

Performance Based Fire Classifications for Plastics Used in Electronic Enclosures

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The National Fire Protection Association has compiled statistics from 1990 to 1994 that indicate significant numbers of fires occur in store and office environments each year (Table 1). The number of deaths, injuries, and amount of property damage is significant. About 20% of these fires are attributable to appliance and other office equipment located in the building.

Table 1

NFPA Store & Office Fire Statistics
Annual Averages, 1990 to 1994

Cause	Number of Fires	Property Damage \$MM	Civilian Deaths	Civilian Injuries
Total	27,600	743	19	534
Appliance	2,900	26	0	36
Other Equip.	3,200	65	4	82

Further study of compiled statistics for fires starting within electronic equipment indicates that confining the fire to the object of origin will eliminate deaths, and cut injuries and property damages by over half (Table 2).

In the US, electronic equipment is typically manufactured to adhere to rigorous UL standards for product safety to prevent any type of fault within the equipment from creating a larger fire. These UL standards have played an important role in helping to confine fires within electronic

equipment and to prevent their occurrence altogether. UL has accomplished this with specifications for metal fire enclosures, flame retarded plastic materials, power supply cutouts, and many other guidelines.

Table 2

Structure Fires Starting Within
Electronic Equipment

Fire Damage Annual Averages, 1990 to 1994	No. of Fires	Injuries, Deaths	Property Damage, \$MM
Confined to object	526	18, 0	9.3
Confined to area, room	235	13, 1	3.1
Confined to floor, building	115	10, 4	6.2
Extended beyond building	18	2, 0	0.6
Totals	892	44, 5	19.1

Reference: NFPA, John R. Hall Jr. Report

The amount of plastic materials used in electronic enclosures for a typical desktop computer setup can reach up to 26 pounds and 21 square feet when each component is accounted for (Table 3).

Table 3

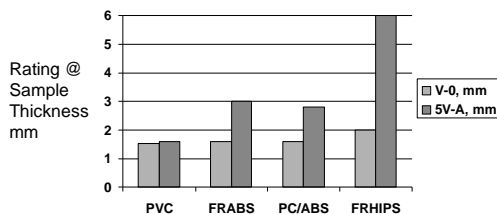
Significance of Plastics Selection
in Electronic Enclosures

- ◆ Amount of plastic in desktop computer setup
 - Monitor enclosure weighs 10 pounds, 7 sq.ft.
 - CPU enclosure weighs 8 pounds, 6 sq.ft.
 - Keyboard housing weighs 2 pounds, 2 sq.ft.
 - Printer cover & frame weigh 6 pounds, 6 sq. ft.
 - Total Plastic Weight is 26 pounds, 21 sq.ft.

The fire contribution of this amount of plastic is significant enough to begin to examine its fire safety performance. UL 94 flammability ratings are the standards that are normally used for classifying which plastics are acceptable to meet guidelines for containing the fire from a fault in the higher voltage electronics within a device. The thickness required to meet the most difficult burn classifications of V-0 and 5VA vary from one plastic to another (Figure 1). Electronic equipment manufacturers whose devices have UL approval often use plastics that meet these flammability specifications at the thickness used for the fire enclosure.

Figure 1

Comparison of UL 94 ratings of Plastics Commonly Used in Electronic Enclosures



But what additional safety considerations can be practiced to further minimize injury, deaths, and damages? The selection of appropriate fire safe plastics will play an important role in this regard in the unlikely event of a fire involving a desktop computer unit or other appliance.

Smaller fires are better! In order to keep the fire contribution of plastics in electronic enclosures to a minimum, selecting plastics materials that have minimum heat release,

flame spread, and smoke generation qualities is preferred (Table 4).

Table 4

Important Fire Performance Characteristics for Plastics

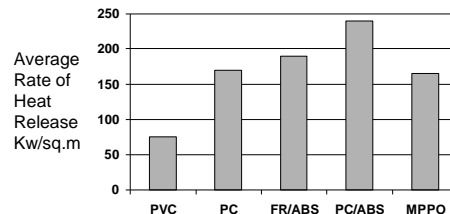
- ◆ Personnel Safety
 - Heat release
 - Smoke generation
 - Toxicity
- ◆ Property Damage
 - Rapid Fire Growth and Spread

Data can be generated using cone calorimetry to compare these other important fire performance properties. From a fire safety perspective, the primary concern is to delay or prevent flashover. The time to flashover is influenced most by fuel content. A comparison of average heat release, the single biggest determinant of a plastic's fuel content in a fire, shows that vinyl has between one third and one half the heat release of typical thermoplastic used in electronics enclosures.

Figure 2

Heat Release of Plastics

Vinyl's low heat release delays flashover in a fire

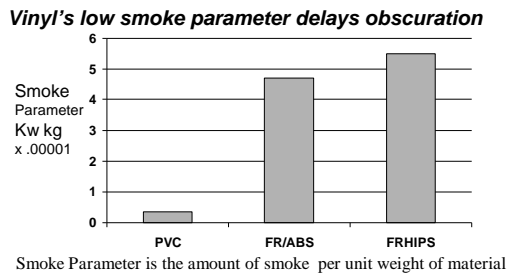


According to Geon data, vinyl molding compound for electronic enclosures has a significantly lower smoke parameter (Figure 3). The benefit of low smoke parameter

means a more visible path to egress during a fire, and less smoke damage to the property.

Figure 3

Smoke Generation of Plastics



Personnel that are close to the origin of a fire are more immediately concerned with burns and heat from the fire. Personnel that are somewhat remote from the flames and heat are subject to toxic combustion byproducts that they might not be physically aware they are breathing. CO (carbon monoxide) is the main toxic threat (Table 5), yet the CO yield from a flashover fire does not appear to be dependent on the fuel. The fuel that yields flashover is the one that is most toxic. If a fuel does not yield flashover, then there is less of a toxicity concern from that fuel. The remote personnel will probably not be affected by a fire that has not reached flashover.

Smoke Toxicity

- ◆ All plastics produce toxic gases during a fire. Because Carbon Monoxide is the most abundant, it is also the most deadly
 - All plastics form carbon monoxide, a toxin
 - ABS forms cyanide, a toxin
 - PC/ABS forms cyanide, a toxin
 - PS depolymerizes to styrene, a carcinogen
 - PVC forms HCL, an irritant

Based on cone calorimeter analysis of burn and smoke generation characteristics, enough differences exist between plastic materials to lead one to believe that finished electronic products would exhibit similar differences in a simulated fire situation. To test this hypothesis, Geon conducted a full scale burn at Omega Point Labs in San Antonio, Texas of computer monitors that were enclosed in various plastic materials. The monitors were set afire using a small 7 oz. wood crib in order to simulate a waste basket that caught on fire next to a desk with a computer on top of it. The alternative fire safety performances studied on the monitors included:

- **Peak rate of heat release**
- **Time to ignition**
- **Duration of burning**
- **Smoke generation**

The test results (Table 6) indicate that a good correlation exists between cone calorimeter data and full scale burn tests of the finished electronic device.

Table 5

Table 6

Monitor Burn Testing

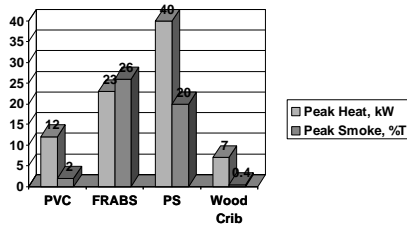
Monitor Enclosure Plastic Type	PVC	FRABS	FRHIPS
Peak Heat , kW	12	19	40
Time of Peak Heat, Min.	9	6	6
Time to Ignition, Min.	6:50	3:25	4:15
Peak Smoke, %T	2	20	20
Time of Peak Smoke, Min.	10	6	6
Duration of Burn, Min.	11:50	16:30	16:00

Actual Burn Test Completed at Omega Point Labs, in San Antonio, TX of Monitors made with these plastics

Under the test conditions of a simulated office fire that initiates outside of the computer monitor, vinyl shows a marked advantage from a fire safety perspective with half to one third the peak heat and one tenth the peak smoke (Figure 4).

Figure 4
Performance Based Testing
of Computer Monitor

Actual Burn Results from Tests at Omega Point Labs, in San Antonio, TX of Monitors Made with These Plastics



The net result of this work shows that selection of plastic materials for use in electronics enclosures plays an important role in the overall fire safety of the device in the unlikely event that it is involved in an office fire that initiates outside of the enclosure. The benefits to performance based testing (Table 7) can now be identified in order to reduce injuries, deaths, and damages.

Table 7

Benefit of Performance Based Testing for Electronic Enclosures

- ◆ With Appropriate materials selections
 - Lower heat release
 - Less smoke generation
 - Longer time to ignition
 - Shorter duration of burn
- ◆ Reduce Injuries, Deaths and Damages
 - Prolong time to flashover
 - Clearer visibility for identifying exit
 - Increase time for egress
 - Confine property damages

Geon vinyl molding compounds demonstrate superior fire safety characteristics for electronics enclosures and in many cases at a substantially lower cost. Please contact the Geon company for further information on how vinyl materials can meet your product's performance requirements and provide more robust fire safety without increasing your costs.

References

- ◆ NIST SP 838-12: Gann, R.G. "Developing Materials Fire Response Information for Assessing Fire Hazard and Risk" Fire Risk and Hazard Assessment Symposium: Research & Practice, June 26-28, 1996 p. 286-294
- ◆ NFPA Fire Data Reports, "Computer Equipment and Computer Areas" John R. Hall Jr., August, 1996

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