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DEC 18 2001

L. Robert Shelton,
Executive Director
NATIONAL HIGHWAY TRAFFIC
SAFETY ADMINISTRATION
400 Seventh Street, S.W., Room 5220
Washington, DC 20590

Dear Mr. Shelton:

Re: **Settlement Agreement**
**Section B. Fire Safety Research**

Enclosed is a copy of the presentation materials prepared by T. J. Ohlemiller of the National Institute of Standards and Technology (NIST), entitled, "An Overview of Fire Test Results On Certain Automotive Components."

This paper relates to Projects B.3 (Fire Initiation and Propagation Tests), B. 4 (Evaluation of Potential Fire Intervention Materials and Technologies), and B.10 (Study of Flammability of Materials).

These materials were presented at the ASTM (American Society for Testing and Materials) E5 Committee Research Review held in Norfolk, Virginia, on June 25, 2001.

Yours truly,

D.K. Nowak-Vanderhoef

Deborah K. Nowak-Vanderhoef
Attorney

Enclosure

# An Overview of Fire Test Results On Certain Automotive Components

T. J. Ohlemiller
National Institute of Standards and Technology
Building and Fire Research Laboratory

ASTM E5 Research Review
Norfolk, VA
June 25, 2001

# Background

**This work was financed by General Motors pursuant to an agreement between General Motors and the United States Department of Transportation.**

**One of at least fourteen safety-related projects engendered by this agreement.**

**NIST conducted two of the projects and collaborated with GM on a third project.**

- **B.3: Fire Initiation and Propagation Tests**

  **(Eight fire growth tests on four types of vehicles subsequent to either a front or rear crash scenario)**

- **B.4: Evaluation of Potential Fire Intervention Materials and Technologies**

  **(Passive and active fire suppression)**

- **B.10: Study of Flammability of Materials**

  **(Flammability of components; FR effects)**

# Project B.10
# Study of Flammability of Materials

## Objectives:

Survey the burning behavior of representative components from a pair of current vehicles.

Develop some understanding of the factors controlling the observed behavior.

Assess the potential reduction in flammability achievable by substituting flame retarded resins.

**<u>This talk briefly summarizes:</u>**

**Ohlemiller and Shields, "Burning Behavior of Selected Automotive Parts from a Minivan," NISTIR 6143, August, 1998**

**Ohlemiller and Shields, "Burning Behavior of Selected Automotive Parts from a Sports Coupe," NISTIR 6316, April, 2001**

**Ohlemiller, *et al*, "Exploring the Role of Polymer Melt Viscosity in Melt Flow and Flammability Behavior," Proceedings of the Fall, 2000 Meeting of the Fire Retardant Chemicals Association, Ponte Vehdra, Florida, October, 2000**

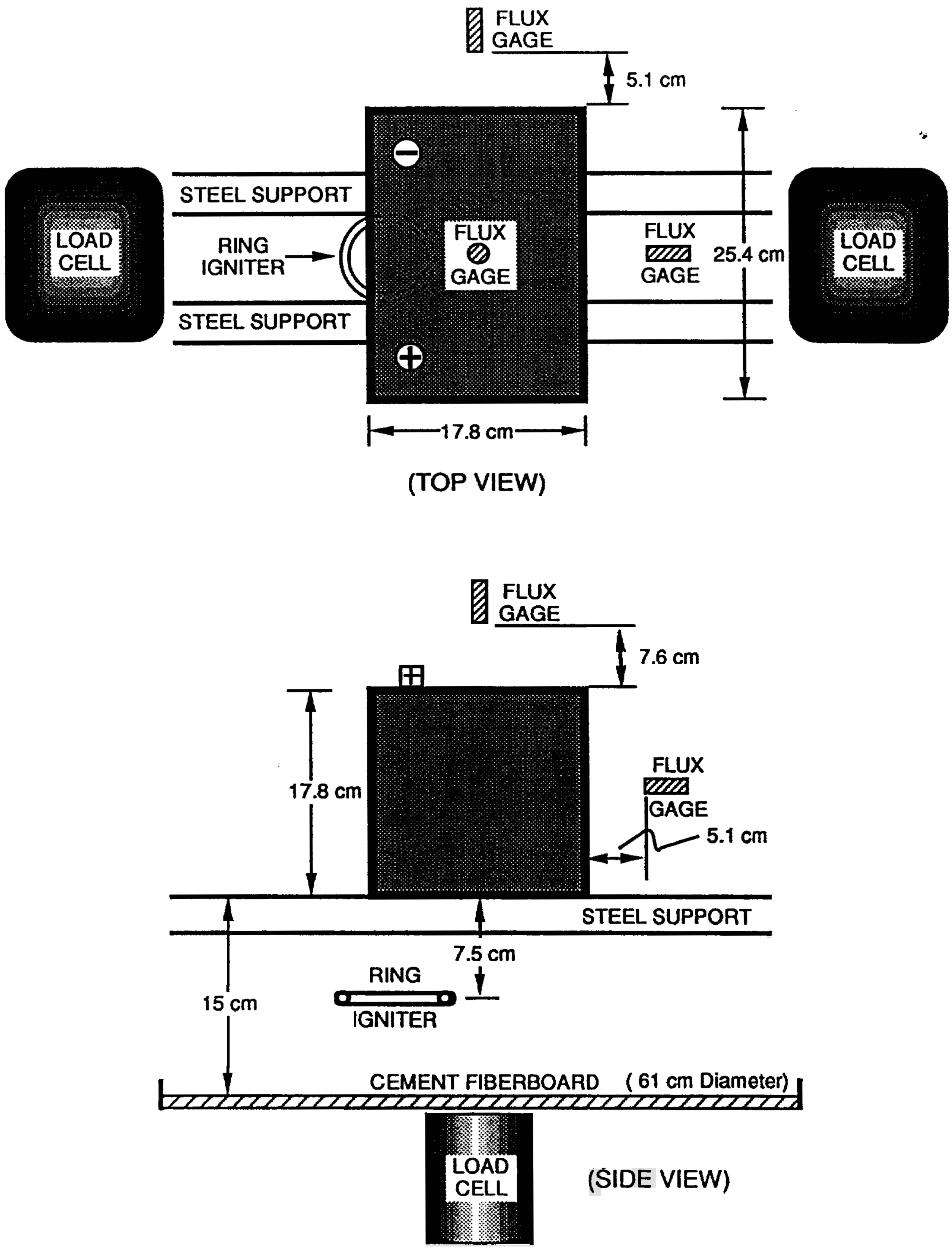
# Fire Growth and HRR for Thermoplastic Objects

**Fire growth is an inherent element of the observed heat release rate curve (HRR(t)) of a real object**

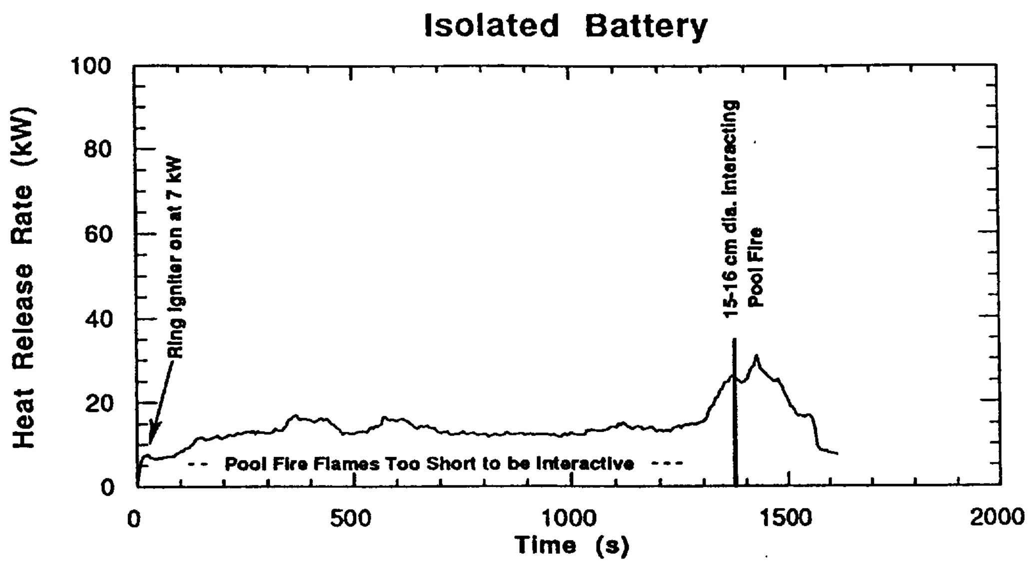
**HRR(t) of a real object depends on the size and intensity of the igniter (imposed heat flux distribution) and its placement on the object**

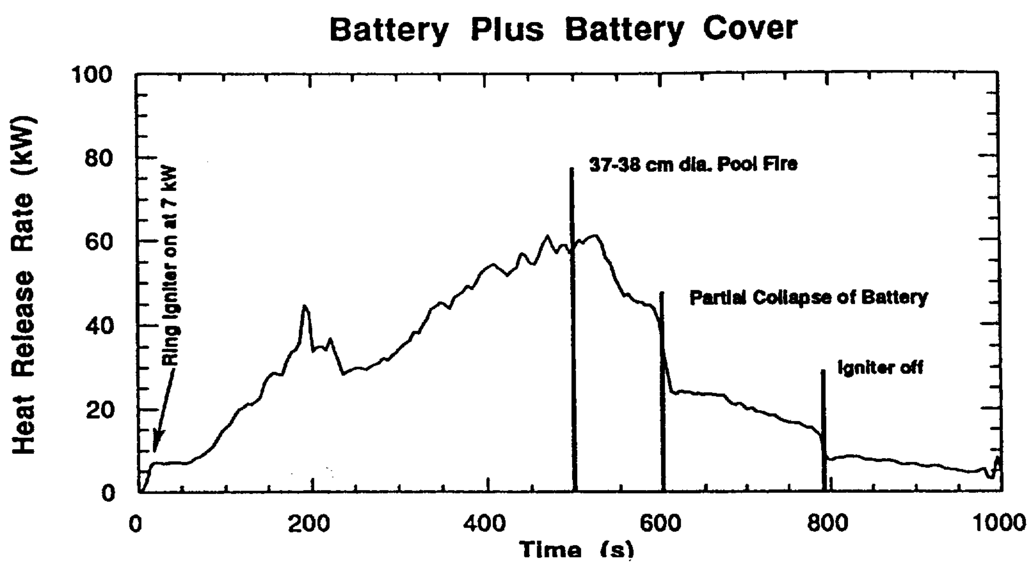
**For thermoplastic objects, HRR(t) further depends on the behavior of the polymer melt (location of any flaming melt pool)**

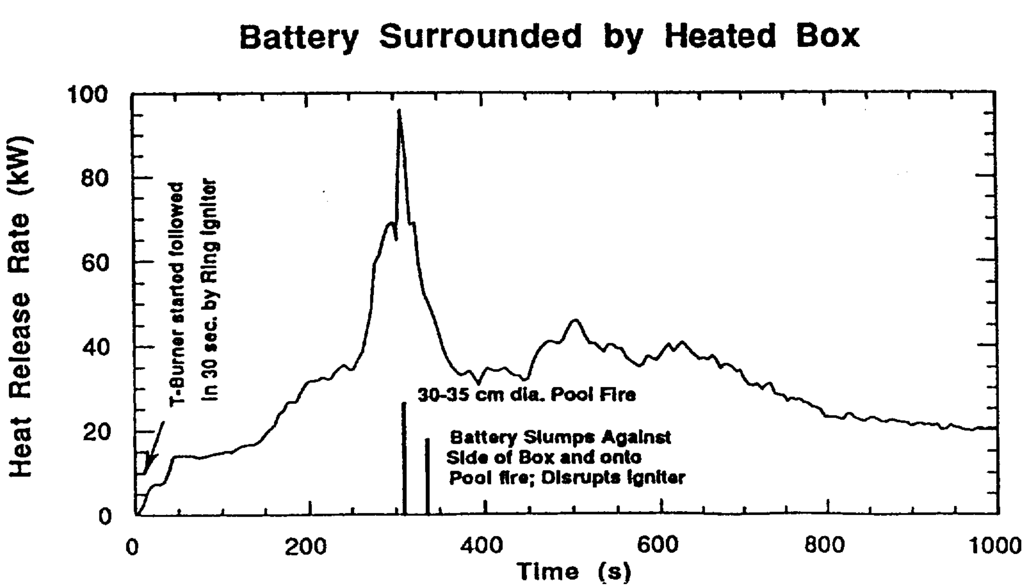
- **Extends burning area**
- **May supplement igniter flame**




**Test Configuration for Automobile Battery**


Isolated Battery
Heat Release Rate (kW)
Time (s)
Ring Igniter on at 7 kW
15-16 cm dia. Interacting Pool Fire
-- Pool Fire Flames Too Short to be Interactive ---
100
80
60
40
20
0
0
500
1000
1500
2000


Battery Plus Battery Cover
Heat Release Rate (kW)
Time (s)
Ring Igniter on at 7 kW
37-38 cm dia. Pool Fire
Partial Collapse of Battery
Igniter off
100
80
60
40
20
0
0
200
400
600
800
1000


Battery Surrounded by Heated Box
Heat Release Rate (kW)
Time (s)
T-Burner started followed in 30 sec. by Ring Igniter
30-35 cm dia. Pool Fire
Battery Slumps Against Side of Box and onto Pool fire; Disrupts Igniter
100
80
60
40
20
0
0
200
400
600
800
1000

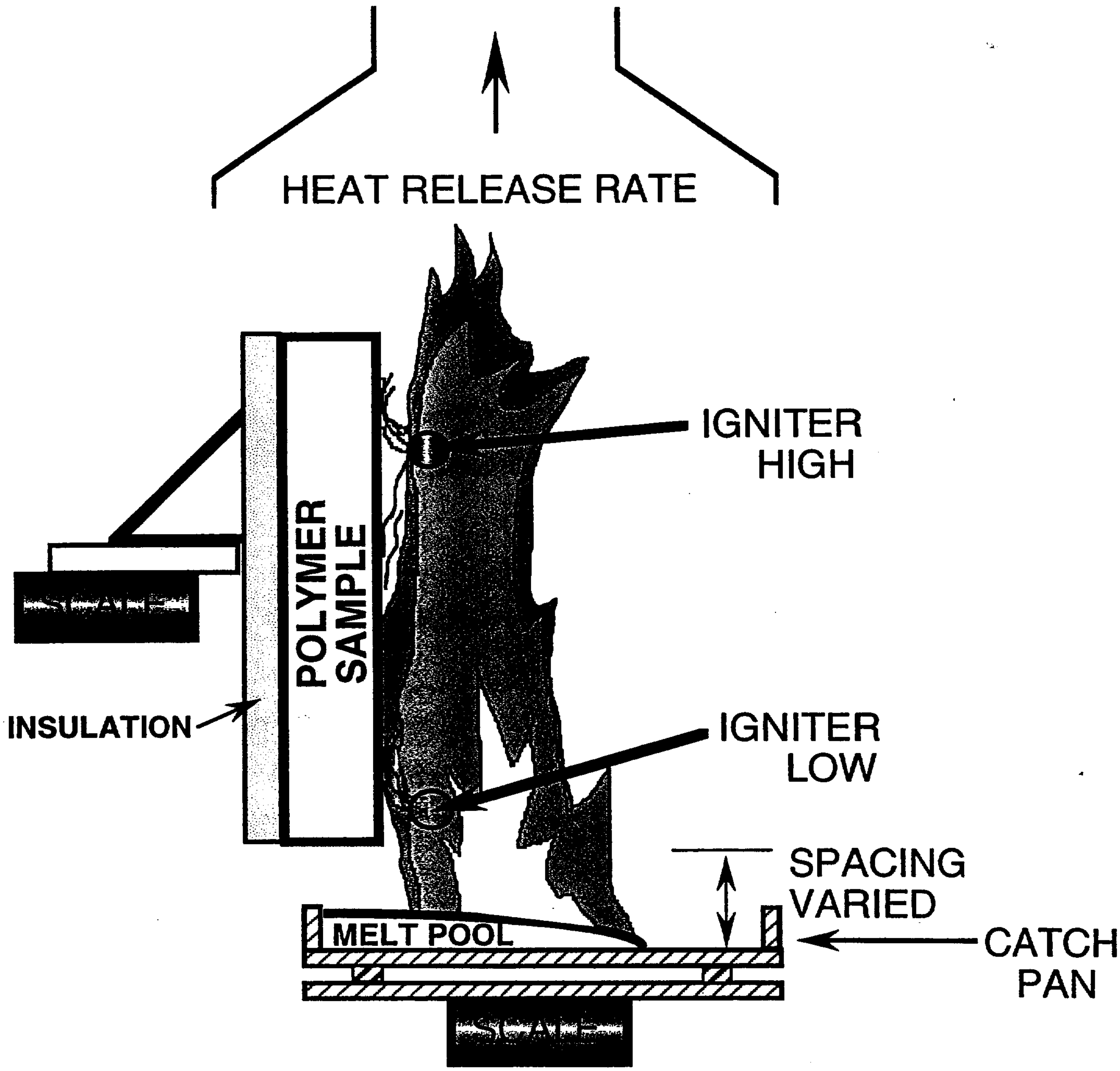



Figure 2. Experimental set-up for polymer melt-drip fires.

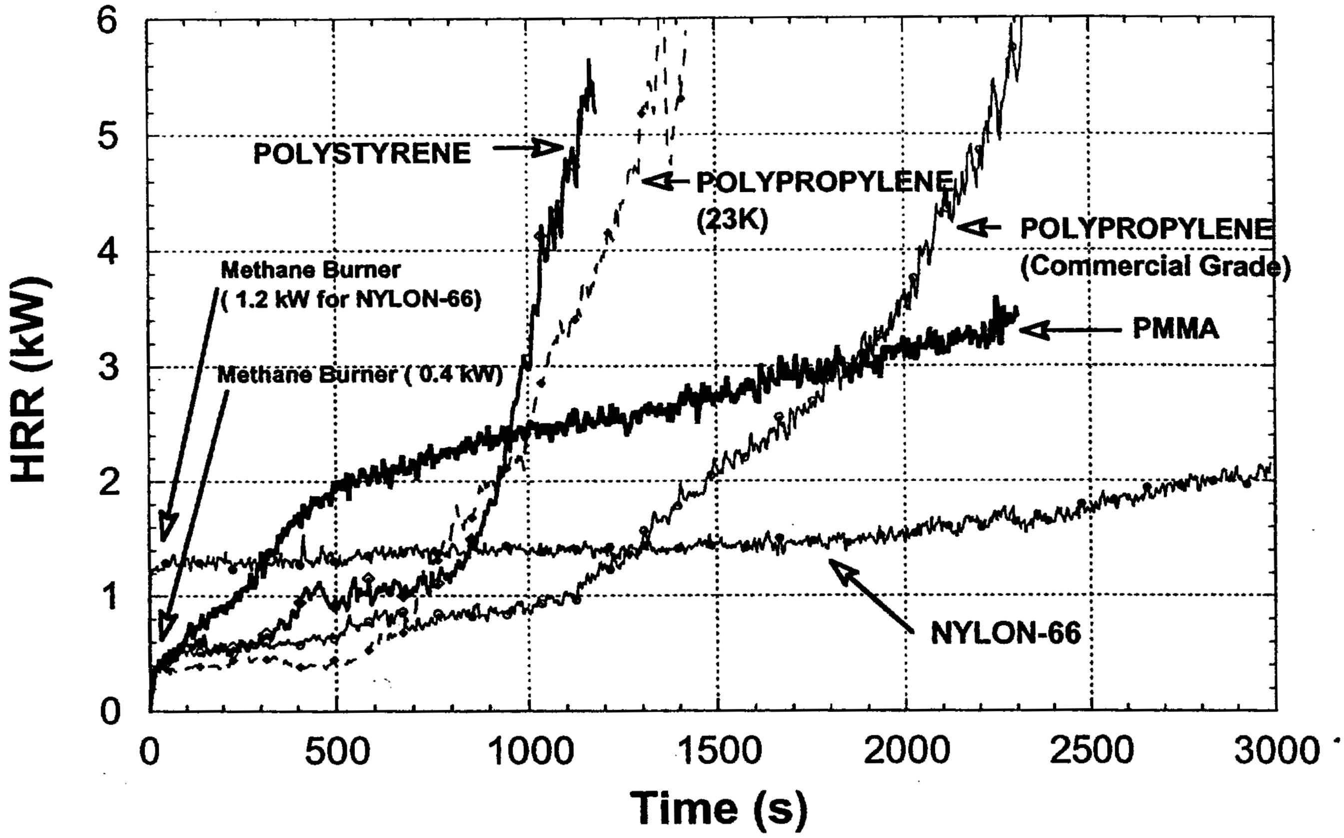



Figure 13. Heat release rate behavior of several thermoplastics, low ignition, sample close to pool.

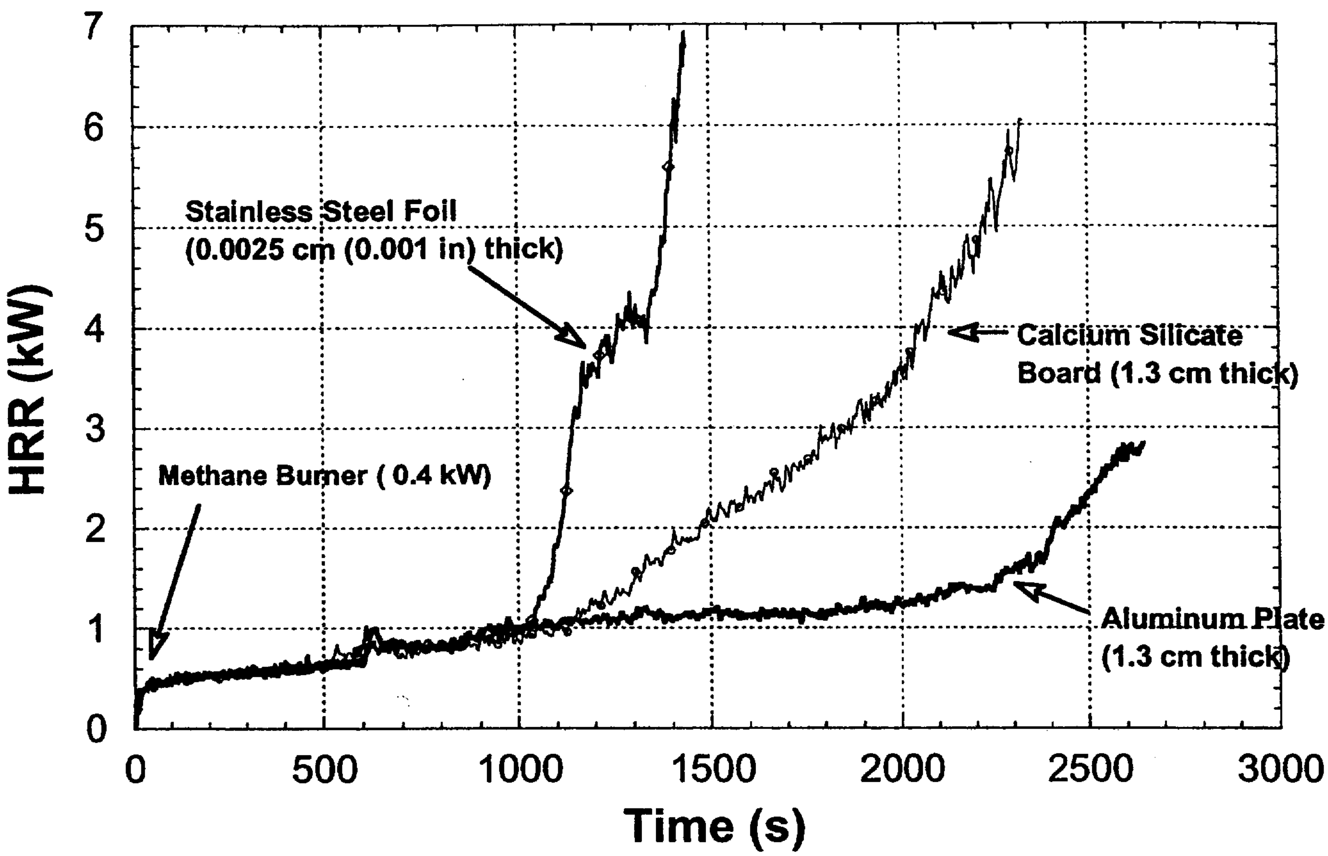



Figure 15. Effect of catch pan material on heat release rate behavior of polypropylene.

# Components Examined

- Battery
- Air Intake Resonator
- Front Headlamp Assembly
- Brake Master Cylinder
- Windshield Wiper Tray
- Hood Liner
- Head Liner
- Wheel Well Liner
- Fuel Tank
- Instrument Panel Assembly
- Front Seat Assembly

- Windshield (Fractured)
- Radiator Outlet Tank
- Radiator Fan Blade
- Power Steering Reservoir

- Air Intake Grill
- Front Fender + Wheel Well Liner
- Rear Bumper Energy Absorber
- Rear Bumper Cover
- Hood Liner
- Rear Interior Trim Panel
- Instrument Panel Assembly

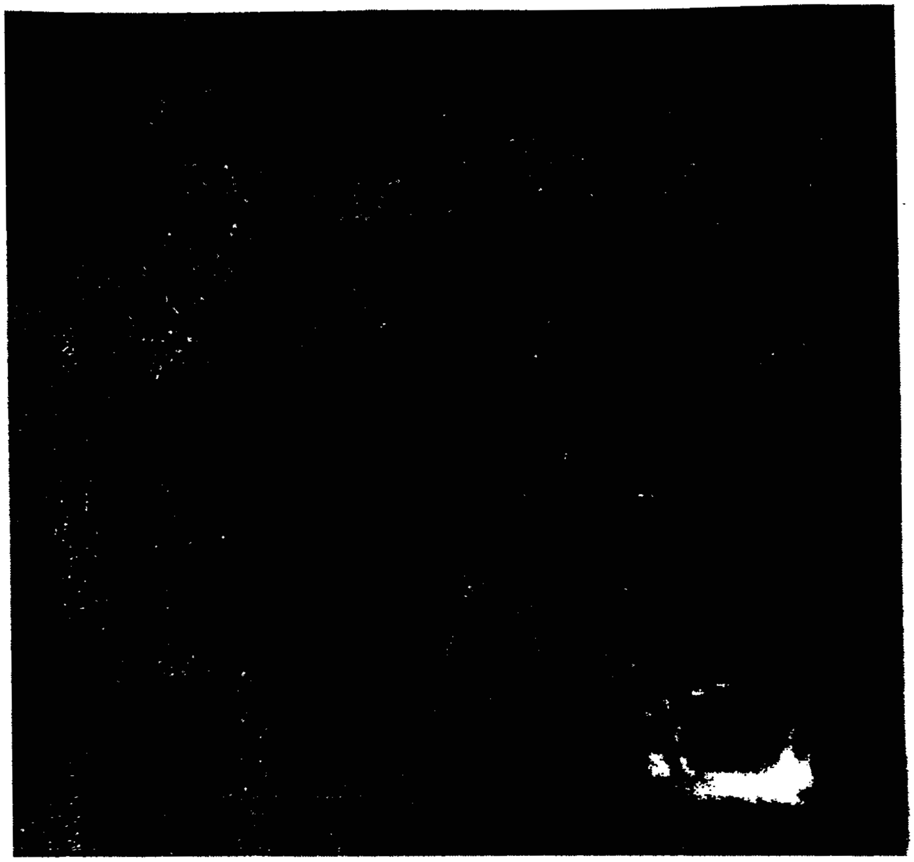


Figure 2. Fractured front window glass as tested in the cone calorimeter (approximately 10 x 10 cm).

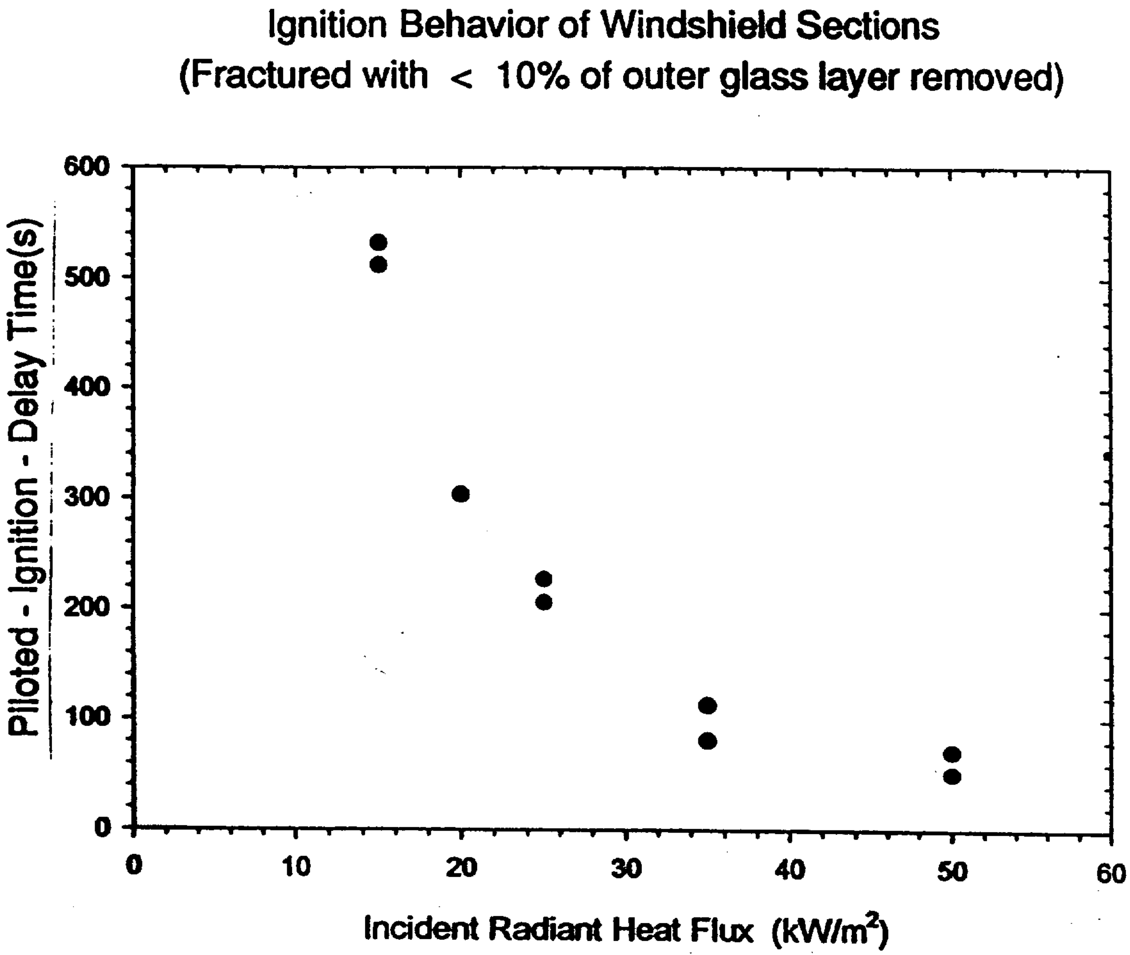



Figure 16. Cone Calorimeter data for windshield sections. Piloted ignition delay time versus incident radiant flux.

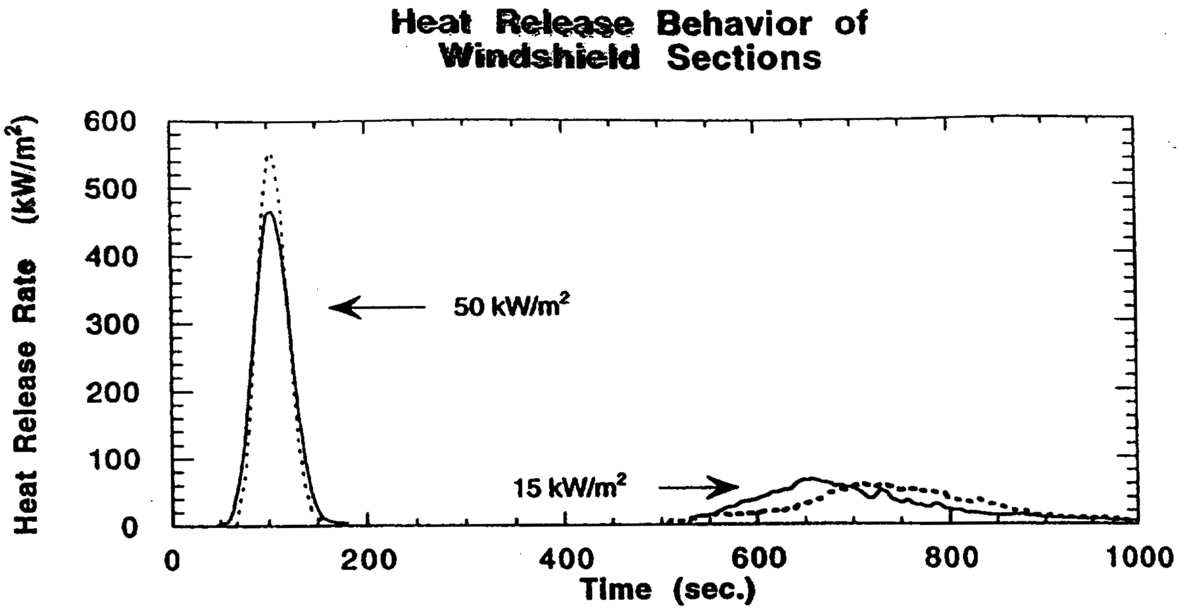



Figure 17. Cone calorimeter test results for windshield sections. Heat release rate history at two heat fluxes. Solid and dotted lines are from separate tests.

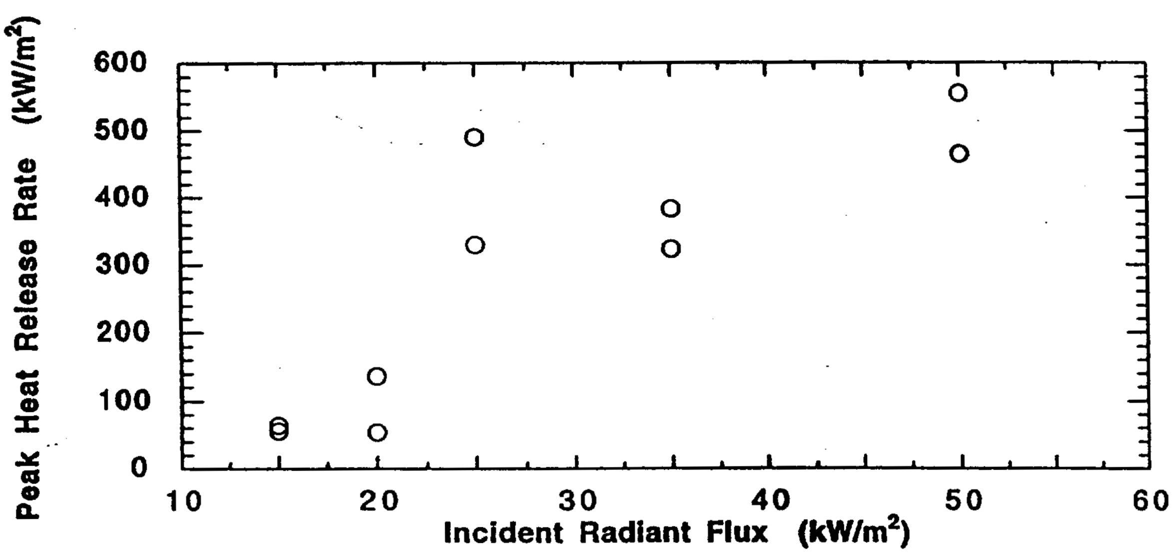



Figure 18. Cone calorimeter test results for windshield sections. Peak heat release rate at five incident heat flux levels.

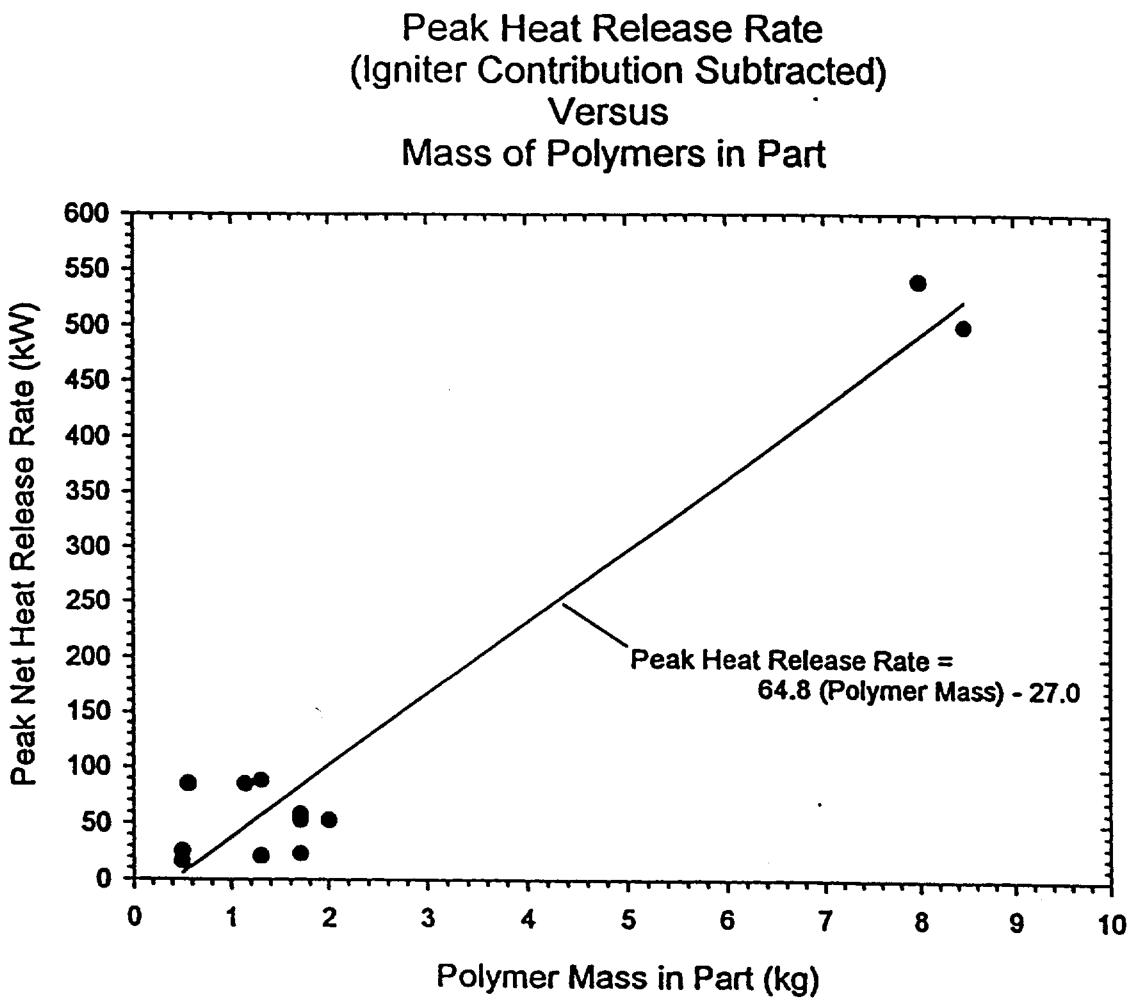



Figure 29a. Peak net heat release rate of various vehicle components versus polymer mass in component.

## Observations on Burning Behavior

- All components examined exhibited sustained burning

- The role of the melt/drip pool in the overall burning process was highly variable (dependent on part geometry and resin properties)

- The size of the fire (peak heat release rate) was roughly proportional to the mass of the part but also substantially dependent on part geometry and resin properties. The size of the fire is not expected to be unique but rather substantially dependent on test conditions.

- It was not possible (from available data) to show a correlation between the fire behavior of a part and measures of the flammability of the component resin.

NHTSA 98-3585

U.S. Department
of Transportation
**National Highway
Traffic Safety
Administration**

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MAY - 7 2002

Deborah K. Nowak-Vanderhoef, Esq.
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Warren, MI 48090-9020

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Dear Ms. Nowak-Vanderhoef:

We have received your letter, dated March 8, 2002, enclosing a paper, entitled "Inductances of Automotive Electromagnetic Devices."

The paper relates to Sub-Project B.10(c) (Evaluation of Spark Ignition of Flammable Air-Fuel Mixtures), and was prepared by H. S. Silvus and Robert E. White of the Southwest Research Institute. You indicate that the paper was presented at and published in the proceedings for the SAE 2002 World Congress, held in Detroit, Michigan, March 4-7, 2002.

Your submission will be placed in the Department of Transportation Dockets, NHTSA-98-3585.

Thank you for your cooperation. If you have any questions or need assistance, please call Ms. Heidi L. Coleman, Assistant Chief Counsel for General Law, at (202) 366-1834 or Mr. Keith Brewer, Director of Human-Centered Research at (202) 366-5662.

Sincerely,

L. Robert Shelton
Executive Director