OBERON
Division of Paramount Corp.

PROTECTION LEVEL OF CLEAR SHIELD WINDOWS

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Introduction: Over the past several years during development and approval of ASTM 2178 Standard Test Method for Face Protective Products there has been discussion regarding the level of protection provided by clear faceshields or clear hood shield windows. Anecdotal evidence would suggest that clear hood shield windows have provided protection from the incident heat energy of an arc flash event. To resolve this issue, testing has been conducted using ASTM F2178 instrumented heads to determine the level of protection provided by a clear shield window.

Arc Test Results: ARC15 hoods assembled with clear 079 polycarbonate shield windows with UV screeners and a scratch resistant thermo-set coating were exposed to a series of arc incident energy levels. The ASTM F2178 test method set up was used, but only one faceshield was tested at each incident energy level. Table 1 indicates that a second-degree burn is predicted for both eye and mouth sensors for all arc test exposure levels. An incident energy level transmitted through the faceshield of 1.2 cal/cm^2 is required for a predicted second- degree burn.

Table 1: Arc Test Results for Clear Shield Windows

Incident Heat Energy, cal/cm²	Predicted second-Degree Burn	Incident Energy Transmitted
2.7	Eyes/Mouth Sensors	54%
4.3	Eyes/Mouth Sensors	49%
6.0	Eyes/Mouth Sensors	51%
27.7	Eyes/Mouth Sensors	23%

Table 1 also indicates that at an exposure level of 27.7 cal/cm^2, the clear shield window blocks a larger percentage of incident energy. This is likely due to the increased formation of opaque char on the faceshield window at the highest exposure level. Figures 1 and 2 indicate the heavy char formation for the highest exposure level of 27.7 cal/cm^2 used in these tests.

079 Clear Shield Window with UV Screener and Scratch Resistant Coating after 27.7 cal/cm^2 arc exposure

Figure 1: Clear Shield Charring

Figure 2 shows a close-up photograph indicating the char formation of a 079 clear shield window with UV screener and scratch-resistant coating after arc test 03-2555 exposure of 27.7 cal/cm^2

Figure 2: ARC15 Hood with Clear Shield Window After a High Incident Energy Arc Exposure

Figure 3 shows an intermediate charring level for an incident heat energy exposure of 6.0 cal/cm^2 on Head A and the low level of char formation for an incident heat energy exposure of 4.3cal/cm^2 on Head B.

The lower char level permits a greater percentage of the incident energy to be transmitted through the clear shield window onto the eye and mouth sensors as shown in Table 1.

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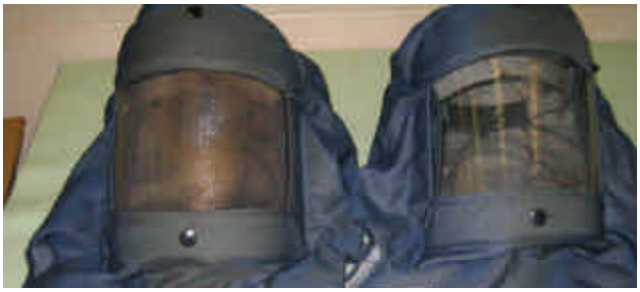

079 Clear Shield Windows
Head A **Head B**
6.0 cal/cm^2 **4.3 cal/cm^2**
Arc Test 03-2557

Figure 3: ARC15 Hoods with Clear Shield Windows After Lower Incident Energy Arc Flash Exposures

Conclusions: Based on these laboratory arc tests, clear faceshields with UV screeners and a scratch resistant coating do not offer effective protection against the incident heat energy from an arc flash exposure. As the incident energy increases, the creation of an opaque char on the shield window surface decreases the percentage of transmitted energy, but at these higher exposure levels, there is still more than sufficient heat energy transmitted to cause a predicted second- degree burn injury.

Based on 54% transmitted incident heat energy for a 2.7 cal/cm^2 exposure, the arc rating of these 079 clear shield windows is in the range of 2.0 to 2.5 cal/cm^2. For arc durations of approximately 0.1 second as used in the low exposure levels of this testing, it has been estimated that the heat energy required for second- degree burn injury increases from 1.2 to 1.5 cal/cm^2. Even considering this higher burn injury threshold, a burn injury with the clear shield windows would occur at an arc exposure of approximately 2.8 cal/cm^2.

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Dr. Neal holds a PhD in Analytical Chemistry from the University of North Carolina and was the Technology Manager of DuPont's Thermal Testing Laboratory from 1994 through 1999. He has over twenty-five years of experience in high performance fibers, fabrics and protective clothing, and he has been a leader in the development of industry standards related to electric arc flash hazard analysis and the application of flame resistant protective apparel for arc flash and flash fire hazards, including ASTM F18, ASTM F23, NFPA 2112, NFPA 2113 and NFPA70E. Tom leads ASTM Task Groups for the ASTM F1506 and F1891 specifying protective clothing and rainwear for the arc flash hazard, a new electric arc instrumented mannequin test method for evaluating full protective clothing systems, and the F1930 flash fire test method for FR clothing.

In 1999 after retiring from DuPont, Tom started his own consulting business, Neal Associates Ltd., and has continued his participation in protective clothing standards organizations and his work on testing and improving

The reason for anecdotal evidence regarding protection provided by clear shield windows remains unclear. There may be cases in which a worker was facing away from the arc source when the arc flash event occurred. Or the face area may have been exposed to lower levels of incident heat energy than other parts of the body giving the impression that a clear shield window had provided protection.

Whatever the reason, it is important to note that clear faceshields or clear shield windows do not offer any significant degree of protection for the face during an arc flash event. Hopefully this can help dispel the myth of clear shield window protection and avoid unnecessary burn injury in the event of an arc flash accident.

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