



Test Report for

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Elvex polycarbonate faceshield model FS-20ARC10 (green tint) with
blue chin protector mounted on Elvex visor bracket VB-30 and
Elvex white ProGuard SC30-R6 safety helmet.

ARC RATING by ASTM F2178-08,

Standard Test Method for Determining the Arc Rating and Specification for Eye or Face Protective Products.

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Note about this report

- The test performed does not apply to electrical contact or electrical shock hazard
- The test result is applicable only to the Test Item, other material or color may have different protection level
- The findings of this report are based on the current test method as described in the Reference Standard
- It is assumed that the information supplied by the client was valid and complete

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TEST REPORT

Test item: Elvex polycarbonate faceshield model FS-20ARC10 (green tint) with blue chin protector mounted on Elvex visor bracket VB-30 and Elvex white ProGuard SC30-R6 safety helmet.

Test Performed: Determination of the arc thermal performance value of lens for use as flash protection against an electric arc.

Reference Standard: ASTM F2178-08, Standard Test Method for Determining the Arc Rating and Specification for Eye or Face Protective Products.

Description of test

The test follows the procedure of ASTM F2178-08 to determine the arc rating for the lens. This test is intended to measure the burn threshold and heat attenuation factor of the lens and observe any adverse reactions of the materials or integrity of the attachment brackets.

This face protection product is a single polycarbonate shield with an adjustable bracket that clips onto the hard cap. The lens with protective helmet are tested as an ensemble using mannequins with instrumented heads to measure the level of protection against the arc energy. Two mannequins are used placed 120° apart and positioned to have the instrumented heads at a distance of 30 cm from the arc. The electrodes are adjusted to provide a 30 cm arc centred on the nose of the instrumented head. The arc energy and measured parameters of the tests are given in Table 1. Photos of the samples as shown in Figures 2 and 3.

RESULTS

Test Parameters: Arc current = 8 kA rms, Arc Gap= 30 cm, distance to the arc = 30 cm

Lens

Elvex polycarbonate faceshield model FS-20ARC10 (green tint)

- ATPV arc rating: 12.5 cal/cm²
- Heat Attenuation Factor, HAF: 90 %
- No melting or dripping and no after-flame at ATPV level
- Ignition of blue thin lip of chin cup at 14.4 cal/cm²


Based on the results observed in Table 1, the first area of burn occurs on the chin. This may occur because the arc energy rises up or gets deflected from the chest to cause a burn to the exposed chin area. At higher energy of approximately 17 cal/cm², the first burns through the lens were recorded. This is energy coming directly through the lens on the sensors in the position the mouth.

Because of the variability of the arc, different values may be observed at individual sensors or incident energy monitors at the different positions and from shot to shot. For these samples, the

range of the heat attenuation factor (HAF) varied between nominal 88% and 94% with an average of 90%.

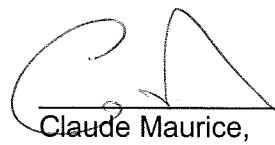
The individual test sheets, photographs and video of every test are provided in digital format to the Client for review.

Test performed by:

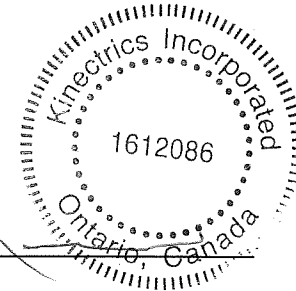


 Joe Ogrodowczyk, Technologist
 High Current Laboratory

Reviewed by:



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Terminology

Arc Rating, n—value attributed to materials that describes their performance to exposure to an electrical arc discharge. The arc rating is expressed in cal/cm² and is derived from the determined value of ATPV or E_{BT50} (should a material system exhibit a breakopen response below the ATPV value)

Arc Thermal Performance Value (ATPV), the incident energy on a fabric or material that results in a 50 % probability that sufficient heat transfer through the tested specimen is predicted to cause the onset of a second-degree skin burn injury based on the Stoll¹ curve.

Breakopen threshold energy (E_{BT50}), *n*—the incident energy on a fabric or material that results in a 50 % probability that sufficient heat transfer through the tested specimen is predicted to cause the tested specimen to break open. The specimen is considered to exhibit breakopen when any hole is at least 1.6 cm² [0.5 in.²] in area or at least 2.5 cm [1.0 in.] in any dimension. In multiple layer specimens of flame resistant material, all the layers must breakopen to meet the definition. In multiple layer specimens, if some of the layers are ignitable, breakopen occurs when these layers are exposed.

Heat Attenuation Factor, HAF, n— in arc testing, the percent of the incident energy that is blocked by a material.

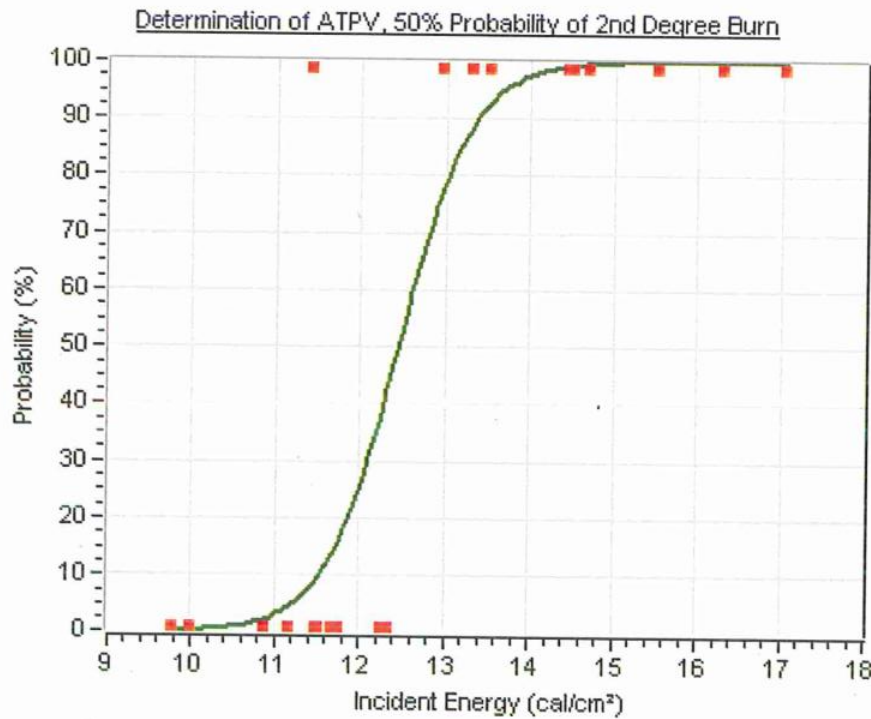
Stoll curve¹, n— an empirical predicted second-degree skin burn injury model, also commonly referred to as the *Stoll Response*.

SCD (Stoll Curve Difference)—The time dependent averaged heat energy response for each panel is compared to the Stoll Curve. A second-degree skin burn injury is predicted if the panel sensor heat energy response exceeds the Stoll Response value at any time (positive SCD). If the sensor response is below the Stoll Curve, no burn injury is predicted and a negative SCD is recorded.

¹Derived from: Stoll, A. M. and Chianta, M. A., "Method and Rating System for Evaluations of Thermal Protection," *Aerospace Medicine*, Vol 40, 1969, pp. 1232-1238 and Stoll, A. M. and Chianta, M. A., "Heat Transfer through Fabrics as Related to Thermal Injury," *Transactions—New York Academy of Sciences*, Vol 33 (7), Nov. 1971, pp. 649-670.

Figure 1: Determination of arc rating by logistic regression method

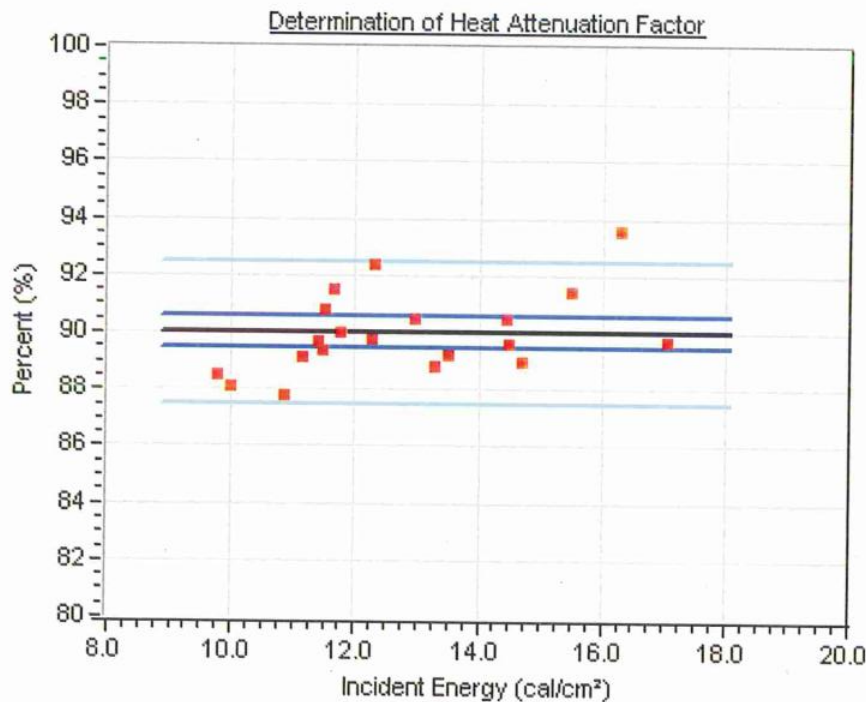
Fabric Elvex polycarbonate faceshield model FS-20ARC10 (green tint) with blue chin
Description: protector. Mounted on Elvex white hard hat with adjustable hinged frame.



ATPV = 12.5 cal/cm²

Probability of Burn	Ei
5%	11.2
10%	11.5
20%	11.9
30%	12.1
40%	12.3
50%	12.5
60%	12.6
70%	12.8
80%	13.0
90%	13.4

Pts = 20
 # Pts above Stoll = 10
 # Pts Break-Open = 1
 # Pts always >STOLL = 9
 # Pts always <STOLL = 4
 # Pts within 20% = 16
 # Pts in mix zone = 7



HAF = 90.0 %

Confidence Intervals
 95% CI = 89.4, 90.5





Data pts 
 Best Fit 
 95% CI 
 95% CI pts 

Figure 2: Elvex Faceshield FS-20ARC-10 with Blue chin protector and ProGuard SC30-R6 safety helmet
As set up for testing

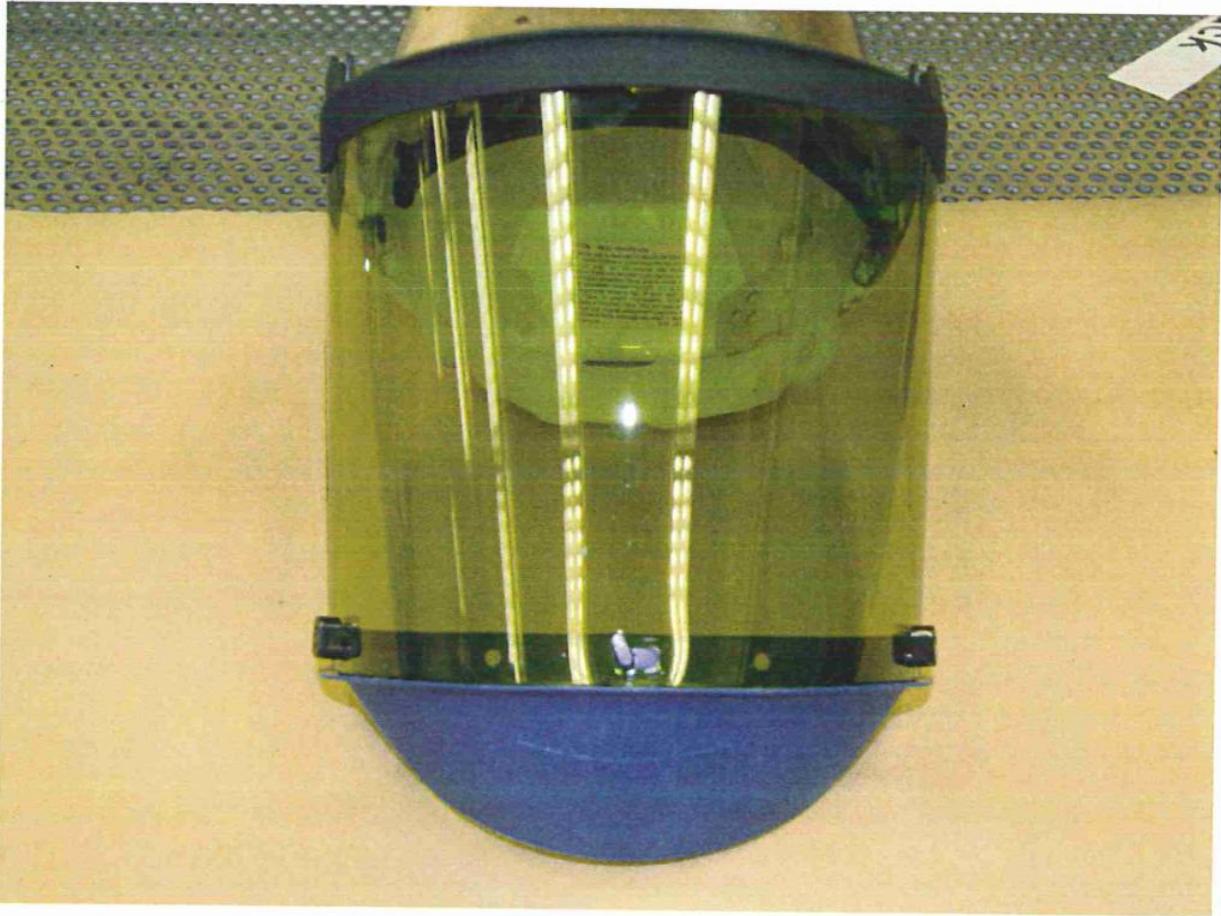


Figure 3

Lens after exposure

09-2029, near 12.5 cal/cm² (near ATPV) Surface charred, no ignition or melting



09-2028, Approx 14.5 cal/cm², Surface more heavily charred, Ignition of chin guard on 1 sample on thin protruding lip.

