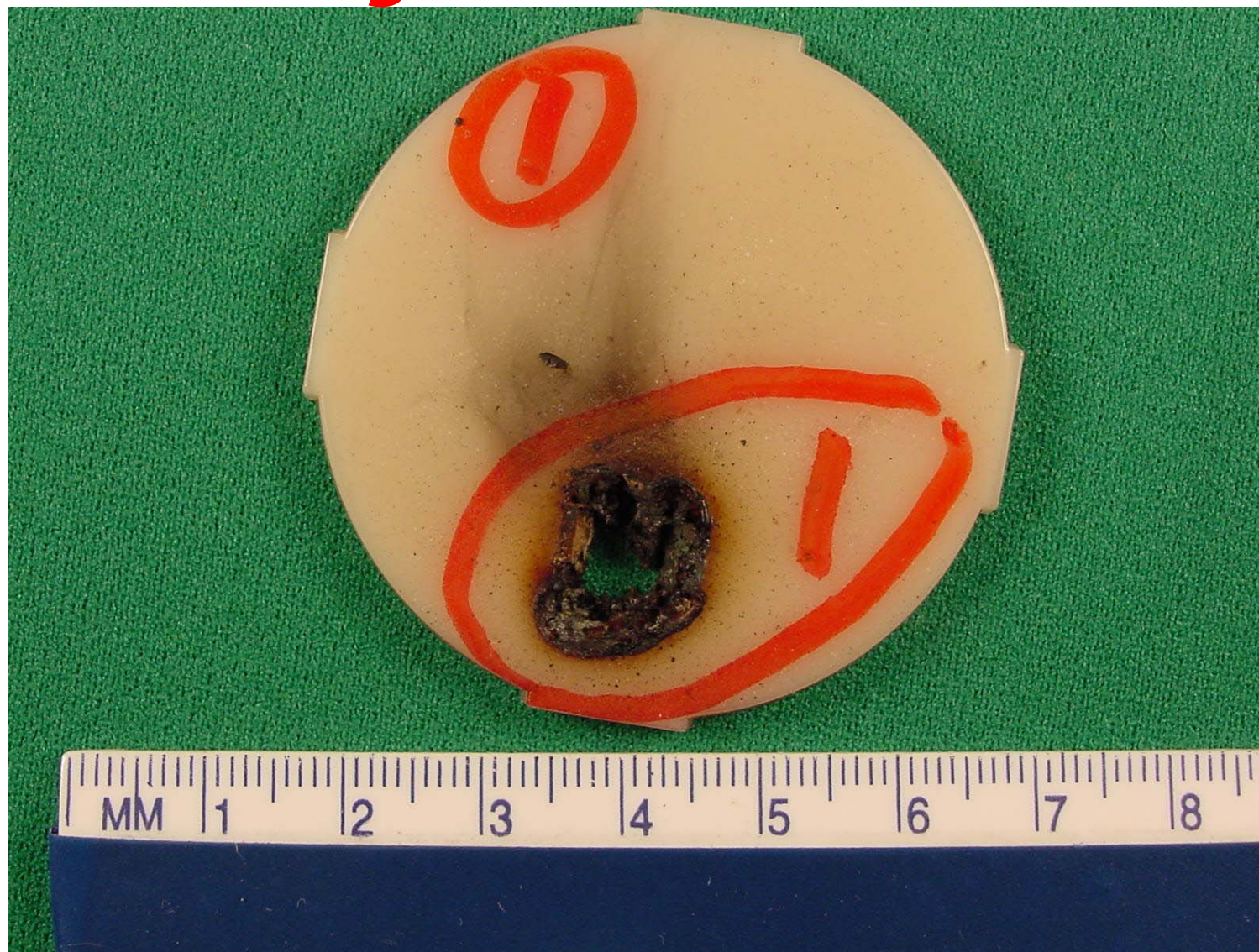
Material Designation 10 @ 60V DC



Material Designation 10



Material Designation 1 – Severe Erosion



Material Designation	Generic Description	Usage	DC CTI
7	15% GR PPA polyphthalamide	Connector	150
11	Polyamide/PPE Unfilled	PDC Box	150
12	PVC Wiring insulation	Insulation	150
13	XLPE Wiring insulation	Insulation	150
23	15%GR Hi Performance Polyamide,Heat Stabilized, toughened	Connector	150
1	Polyamide 46 Unfilled	Connector	100
15	13%GR Nylon 66 Impact Modified, Low Tracking Index	Connector	100
17	15%GR Nylon 66 Dimensionally Stabilized, Low Tracking Index, High Flow	Connector	100
22	35%GR Hi Performance Polyamide,Heat Stabilized, toughened	Connector	100

Material Designation	Generic Description	Usage	DC CTI
3	PBT unfilled FR	Connector	60
4	Polyamide 46 GF15 HS	Connector	60
9	PBT unfilled FR	PDC Cover	60
10	Polyamide/PPE 10% GF	Connector	60
14	15% GR PBT Hydrolysis Resistant, High Flow	Connector	60
19	15%GR PBT Hydrolysis Resistant, High Flow	Connector	60
20	30%GR PBT Hydrolysis Resistant, High Flow	Connector	60
21	30%GR PBT Fire Retardant (V-0)	Connector	60
24	35%GR Hi Performance PA, Heat Stabilized, water mold temp.	Connector	60
25	15%GR Fire Retardant (V-0) PBT	Connector	60

Material Designation	Generic Description	Usage	DC CTI
2	Polyamide 46 Unfilled FR	Connector	50
8	PBT 17% GF FR	Connector	50
16	15%GR PBT	Connector	50
6	Polyamide 46 GF15 HS	Connector	42
5	Polyamide 46 GF30 HS FR	Connector	12

DC CTI REPORT

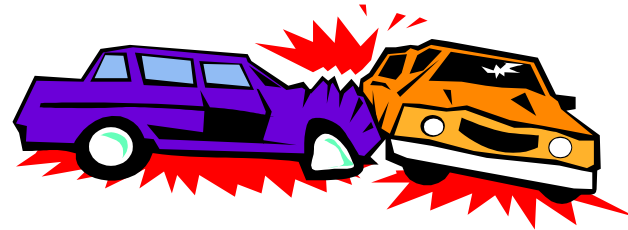
The full DC CTI report is available online at:

<http://www.ul.com/plastics>

Select "What's New"

Electrical Arcing Sources

Overloaded Components
Arcing Parts
Loose Connections
Collision



High-Current Arc Ignition Test

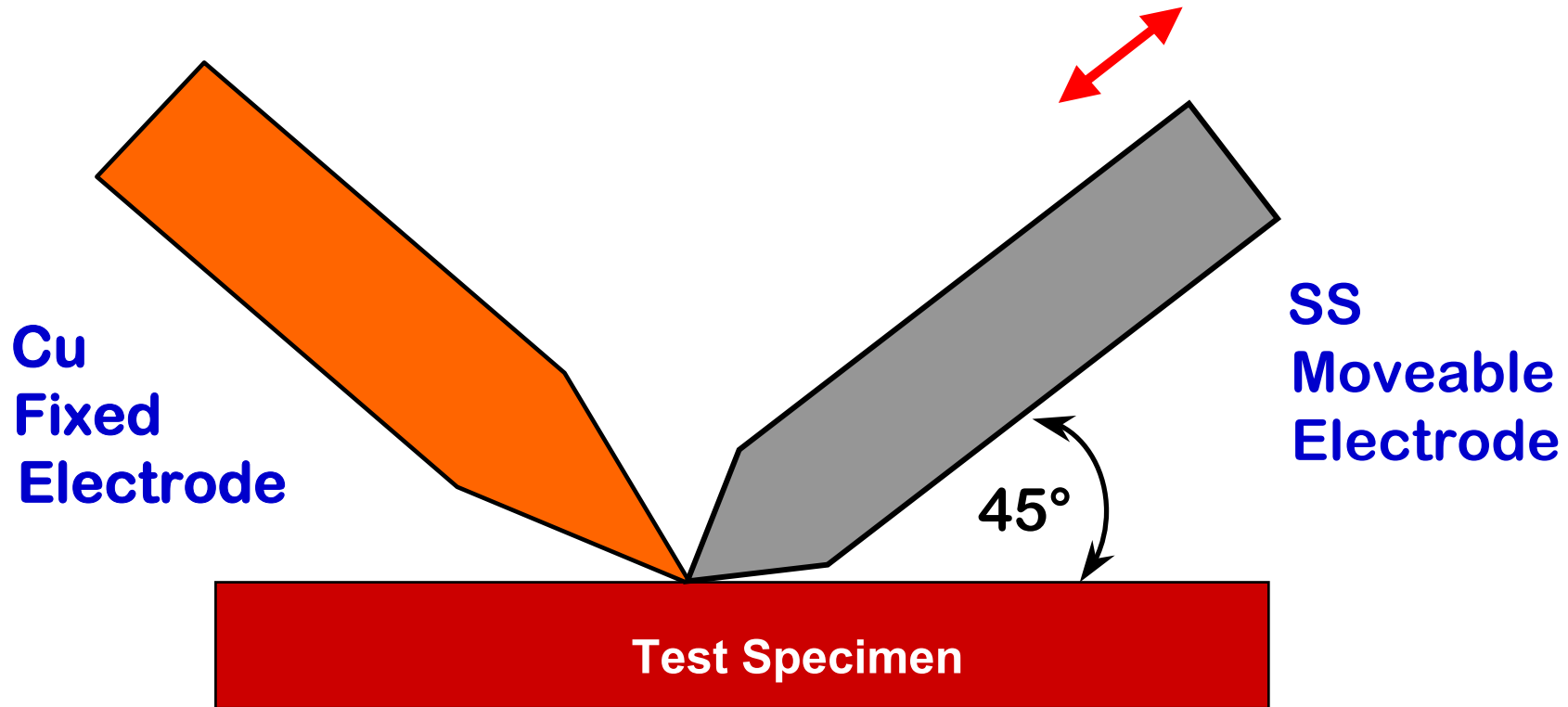
Fixed Copper and Moveable Stainless Steel Electrodes

Electrodes are separated to create arc
40 arcs per minute until ignition occurs or a maximum of 120 arcs

Electrical source delivering 32.5 A under short circuit, and open circuit voltage of 240 V AC @ Power Factor of 50 percent

High-Current Arc Ignition Test

HAI



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DC HAI Modifications

The AC voltage supply to the electrodes will be replaced with a DC power supply.

DC HAI Modifications

The supply will be limited to a maximum available current of 100 A DC.

DC HAI Modifications

Electrode material and retraction angle will be researched.

DC HAI Modifications

Methods of initiating the arc will be experimented with.

DC-HAI Test Prototype





DC HAI Research Status

- ✓ **Technical research proposal completed.**
- ✓ **Situation analysis completed.**
- ✓ **Research test equipment in development.**
- ✓ **Samples being gathered for testing.**

Standards Development

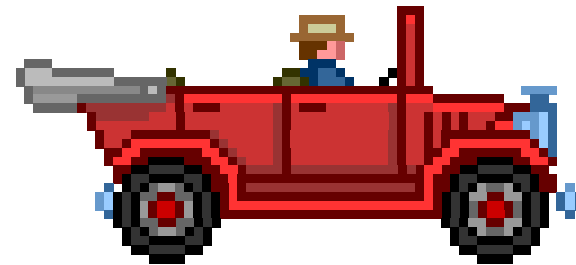
New ASTM Committee Formed – D09.42

Electrical and Electronic Insulating Materials

Scope - The development of test methods, definitions, specifications, practices, the promotion of knowledge and research relating to electrical and insulating materials for use in 42 volt systems and related road vehicle applications.

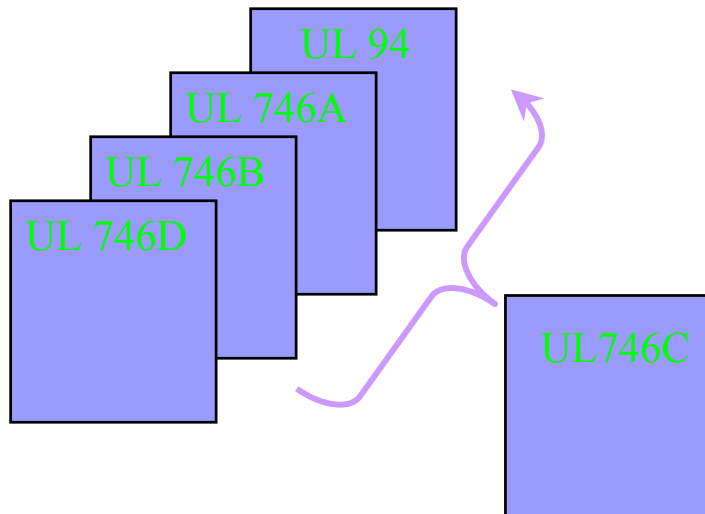
The work of the Committee will be coordinated with ASTM Committee and other organizations having mutual interests.

***Plastic Materials for Use
In Components for
Automotive &
Transportation
Applications***



THE BRIDGE TO AUTOMOTIVE COMPONENT DESIGN

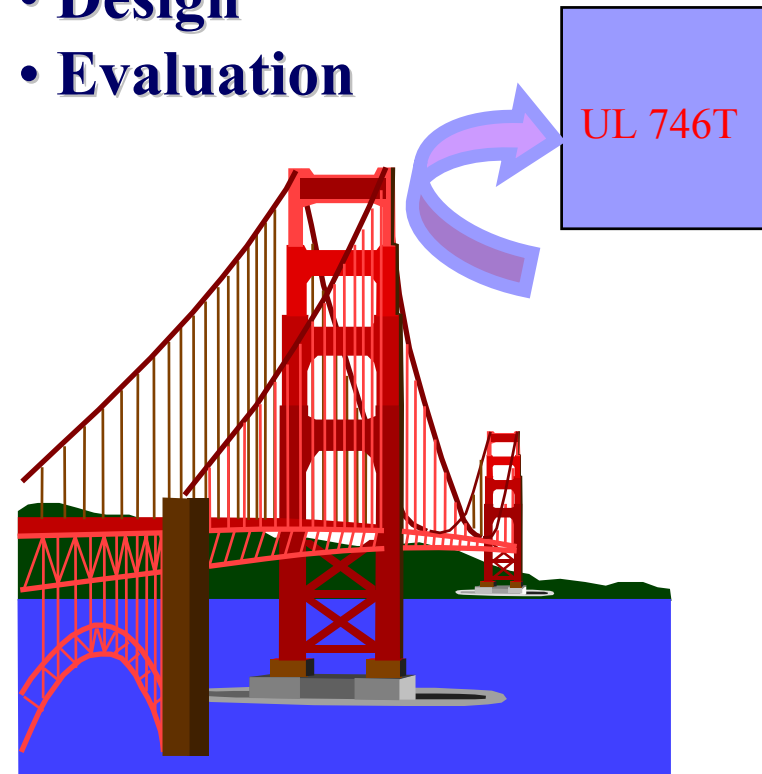
Material/System Properties



- 94 – Flammability of Plastic Materials**
- 746A – Short Term Property Evaluations**
- 746B – Long Term Property Evaluations**
- 746C – Use in Electrical Equipment**
- 746D – Fabricated Parts**

End Product

- Design**
- Evaluation**



Questions on DC CTI or DC HAI Research

