PROTECTIVE CLOTHING LABORATORY DATA SHEET
NFPA 1994 - Protective Ensembles for First Resonders to CBRN
Section 8.7 - Chemical Permeation Resistance Testing

Client:	**Radiation Shield Technologies, Inc.**	**Log Number(s):**	**CRT 1507161034**
Product Description:	**Red Demron ICE lot**		
Job Number:	**G102180184**	**SEI Reference Number:**	**500608000**
Reference:	**NFPA 1994 - section 8.7**		
Conditioning:	**In accordance with NFPA 1994 - section 8.7.3.7, Samples shall be conditioned at a temperature of 32°C (±1°C) and a relative humidity of 80% (±5%) for at least 24 hours.**		

Conditioning Start: 7/21/2015 **Conditioning Stop:** 7/30/2015
Conditioning Temp Range (°C): 32±1 **Conditioning RH Range (%):** 80±5
Condition Location: Chem chamber #1

Sample Area*: 9.93 cm^2 **Collection Medium*:** 10 ml DI water
Average Cumulative Perm. Limit*: 6.0 µg/cm^2 **Minimum Detectable Rate*:** 0.1 µg/cm^2
Challenge Contact*: Continuous

* applies to all test, samples and chemicals

Challenge Chemical: Dimethyl sulfate (10g/m²) CAS #: 77-78-1
Source / Product # : Sigma Aldrich
Challenge Length : 60 minutes Sampling Frequency: Once

Test Results	Cell 1	Cell 2	Cell 3	AVG	Std Dev
Cumulative Permeation Mass (µg/cm^2)	3.42	1.76	3.34	2.84	0.94
Ave. Sample Thickness (mils)	23	24	24	24	1
Ave. Sample Thickness (mm)	0.58	0.61	0.61	0.60	0.01

Challenge Chemical: Chlorine (350 ppm) CAS #: 7782-50-5
Source / Product # : AirGas
Challenge Length : 60 minutes Sampling Frequency: Once

Test Results	Cell 1	Cell 2	Cell 3	AVG	Std Dev
Cumulative Permeation Mass (µg/cm^2)	0.28	2.65	1.78	1.57	1.20
Ave. Sample Thickness (mils)	23	23	24	23	1
Ave. Sample Thickness (mm)	0.58	0.58	0.61	0.59	0.01

Challenge Chemical: Ammonia (350 ppm) CAS #: 7664-41-7
Source / Product # : AirGas
Challenge Length : 60 minutes Sampling Frequency: Once

Test Results	Cell 1	Cell 2	Cell 3	AVG	Std Dev
Cumulative Permeation Mass (µg/cm^2)	0.16	0.19	0.19	0.18	0.02
Ave. Sample Thickness (mils)	23	23	23	23	0
Ave. Sample Thickness (mm)	0.58	0.58	0.61	0.59	0.01

Challenge Chemical: Acrolein (350 ppm) CAS #: 107-02-8
Source / Product # : AirGas
Challenge Length : 60 minutes Sampling Frequency: Once

Test Results	Cell 1	Cell 2	Cell 3	AVG	Std Dev
Cumulative Permeation Mass (µg/cm^2)	<0.1	<0.1	<0.1	0.10	0.00
Ave. Sample Thickness (mils)	23	24	24	24	1
Ave. Sample Thickness (mm)	0.58	0.61	0.61	0.60	0.01

Challenge Chemical: Acrylonitrile (350 ppm) CAS #: 107-13-1
Source / Product # : AirGas
Challenge Length : 60 minutes Sampling Frequency: Once

Test Results	Cell 1	Cell 2	Cell 3	AVG	Std Dev
Cumulative Permeation Mass (µg/cm^2)	0.36	0.36	0.36	0.36	0.00
Ave. Sample Thickness (mils)	23	24	23	23	1
Ave. Sample Thickness (mm)	0.58	0.61	0.58	0.59	0.01

Time of Test: 23:00 **Test Location:** Chemistry Lab **Test Temp.:** 32±1°C **RH:** 80%

Equipment Used	Control Number	Calibration Date	Calibration Due
Thickness	**N1244**	**1/8/2015**	**1/8/2016**
Conductivity meter	**C203**	**11/13/2014**	**11/13/2015**

Test Date: 7/30/2015 **Chemist** Adam Stringer
GC Date: 7/31/2015 **Type name:** Adam Stringer

PROTECTIVE CLOTHING LABORATORY DATA SHEET
SECTION 7.1.2.7
VIRAL PENETRATION RESISTANCE TEST
ASTM F1671-07 Standard Test Method for Resistance of Materials Used in Protective Clothing to Penetration by Blood-Borne Pathogens Using Phi-X174 Bacteriophage Penetration as a Test System

Client:	**Radiation Shield Technologies, Inc.**	**Sample Log Number(s):**	**CRT1507161034-001**
PRODUCT DESCRIPTION: Red Demron Ice- Lot # RSC-01-150615-35-48			
Job Number:	**G102180184**	**Quote Number:**	**500608000**
Reference:	NFPA 1994 (2012 Edition), Section 7.1.2.7 & Section 8.21; ASTM F1671.		
PRE-CONDITIONING: In Accordance with Section 8.1.3 and Section 8.1.4			
CONDITIONING: In Accordance with Section 8.1.2 In accordance with NFPA 1994; section 8.1.2, at a temperature 21°C ± 3°C (70°F ± 5°F) and a relative humidity of 65% ± 5% until equilibrium is reached or for at least 24 hours, whichever is shorter.			

Quality Control Samples	PFU/ml	Results
Positive Control	>150	Acceptable (valid test)
Negative Control	0	Acceptable (valid test)
Pre-test Bacteriophage Titer	1.1×10^8	Acceptable (valid test)
Post Test Bacteriophage Titer	1.1×10^8	Acceptable (valid test)
Settle Plate(s)	0	Acceptable (valid test)

Testing Procedure Used:	Procedure A: 0 psig for 5 minutes, 2 psig for 1 minute, 0 psig for 54 minutes. No retaining screen used.

Test Results	Cell 1		Cell 2		Cell 3	
	Plate 1	Plate 2	Plate 1	Plate 2	Plate 1	Plate 2
Number of Plaques	0	0	0	0	0	0
Assay Volume (ml)	5		5		5	
Assay Titer (pfu/ml)	0		0		0	
Sample Thickness (mils)	23		23		23	
Sample Weight (g)	2.2613		2.2186		2.3185	
Test Terminated due to Liquid Penetration	No		No		No	
Pass/Fail	Pass		Pass		Pass	

Equipment Used	Asset Number	Calibration Date	Calibration Due
Thickness	N1244	1/8/2015	1/8/2016
Weight	S940	4/8/2015	4/8/2016
Pressure	P1058	4/23/2015	4/23/2016

Analytical Notes:

Test Date: 7/29/2015 **Technician Name:** Kimberly Lea

Technician Signature:

SECTION 7.1.2.1
WARFARE AGENT CHEMICAL PERMEATION RESISTANCE
(TEST CONDUCTED AT AVARINT, LOCATED IN BUFFALO, NY)

Avarint
A CUBIC Company

NFPA TEST REPORT

Method: NFPA 1994; Class 1 (2018 ed)
Material ID: Radiation Shield Tech G103707701 CRT1902011100-001
Material Type: Demron Ice Material
Test Date: 2/8/2019
Report Date: 2/11/2019

Customer: Intertek
3933 US Route 1
Cortland, NY 13045

Test Trial Summary Information

Test Trial: A0026-99
Test Duration: 60 minutes
Temperature: 90.3°F
Pass Criteria: < 0.43 $\mu g/cm^2$ (15 min); 1.25 $\mu g/cm^2$ (60 min)

Chemical: GD
DCR Response: 107%
Relative Humidity: 78.5%
Detection Limit: 0.05 $\mu g/cm^2$

Test Results

Demron Ice Material

Avarint Sample Control Number	Sample Type	Permeation ($\mu g/cm^3$)	
		t = 15 min	t = 60 min
A0026-2081	Replicate 1	ND	0.16
A0026-2082	Replicate 2	ND	0.13
A0026-2083	Replicate 3	ND	0.18
A0026-2084	Neg. Ctrl	ND	ND
Pos. Ctrl	Average recovery (%)	58%	ND

Avarint Sample Control Number	Sample Type	Permeation ($\mu g/cm^2$)	
		t = 15 min	t = 60 min

Avarint Sample Control Number	Sample Type	Permeation ($\mu g/cm^3$)	
		t = 15 min	t = 60 min

Avarint Sample Control Number	Sample Type	Permeation ($\mu g/cm^2$)	
		t = 15 min	t = 60 min

Avarint Sample Control Number	Sample Type	Permeation ($\mu g/cm^3$)	
		t = 15 min	t = 60 min

Avarint Sample Control Number	Sample Type	Permeation ($\mu g/cm^2$)	
		t = 15 min	t = 60 min

Permeation results that are below the detection limit are reported as non-detect (ND).

Prepared by:
Scott C. Glogowski
Research Scientist

Approved by:
Rich Fitzpatrick
Director, Chemical Sciences Group

ASTM C177

STEADY–STATE HEAT FLUX MEASUREMENTS AND THERMAL TRANSMISSION PROPERTIES BY MEANS OF THE GUARDED-HOT-PLATE APPARATUS

Significance and Use

This test method covers the measurement of heat flux and associated test conditions for flat specimens. The guarded-hot-plate apparatus is generally used to measure steady-state heat flux through materials having a “low” thermal conductivity and commonly denoted as “thermal insulators.” Acceptable measurement accuracy requires specimen geometry with a large ratio of area to thickness.

Two specimens are selected with their thickness, areas, and densities as identical as possible, and one specimen is placed on each side of the guarded-hot-plate. The faces of the specimens opposite the guarded-hot-plate and primary guard are placed in contact with the surfaces of the cold surface assemblies.

Steady-state heat transmission through thermal insulators is not easily measured, even at room temperature. This is because heat may be transmitted through a specimen by any or all of three separate modes of heat transfer (radiation, conduction, and convection); any inhomogeneity or anisotropy in the specimen may require special experimental precautions to measure that flow of heat; hours or even days may be required to achieve the thermal steady-state; no guarding system can be constructed to force the metered heat to pass only through the test area of insulation specimen being measured; moisture content within the material may cause transient behavior; and physical or chemical change in the material with time or environmental condition may permanently alter the specimen.

Application of this test method on different test insulations requires that the designer make choices in the design selection of materials of construction and measurement and control systems. Thus there may be different designs for the guarded-hot-plate apparatus when used at ambient versus cryogenic or high temperatures. Test thickness, temperature range, temperature difference range, ambient conditions and other system parameters must also be selected during the design phase. Annex A1 is referenced to the user, which addresses such issues as limitations of the apparatus, thickness measurement considerations and measurement uncertainties, all of which must be considered in the design and operation of the apparatus.

Apparatus constructed and operated in accordance with this test method should be capable of accurate measurements for its design range of application. Since this test method is applicable to a wide range of specimen characteristics, test conditions, and apparatus design, it is impractical to give an all-inclusive statement of precision and bias for the test method. Analysis of the specific apparatus used is required to specify a precision and bias for the reported results. For this reason, conformance with the test method requires that the user must estimate and report the uncertainty of the results under the reported test conditions.

Qualification of a new apparatus: When a new or modified design is developed, tests shall be conducted on at least two materials of known thermal stability and having verified or calibrated properties traceable to a national standards laboratory. Tests shall be conducted for at least two sets of temperature conditions that cover the operating range for the apparatus. If the differences between the test results and the national standards laboratory characterization are determined to be significant, then the source of the error shall, if possible, be identified. Only after successful comparison with the certified samples, can the apparatus claim conformance with this test method. It is recommended that checks be continued on a periodic basis to confirm continued conformance of the apparatus.

The thermal transmission properties of a specimen of material: may vary due to the composition of the material; may be affected by moisture or other environmental conditions; may change with time or temperature exposure; may change with thickness; may change with temperature difference across the specimen; or may change with mean temperature. It must be recognized, therefore, that the selection of a representative value of thermal transmission properties for a material must be based upon a consideration of these factors and an adequate amount of test information.

Since both heat flux and its uncertainty may be dependent upon environmental and apparatus test conditions, as well as intrinsic characteristics of the specimen, the report for this test method shall include a thorough description of the specimen and of the test conditions.

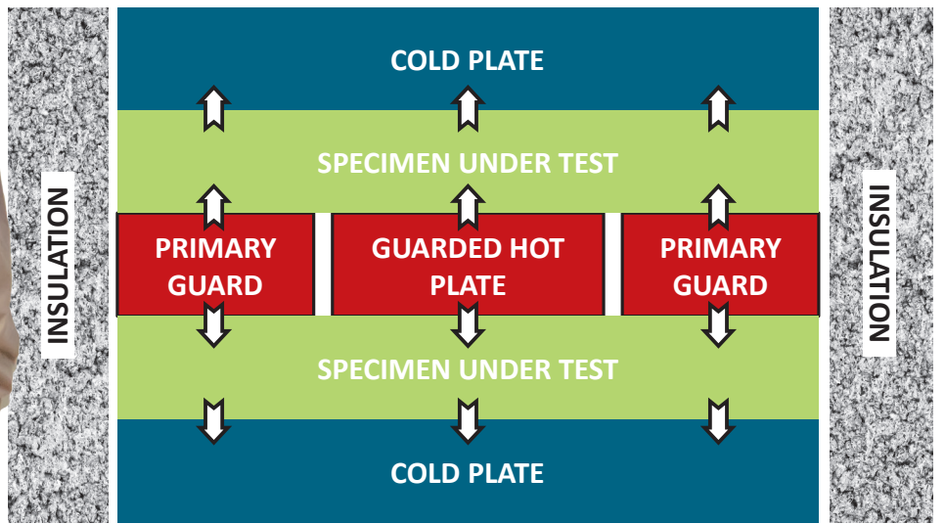
The results of comparative test methods such as Test Method C518 depend on the quality of the heat flux reference standards. The apparatus in this test method is one of the absolute methods used for generation of the reference standards. The accuracy of any comparative method can be no better than that of the referenced procedure. While the precision of a comparative method such as Test Method C518 may be comparable with that of this test method, Test Method C518 cannot be more accurate. In cases of dispute, this test method is the recommended procedure.

1. Scope

1.1 This test method establishes the criteria for the laboratory measurement of the steady-state heat flux through flat, homogeneous specimen(s) when their surfaces are in contact with solid, parallel boundaries held at constant temperatures using the guarded-hot-plate apparatus.

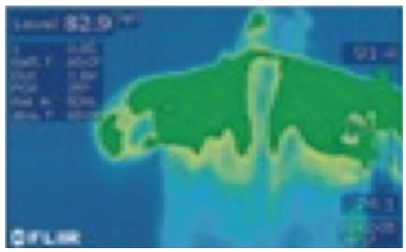
1.2 The test apparatus designed for this purpose is known as a guarded-hot-plate apparatus and is a primary (or absolute) method. This test method is comparable, but not identical, to ISO 8302.

IDEALIZED HEAT FLOW IN A BIDIRECTIONAL GUARDED HOT PLATE APPARATUS



Two identical specimens are needed for one test.

Heat Flow Direction Indicators



FLIR thermal imaging camera shows heat being transferred to the thermally conductive Demron ICE suit and being released into the atmosphere. Complete video may be viewed at: www.youtube.com/watch?v=WzUEx87lZnM