National Fire Protection Association

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MEMORANDUM

TO: NFPA Technical Correlating Committee on Fire and Emergency Services Protective Clothing and Equipment

FROM: Stacey Van Zandt

DATE: October 20, 2010

SUBJECT: NFPA 1971 ROP TCC Letter Ballot (F2011)

In accordance with the NFPA Regulations Governing Committee Projects, attached is the Letter Ballot on the Report on Proposals (ROP) for the 2012 Edition of NFPA 1971. Also attached is a copy of the Proposals that have TCC Notes.

Please note the ballot has two parts:

Part 1 is a Letter Ballot on the Technical Correlating Committee Amendments to the ROP (TCC Notes), and not on the Proposals themselves. Reasons must accompany "Negative" and "Abstaining" votes.

Part 2 is an Informational Letter Ballot Authorizing the Release of the ROP.

Negative votes are limited to subjects within the purview of the TCC. Opposition on a strictly technical basis is not sufficient grounds for substantiating a negative vote. If you have correlation issues please identify and describe your concerns in the area of the ballot form for identification of correlation issues.

Please complete and return your ballot as soon as possible but no later than Thursday, November 4, 2010, 5:00 PM ET. As noted on the ballot form, please return the ballot to Stacey Van Zandt via e-mail to svanzandt@nfpa.org or via fax to 617-984-7056. You may also mail your ballot to the attention of Stacey Van Zandt at NFPA, 1 Batterymarch Park, Quincy, MA 02169.

The return of ballots is required by the Regulations Governing Committee Projects. As usual, nonvoting members (for example, the nonvoting technical committee chairs) need not return ballots.

Attachments: Ballot Form
NFPA 1971 Proposals that have TCC Notes

Technical Correlating Committee on Fire and Emergency Services Protective Clothing and Equipment

Ballot on the NFPA 1971 Report on Proposals (F2011)

Part 1: Letter Ballot on the Technical Correlating Committee Amendments to the ROP (TCC Notes), please record me as voting:

_______ AFFIRMATIVE _______ NEGATIVE* _______ ABSTAINING*

EXPLANATION OF VOTE - Please type or print your comments:
*An explanation must accompany a negative or abstaining vote.

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____

____

Part 2: Letter Ballot Authorizing the Release of the ROP (This is an Informational Letter Ballot only), please record me as voting:

_______ AFFIRMATIVE _______ NEGATIVE* _______ ABSTAINING*

EXPLANATION OF VOTE - Please type or print your comments:
*An explanation must accompany a negative or abstaining vote.

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For either Part 1 or Part 2, if you have correlating issues, please describe below (include section/paragraph and the issue):

____

____

____
Signature

____
Name (Please Print)

____
Date

Please return the ballot as soon as possible but not later than Thursday, November 4, 2010.

PLEASE RETURN TO:

Stacey Van Zandt

NFPA, 1 Batterymarch Park, Quincy, MA 02169

FAX: 617-984-7056 /Email: svanzandt@nfpa.org

1971-75 Log #CP33 FAE-SPF Final Action: Accept
(7.4.2 and 8.16)

TCC Action: The TCC notes that the negative ballot is not applicable to NFPA 1971-175, Log CP 33, but should reference Log CP-58.

Submitter: Technical Committee on Structural and Proximity Fire Fighting Protective Clothing and Equipment,

Recommendation: Revise text to read as follows:

7.4.2 Helmets shall be tested for resistance to impact as specified in Section 8.16, Impact Resistance Test (Acceleration), and shall have no specimen exceed the maximum acceleration specified in Table 7.4.2. Any acceleration above 200 Gn shall not exceed a duration of 3 milliseconds, and an acceleration above 150 Gn shall not exceed a duration of 6 milliseconds. Helmets shall maintain sufficient structural integrity to withstand impacts in all five locations.

8.16.5.3 The impact areas shall be as specified in Figure 8.1.6.1. The top, front, left, right, and rear~~, and side areas~~ of the helmet shall be tested in this order. Each helmet test specimen shall be impacted in all five test areas. All five impacts shall occur on the same helmet.

8.16.5.3.1 Reattachment of components is allowed between impacts, but no broken components shall be replaced. The helmet test specimen shall continue to be tested as long as the specimen can be held on the test headform using existing components as originally received.

8.16.5.8 Each conditioned specimen in a series shall be impacted one on the top, ~~rear,~~ front, left, right, and rear ~~and side~~ test areas of the helmets as defined in Figure 8.1.6.1. Helmets shall be tested in this order. At least one impact shall occur in each test area.

8.16.7.1 Pass or fail performance shall be determined for each specimen. If the helmet test specimen cannot be held on the test headform and impacted in all five locations, then this shall be considered failing performance.

Substantiation: The standard was not clear as to whether or not all acceleration impacts were to be performed on one helmet. There was also no explanation of the order of impacts. There was also no explanation of fail criteria if the helmet could not be tested for all impact locations. The Task Group agreed that the intent was to test all locations on one helmet, starting with the top location, and that helmets unable to withstand all five impacts should be considered failing.

Committee Meeting Action: Accept

Number Eligible to Vote: 30

Ballot Results: Affirmative: 26 Negative: 1

Ballot Not Returned: 3 Davis, R., Doan, S., Scianna, M.

Explanation of Negative:

STULL, J.: While there is merit for improved dexterity testing, no specific data have been presented as part of the substantiation to justify the implementation of this test. The required coefficient of variation is completely unrealistic for a human subject based test.

1971-114 Log #87 FAE-SPF Final Action: Reject
(7.20.1.1 and 8.66)

TCC Action: The TCC instructs the Technical Committee on Structural and Proximity Fire Fighting Protective Clothing and Equipment to consider information provided by the task group for CBRN Test Methods pertaining to the criteria in 7.20.1.1 in NFPA 1971, and the test method in 8.66 in NFPA 1971 as follows:

a) Provide detailed specifications for the PADs that meet test requirements for the uptake rate as set in the standard. These specifications should go beyond the current edition of ASTM F2588, which have not been validated to meet the uptake rate of 3.5 cm/min, ±1.0 cm/min. ASTM is considering similar changes to the uptake rate specifications.

b) Establish specific methodology for the determination of uptake rate.

c) Provide a method for a pre-assessment of the exposure concentration in the chamber as determined by the measured uptake rate of the PADs.

d) Remove the conflict in the test method for the exposure of the exterior PADs (15 minutes as indicated in the apparatus section versus 30 minutes in the procedure section)

e) Provide more detailed specifications for the placement of PADs for measurement of chamber concentrations and for the placement of PAD on individual test subjects.

f) Determine an approach to consistently set the inside Ct value for the determination of local protection factors.

g) Establish limits for the time of analysis of exposed PADs.

h) Investigate the accuracy and appropriateness of the body region hazard analysis as applied in the determination of systemic physiological protective dosage factor.

i) Consider using the average systemic physiological protective dosage factor to determine pass fail performance for specific ensembles.

Submitter: Jeffrey O. Stull, International Personnel Protection, Inc.

Recommendation: Modifications to the MIST criteria and how it is applied to the ensemble (Section 7.20.1.1) together with any changes in test methodology (Section 8.66) should be made consistent with the proposals provided for changes to NFPA 1994, Class 2.

Substantiation: Optional CBRN performance was based on parallel criteria established in NFPA 1994, Class 2 for SCBA use. This includes how the ensemble affects the performance of the respirator. This relationship should be maintained with the difference in the specification of ensemble conditioning for extended service life.

Committee Meeting Action: Reject

Committee Statement: The technical committee rejected the proposal based on unresolved modifications to the ASTM MIST test method. In addition, no modifications were made to the requirements in NFPA 1994 MIST test method. Once the ASTM test method modifications are resolved, the technical committee will accept comments for further review and discussion.

Number Eligible to Vote: 30

Ballot Results: Affirmative: 26 Abstain: 1

Ballot Not Returned: 3 Davis, R., Doan, S., Scianna, M.

Explanation of Abstention:

STULL, J.: A separate TCC task group has been established to harmonize CBRN requirements, including MIST among all affected standards, including NFPA 1971 that is not dependent on the activities of ASTM.

1971-115 Log #86 FAE-SPF Final Action: Reject
(7.20.1.3)

TCC Action: The TCC instructs the Technical Committee on Structural and Proximity Fire Fighting Protective Clothing and Equipment to consider information provided by the task group for CBRN Test Methods to update the permeation resistance test method in 8.67 in NFPA 1971 consistent with the latest research and laboratory test practices by undertaking the following actions:
a) Remove the reference to ASTM F 739
b) Base revised test procedures on recommendations provided in Technical Support Working Group (TSWG) report, *Risk-Based Protective Clothing Material Permeation Criteria*, dated March 31, 2010, in the following table.

******Insert Table 1971_L86_Tb_TCC Note Here******

Submitter: Jeffrey O. Stull, International Personnel Protection, Inc.
Recommendation: Modify CBRN Protective Ensemble Performance Requirements consistent with proposed changes for NFPA 1994, Class 2 in terms of test chemical selection and permeation resistance criteria.
Substantiation: Optional CBRN performance was based on parallel criteria established in NFPA 1994, Class 2 for SCBA use. This relationship should be maintained with the difference in the specification of material conditioning for extended service life.
Committee Meeting Action: Reject
Committee Statement: The technical committee rejected the proposal because no changes to the relative Class 2 performance requirements in NFPA 1994, Standard on Protective Ensembles for First Responders to CBRN Terrorism Incidents, were included.
Number Eligible to Vote: 30
Ballot Results: Affirmative: 26 Abstain: 1
Ballot Not Returned: 3 Davis, R., Doan, S., Scianna, M.
Explanation of Abstention:
STULL, J.: A separate TCC task group has been established to harmonize CBRN requirements, including chemical permeation resistance among all affected standards, including NFPA 1971.

NFPA Technical Correlating Committee on
Fire and Emergency Service Protective Clothing and Equipment

NFPA 1971
Table for Log 86

Table of Recommended Changes to Permeation Resistance Test Method

Test Parameter	**Current Specification**	**Proposed Change**
Referenced standards	ASTM F 739	ASTM D 1777 for thickness measurement; ASTM D 3776 for unit area weight measurement
Test environment	None; however, testing to be performed at 32 ±1°C	All testing to be performed in separate test chamber that will be maintained at test conditions; specimens, chemicals, and test apparatus will be placed in chamber and required to be in place 24 hrs prior to testing
Test cell	Per ASTM F 739, alternative test cells permitted; no requirements for determining equivalency	Modified TOP 8-2-501 test cell with drawing specification for modified specimen plate to accommodate control of exposed surface area in saturated surface exposure tests; test cap to contain fitting for measuring integrity of test cell after specimen is mounted
Air flow requirements in collection side	Filtered air at rate of 1 ±0.1 Lpm at 80 ±5% RH	Balance air flow with challenge side for consistency and absence of pressure drop; measure temperature and relative humidity at test cell inlet; principal air flow system to be positioned inside environmental chamber
Specimen size	Varies with test cell	Standardized for TOP 8-2-501 test cell
Permeation specimen conditioning	21 ±3°C and 65 ±5% RH (standard textile conditioning)	32 ±1°C and 80 ±5% RH to be conducted inside test chamber; tolerance on temperature to be relaxed to ±2°C
Test cell sealing	None	Alternative gasketing material to be specified; O-rings and fittings must be assessed for compatibility with test chemical; Specific torque to be applied in sealing test cell

Test Parameter	Current Specification	Proposed Change
Test cell integrity check	None	Using fitting in test line cap, test cell to be pressurized with air to 2 psig with specimen in place with pressure drop measured after 1 minute (only 10% pressure drop permitted)
Liquid challenge conditions	Liquid applied at surface density of 10 g/m^2 using appropriate number of 1-µL droplets uniformly dispensed on material specimen surface	For each liquid chemical (including chemical warfare agents), nine (9) 1-µL droplets will be applied in specific pattern on exposed specimen surface; time of 30 seconds will be required for opening test cell cap, dispensing droplets, and closing test cell cap.
Air flow on challenge side for open top test cell configuration	Filtered air at rate of 0.3 ±0.03 Lpm at 80 ±5% RH	Filtered air at rate of 0.3 ±0.03 Lpm at 80 ±5% RH, temperature conditioning with environmental chamber
Volatile liquid toxic industrial chemical challenge	None	Chemicals with vapor pressures of 5 mm Hg or greater at 25°C will be tested as vapors at the corresponding gas concentration in the respective standard
Collection technique	Combination of analytical technique and collection medium shall be selected to maximize sensitivity for the detection of the test chemical and represent actual occupational conditions as closely as possible	Test system collection efficiency evaluated using procedure to determine total test chemical collected; evaluation must be performed for each test chemical and verified periodically by laboratory
Analytical sensitivity	Test system must have detection limit that is one order of magnitude lower than prescribed permeation end point	Specification to be based on each individual chemical; good laboratory practice standards will be referenced for correct analytical procedures
Results reported	Breakthrough time Permeation rate (optional) Test parameters as part of report	Cumulative permeation Test parameters as part of report
Interpretation of results	Average of all results	Average of all results; however, if one or two test cells show no cumulative permeation, the standard-defined minimum detection limit will be used for no detectable permeation test results for purposes of averaging results

1971-116 Log #26 FAE-SPF Final Action: Accept
(7.20.1.3, 8.67.4.1, 8.67.5, 8.67.6, and A.8.67.1(3))

TCC Action: The TCC instructs the Technical Committee on Structural and Proximity Fire Fighting Protective Clothing and Equipment to consider information provided by the task group for CBRN Test Methods to update the permeation resistance test method in 8.67 in NFPA 1971 consistent with the latest research and laboratory test practices by undertaking the following actions:

a) Remove the reference to ASTM F 739

b) Base revised test procedures on recommendations provided in Technical Support Working Group (TSWG) report, *Risk-Based Protective Clothing Material Permeation Criteria* , dated March 31, 2010, in the following table.

******Insert Table 1971_L26_Tb_TCC Note Here******

Submitter: Jeffrey O. Stull, International Personnel Protection, Inc.

Recommendation: This Proposal originates from Tentative Interim Amendment TIA 902 issued by the Standards Council on March 4, 2008.

1. Make the following changes in Chapter 7, Performance Requirements to read:

7.20.1.3 Each ensemble element's CBRN barrier layer and the CBRN barrier layer seams shall be tested for permeation resistance as specified in Section 8.67, Chemical Permeation Resistance Test, and shall meet the following performance criteria:

(1) For permeation testing of chemical warfare agent Distilled Mustard (HD), the average cumulative permeation in 1 hour shall not exceed 4.0 μg/cm^2.

(2) For permeation testing of chemical warfare agent Soman (GD), the average cumulative permeation in 1 hour shall not exceed 1.25 μg/cm^2.

(3) For permeation testing of liquid and gaseous toxic industrial chemicals, ~~the average breakthrough time shall not be less than 60 minutes~~ the average cumulative permeation in 1 hour shall not exceed 6.0 μg/cm^2.

2. Modify permeation test procedures for measurement of cumulative permeation for liquid chemical warfare agents and liquid and gaseous toxic industrial chemicals to read:

8.67.4.1 Specimens shall be tested for permeation resistance for ~~not less than~~ 60 minutes, +1 minute, -0 minute against the chemicals specified in 8.67.4.2, 8.67.4.3 and 8.67.4.4 in accordance with ASTM F 739, *Standard Test Method for Resistance of Protective Clothing Materials to Permeation by Liquids or Gases Under Conditions of Continuous Contact*, with the following modifications:

Note to reviewers: Reference to 8.67.4.4 was added by TIA 07-3

(1) The test cells shall be designed to accommodate the introduction of liquid chemicals in a safe manner.

~~(2) The testing mode shall be in an open loop configuration for the collection of permeant.~~

~~(3) The collection media shall be filtered air flowed through the bottom of the test cell at a rate of 1 Lpm, ±0.1 Lpm, with a relative humidity of 80 percent, ±5 percent.~~

~~(4) Analytical methods used shall be sensitive to the permeant at concentrations of at least one order of magnitude lower than the required end points.~~

~~(5) Where cumulative permeation end points are not specified in this standard, a permeation rate of 0.1 μg/cm^2/min, as defined by ASTM F 739, *Standard Test Method for Resistance of Protective Clothing Materials to Permeation by Liquids or Gases Under Conditions of Continuous Contact*, shall be used.~~

(2) The testing mode shall be open loop and the collection media shall be filtered air at a temperature of 32°C ±3°C (90°F ±5°F) and a relative humidity of 80 percent ±5 percent, flowed through the collection chamber of the test cell at a rate of 1 Lpm ±0.1 Lpm.

(3)* A means shall be used to determine the total amount of permeating chemical over a 60-minute period following initial contact of the material with the challenge chemical.

(4) The cumulative permeation in micrograms per square centimeter at 60 minutes, +1 minute, -0 minute of chemical exposure shall be determined.

(5) The selected method of detection shall have a sensitivity that is at least one order of magnitude less than the specified end point for the respective chemical over the 60-minute test period. The actual sensitivity of the selected method of detection shall be determined.

8.67.5 Report.

8.67.5.1 ~~For the permeation testing of chemical warfare agents, t~~The cumulative permeation in 1 hour shall be recorded and reported in micrograms per square centimeter (μg/cm^2) for each specimen. ~~The average cumulative permeation in 1 hour for all specimens shall be calculated, recorded, and reported. The report shall include the pass or fail results for each chemical tested.~~

~~8.67.5.2 For permeation testing of liquid and gaseous toxic industrial chemicals, the normalized breakthrough time shall be record and reported in minutes for each specimen. The average normalized breakthrough time shall also be calculated, recorded, and reported.~~

8.67.5.2 If no challenge chemical is detected at the end of the 1-hour test period, the cumulative permeation shall be reported as less than the minimum detectable mass per unit area for the specific chemical being tested.

8.67.5.3 The average cumulative permeation shall be calculated and reported for all specimens.

8.67.5.3.1 If no challenge chemical is detected for one or two specimens, the average cumulative permeation shall be the average of all specimens where cumulative permeation is measured and the minimum detectable cumulative permeation for those specimens where no challenge chemical is detected.

8.67.5.3.2 If no challenge chemical is detected in all of the specimens tested, the average cumulative permeation shall be reported as less than the minimum detectable mass per unit area for the specific chemical being tested.

8.67.5.4 The report shall include the pass or fail results for each chemical tested.

8.67.6 Interpretation.

~~8.67.6.1~~ For permeation testing of chemical warfare agents specified in 8.67.4.2(1) and liquid and gaseous industrial chemicals specified in 8.67.4.2(2), 8.67.4.3 and 8.67.4.4, the average cumulative permeation shall be used to determine pass or fail performance.

~~8.67.6.2 For permeation testing of liquid and gaseous industrial chemicals specified in 8.67.4(2), the average normalized breakthrough time shall be used to determine pass or fail performance.~~

Note to reviewers: References to 8.67.4.3 and 8.67.4.4 were added to 8.67.6.2 by TIA 07-3. As 8.67.6.2 is being combined with 8.67.6.1, those references need to be carried forward.

3. Add new annex to read:

A.8.67.4.1(3) One method of determining the total amount of permeating chemical is to flow the conditioned collection medium through an appropriate filter or sorbent that captures the chemical. Following the 60-minute exposure period of the protective clothing material specimen (for each challenge chemical), the filter or sorbent can then be removed, and the collected challenge chemical extracted for analysis using an extract chemical and analytical technique that is specific to the challenge chemical.

Substantiation: The permeation test procedures for CBRN barrier layer materials have already been modified as proposed for both NFPA 1994 and NFPA 1951 in Tentative Interim Amendments NFPA 1994 TIA 07-1 and NFPA 1951 TIA 07-2, respectively, both issued 4 June 2007. The proposed changes in NFPA 1971 harmonize the permeation procedures with the other two current standards addressing CBRN protection. The justifications used for these previous accepted amendments are provided below.

NFPA 1971-2007 requires that CBRN barrier layer materials used in CBRN protective ensembles be tested for permeation resistance against both selected chemical warfare agents and toxic industrial chemicals. Permeation testing is specified in accordance with ASTM F 739 with modifications. Both chemical warfare agents and toxic industrial chemicals must be tested for a period of at least one hour. In the case of chemical warfare agents, the total cumulative permeation that occurs is measured and compared against the maximum permitted cumulative permeation for one hour. However, in the case of measuring permeation resistance of protective clothing materials against toxic industrial chemicals, the breakthrough time is measured instead and is used as the criterion for judging acceptance of the material's performance against the respective challenge chemical. Breakthrough time is defined as the elapsed time between the beginning of the chemical contact with the material to the time that the rate of permeation is equal to 0.1 μg/cm^2/min. When the testing is performed using sampling at specific time points, the breakthrough time is established at the sampling time prior to the time where the permeation rate exceed 0.1 μg/cm^2/min. NFPA 1971-2007 currently requires that the breakthrough time be greater than 60 minutes for the toxic industrial chemicals.

The determination of normalized breakthrough time during the 60 minute test is dependent on the frequency of sampling. The prescribed procedures in ASTM F 739, referenced in NFPA 1971, do not set the frequency for sampling. Certification test laboratories are free to choose the frequency at which the collection side of the permeation test cell is sampled for evidence of permeation. The frequency interval can be any time from a fraction of a minute to the complete one hour test exposure. Therefore, it is possible for the permeation rate of a toxic industrial chemical to increase, reach a peak, and then decline during the 60 minute chemical exposure period and go unnoticed unless the specific sampling by the laboratory coincides with the occurrence of this peak. Relatively large levels of permeation can take place and not be detected using methods where the sampling frequency is not specified.

The use of a cumulative permeation-based approach can overcome the potential inconsistency and hazards in permeation testing that uses breakthrough determinations without a specified uniform sampling frequency. It also has the added benefit of capturing any peak excursions of permeation that might be missed by low frequency/long period sampling, thereby assuring a more complete (safe) evaluation of a materials performance. With the current methodology, if a 60-minute exposure period is used and it is assumed that the permeation that takes place is at the specified permeation rate of 0.1 μg/cm^2/min (currently used to define normalized breakthrough time), then the total maximum cumulative permeation that could take place is 6.0 μg/cm^2. Thus, with the proposed methodology, if the total cumulative permeation were less than 6.0 μg/cm^2, then the average permeation rate must be below 0.1 μg/cm^2/min. This cumulative or dose-based approach is consistent with procedures for evaluating the permeation resistance of chemical warfare agents and practices for determining the safe use of respirators.

As a basis for comparison, the current specified maximum cumulative permeation masses for chemical warfare agents in NFPA 1971-2007 are as follows (i.e., Paragraph 7.1.20.3):

Distilled Mustard (HD): = ≤ 4.0 μg/cm^2

Soman (GD) = ≤ 1.25 μg/cm^2

Emergency Nature: The procedures for the measurement of toxic industrial chemical permeation through protective ensemble materials do not provide a framework for reproducible results. Due to this lack of framework, it is possible for one lab to pass a material and another lab to fail that material under the same procedure. The recommended modifications to the permeation resistance procedures will minimize test variation and result in more accurate, lab-to-lab reproducible and safer measurements representing the true amount of chemical that passes through the material or seam.

The requirements in NFPA 1971 for CBRN protective ensembles are based on NFPA 1994 Class 2 requirements. The specific criteria in NFPA 1971 for CBRN protective ensembles address ensembles that can be used as part of structural fire fighting multiple times to provide needed protection against physical, liquid, and other hazards, and yet afford CBRN protection when needed. As such, NFPA 1971 defines a balance between CBRN barrier requirements, ensemble ruggedness, and breathability of materials to provide longer wear periods with less stress on individuals. However, the emerging technologies that address material ruggedness, breathability and barrier performance can allow variable permeation over a short period of time, though at levels resulting in cumulative permeation of certain toxic industrial chemicals that would be less than the currently allowed maximum cumulative permeation if you assumed a permeation rate of 0.1 μg/cm^2/min over the 1-hour exposure period (i.e., 6.0 μg/cm^2). These levels are generally lower than what is considered acceptable for chemical warfare agent permeation and thus represent conservatively safe performance for first responder barrier materials, particularly when skin toxicity exposure levels are generally found to be substantially less for toxic industrial chemicals as compared to chemical warfare agents. Without the approval of this amendment, the industry will not be able to achieve the necessary balance between ensemble stress reduction and barrier performance.

Committee Meeting Action: Accept

Number Eligible to Vote: 30

Ballot Results: Affirmative: 27

Ballot Not Returned: 3 Davis, R., Doan, S., Scianna, M.

NFPA Technical Correlating Committee on
Fire and Emergency Service Protective Clothing and Equipment

NFPA 1971
Table for Log 26

Table of Recommended Changes to Permeation Resistance Test Method

Test Parameter	**Current Specification**	**Proposed Change**
Referenced standards	ASTM F 739	ASTM D 1777 for thickness measurement; ASTM D 3776 for unit area weight measurement
Test environment	None; however, testing to be performed at 32 ±1°C	All testing to be performed in separate test chamber that will be maintained at test conditions; specimens, chemicals, and test apparatus will be placed in chamber and required to be in place 24 hrs prior to testing
Test cell	Per ASTM F 739, alternative test cells permitted; no requirements for determining equivalency	Modified TOP 8-2-501 test cell with drawing specification for modified specimen plate to accommodate control of exposed surface area in saturated surface exposure tests; test cap to contain fitting for measuring integrity of test cell after specimen is mounted
Air flow requirements in collection side	Filtered air at rate of 1 ±0.1 Lpm at 80 ±5% RH	Balance air flow with challenge side for consistency and absence of pressure drop; measure temperature and relative humidity at test cell inlet; principal air flow system to be positioned inside environmental chamber
Specimen size	Varies with test cell	Standardized for TOP 8-2-501 test cell
Permeation specimen conditioning	21 ±3°C and 65 ±5% RH (standard textile conditioning)	32 ±1°C and 80 ±5% RH to be conducted inside test chamber; tolerance on temperature to be relaxed to ±2°C
Test cell sealing	None	Alternative gasketing material to be specified; O-rings and fittings must be assessed for compatibility with test chemical; Specific torque to be applied in sealing test cell

Test Parameter	Current Specification	Proposed Change
Test cell integrity check	None	Using fitting in test line cap, test cell to be pressurized with air to 2 psig with specimen in place with pressure drop measured after 1 minute (only 10% pressure drop permitted)
Liquid challenge conditions	Liquid applied at surface density of 10 g/m^2 using appropriate number of 1-µL droplets uniformly dispensed on material specimen surface	For each liquid chemical (including chemical warfare agents), nine (9) 1-µL droplets will be applied in specific pattern on exposed specimen surface; time of 30 seconds will be required for opening test cell cap, dispensing droplets, and closing test cell cap.
Air flow on challenge side for open top test cell configuration	Filtered air at rate of 0.3 ±0.03 Lpm at 80 ±5% RH	Filtered air at rate of 0.3 ±0.03 Lpm at 80 ±5% RH, temperature conditioning with environmental chamber
Volatile liquid toxic industrial chemical challenge	None	Chemicals with vapor pressures of 5 mm Hg or greater at 25^oC will be tested as vapors at the corresponding gas concentration in the respective standard
Collection technique	Combination of analytical technique and collection medium shall be selected to maximize sensitivity for the detection of the test chemical and represent actual occupational conditions as closely as possible	Test system collection efficiency evaluated using procedure to determine total test chemical collected; evaluation must be performed for each test chemical and verified periodically by laboratory
Analytical sensitivity	Test system must have detection limit that is one order of magnitude lower than prescribed permeation end point	Specification to be based on each individual chemical; good laboratory practice standards will be referenced for correct analytical procedures
Results reported	Breakthrough time Permeation rate (optional) Test parameters as part of report	Cumulative permeation Test parameters as part of report
Interpretation of results	Average of all results	Average of all results; however, if one or two test cells show no cumulative permeation, the standard-defined minimum detection limit will be used for no detectable permeation test results for purposes of averaging results

1971-120 Log #CP36 FAE-SPF Final Action: Accept
(Chapter 8)

TCC Action: The TCC directs the Technical Committee on Structural and Proximity Fire Fighting Protective Clothing and Equipment to review the "accept" final action on 1971-120 Log CP 36. The proposed HPI seems to be design restrictive requiring that helmets have brims and requiring that helmet brims be of a certain geometry so that they can be properly positioned on the headform.

Submitter: Technical Committee on Structural and Proximity Fire Fighting Protective Clothing and Equipment,

Recommendation: Add new text or revise existing text as follows:

Note: Sections below indicate proposed new text placement in document

8.1.15* Helmet Positioning

8.1.15.1 The helmet shall be seated firmly and adjusted to a size sufficient to properly fit on the headform.

8.1.15.2 Where helmets have a brim, the helmet shall be positioned on the headform such that the alignment of the brim is parallel with the horizontal within 3 degrees of level.

8.1.15.3 Where helmets do not have a brim, the helmet shall be positioned on the headform in the recommended wearing position and such that the alignment of the helmet is parallel with the horizontal within 3 degrees of level.

8.1.15.4 Where the crown clearance of the helmet is adjustable, the helmet shall be mounted with the amount of clearance as described in the design requirement or test method.

A.8.1.15 This section provides guidelines for positioning helmets consistently on a headform. The intent is to test helmets which are positioned squarely on the headform, both front to back and side to side. It is more simple to explain and describe the front to back horizontal positioning for helmets that have a brim. However, for helmets that do not have a brim, it is more difficult to convey. The intent in both cases is to have the helmets positioned in a horizontal fashion on the headform. Examples are given below:

Add a new section as follows:

5.4.8 For helmets only, the manufacturer shall provide the recommended wearing position of the helmet by way of a description and diagram.

6.4.5.2 The ~~faceshield or the faceshield/goggle component~~ helmet shall be positioned ~~in accordance with the helmet positioning index~~ as described in Section 8.1.X on an Alderson 50th percentile male headform specified in Figure 8.17.4.1.1. Where the crown clearance of the helmet is adjustable, the helmet shall be mounted with the least amount of clearance.

Delete the following section, and renumber remaining sections:

~~6.4.5.3 The helmet positioning index shall be the vertical distance, as specified by the helmet manufacturer, from the lowest point of the brow at the lateral midpoint of the helmet to the basic plane of the Alderson 50th percentile male headform with the helmet firmly positioned on the headform.~~

6.4.6.1 The peripheral vision clearance shall be measured from the center of the eye with the helmet positioned ~~according to the helmet positioning index~~ as described in Section 8.1.X on the Alderson 50th percentile male headform specified in Figure 8.17.4.1.1. Where the crown clearance of the helmet is adjustable, the helmet shall be mounted with the least amount of clearance.

6.5.4.1 The helmet, with the ear covers or the portion of the helmet providing the ear coverage deployed, shall be ~~donned in the proper wearing position as specified by the helmet manufacturer~~ positioned as described in Section 8.1.X on an ISO J headform ~~according to its helmet positioning index~~. Where the crown clearance of the helmet is adjustable, the helmet shall be mounted with the most amount of clearance.

Delete the following section, and renumber existing sections that follow accordingly:

~~6.5.4.2 The helmet positioning index shall be the vertical distance, as specified by the helmet manufacturer, from the lowest point of the brow at the lateral midpoint of the helmet to the basic plane of the ISO J headform with the helmet firmly positioned on the headform.~~

6.6.5.5.2 The helmet with the shroud attached shall be ~~seated according to its helmet positioning index~~ positioned as described in Section 8.1.X on the Alderson 50th percentile male headform illustrated in Figure 8.17.4.1.1. Where the crown clearance of the helmet is adjustable, the helmet shall be mounted with the least amount of clearance.

Delete the following section:

~~6.6.5.5.3 The helmet positioning index shall be the vertical distance, as specified by the helmet manufacturer, from the lowest point of the brow at the lateral midpoint of the helmet to the basic plane of the Alderson 50th percentile male headform with the helmet firmly positioned on the headform.~~

8.3.7.1 The helmet shall be positioned as described in Section 8.1.X on the ISO size J headform specified in Figure 8.16.4.1(d) ~~according to the helmet positioning index~~. The helmet shall then be placed under the radiant heat source specified in Section 8.1.6, while the basic plane of the headform is parallel to the radiant heat source as shown in Figure 8.3.7.1.

8.3.8.1 Specimen helmets with faceshield/goggle component attachment hardware in place shall be positioned as described in Section 8.1.X on the ISO size J headform specified in Figure 8.16.4.1 ~~according to the helmet positioning index~~.

8.6.12.3 Helmets with ear covers deployed and with the faceshield/goggle component in the stowed position shall be ~~seated~~ positioned as described in Section 8.1.X on the nonconductive test headform specified in Figure 8.6.12.3 ~~and shall be positioned according to the helmet positioning index~~. The headform with helmet attached shall be placed in the center of the test oven with the centerline of the front of the helmet facing the airflow. Only one helmet specimen shall be tested at a time.

8.15.5.1 Where faceshield/goggle component(s) are provided, the device shall be removed from the helmet for this test. Specimen helmets shall be ~~adjusted to a size sufficient to properly fit~~ as described in Section 8.1.X on the headform. ~~Specimens shall be positioned on the headform with the horizontal center plane parallel within 5 degrees of the reference plane. The front-to-back centerline of the shell shall be within 13 mm (½ in.) of the midsagittal plane of the headform.~~ Where the crown clearance of the helmet is adjustable, the helmet shall be mounted with the least amount of clearance. Specimens shall be subjected to the environmental conditions specified in Sections 8.1.3, 8.1.4, 8.1.5, 8.1.6, and 8.1.7 prior to each impact and within the specified time after being removed from conditioning.

8.16.5.1 A conditioned specimen with faceshield/goggle component(s) removed shall be positioned as described in Section 8.1.X on the headform ~~with the horizontal center plane of the helmet parallel within 5 degrees of the reference plane of the headform~~ and shall be secured to the drop assembly by its retention system so as to maintain this position during the test. Where the crown clearance of the helmet is adjustable, the helmet shall be mounted with the least amount of clearance. No part of the helmet shell shall be cut away to accommodate the test system, and no part of the test system shall contact the helmet shell either as mounted or during an impact test.

8.17.4.2.2 The complete helmet shall be ~~placed~~ positioned as described in Section 8.1.X on the headform ~~in accordance with the helmet positioning index~~. Where the crown clearance of the helmet is adjustable, the helmet shall be mounted with the most amount of clearance. The alignment shall be such that, with the faceshield/goggle component deployed, when the missile is dropped, it points in line with one of the eyes of the headform.

Delete the following section:

~~8.17.4.2.3 The helmet positioning index shall be the vertical distance, as specified by the helmet manufacturer, from the lowest point of the brow at the lateral midpoint of the helmet to the basic plane of the Alderson 50th percentile male headform when the helmet is firmly positioned on the headform~~

8.17.5.2.2 The helmet with faceshield/goggle component deployed shall be ~~mounted to~~ positioned as described in Section 8.1.X on the Alderson 50th percentile male headform ~~in accordance with the helmet positioning index~~. Where the crown clearance of the helmet is adjustable, the helmet shall be mounted with the most amount of clearance.

Delete the following section, and renumber existing sections that follow accordingly:

~~8.17.5.2.3 The helmet positioning index shall be the vertical distance, as specified by the helmet manufacturer, from the top lateral midpoint of the faceshield or the faceshield/goggle component to the basic plane of the Alderson 50th percentile male headform where the faceshield or the faceshield/goggle component is positioned on the headform.~~

8.19.5.1 The environmentally conditioned helmet shall be ~~placed~~ positioned as described in Section 8.1.X on the rigidly mounted test headform and secured by the helmet retention system or by other means that will not interfere with the test. Where the crown clearance of the helmet is adjustable, the helmet shall be mounted with the least amount of clearance. The helmet shall be positioned so that the penetration striker shall impact perpendicular to the helmet anywhere above the test line. The impact site shall be at least 75 mm (3 in.) from the center of a previous penetration or impact site.

8.31.5.1.1 ~~Where helmets specimens have a vertical adjustment to the suspension system, the vertical adjustment shall be set to raise the helmet to the highest position with maximum crown clearance between the headform and the inside of the helmet shell prior to establishing the helmet positioning index.~~ The helmet specimen shall be ~~placed~~ positioned as described in Section 8.1.X on the ISO size J headform specified in Figure 8.16.4.1 ~~and positioned according to the helmet positioning index~~. Where the crown clearance of the helmet is adjustable, the helmet shall be mounted with the most amount of clearance.

8.31.5.1.2 ~~After proper positioning in accordance with the helmet positioning index, t~~The dielectric test plane specified in Figure 8.31.5.1.2 shall be marked on the shell of the helmet. The dielectric test plane shall be the plane that passes through the point located 85 mm (3 in.) above the basic plane, where the basic plane and the midsagittal plane intersect at the front of the headform and the point located 60 mm (2 in.) above the basic plane, where the basic plane and the midsagittal plane intersect at the rear of the headform.

Substantiation: Helmet positioning is very important for performing design review and testing of helmets. The HPI currently referenced in the standard is rarely provided by manufacturers and it does not provide a consistent means of determining the positioning. Since the helmet positioning may be difficult to determine for some styles or designs, the manufacturers will be required to explain the positioning in their user guides. Also, adjustable crown clearance is not currently addressed in the standard and is an important consideration for testing.

Committee Meeting Action: Accept

Number Eligible to Vote: 30

Ballot Results: Affirmative: 19 Negative: 8

Ballot Not Returned: 3 Davis, R., Doan, S., Scianna, M.

Explanation of Negative:

ALLEN, J.: The manufacturer's helmet positioning index (HPI) is a reliable and repeatable means of positioning each model helmet on the test headform. However, some helmet brims have complex curves and it is unknown what part to level.

CURTIS, P.: Based on the new information provided in the responses submitted by others I respectfully change my vote from the affirmative to the negative.

FANNING, D.: Proposal 1971-120 #CP36 should be eliminated as drafted. The current helmet positioning index (HPI) should not be eliminated from the standard; rather, the requirement of manufacturers to provide appropriate HPI information must be enforced. This draft proposal is too arbitrary, may not be repeatable, is too restrictive on types of helmets that can be certified, and leaves room open for interpretation by the respective lab, all of which does not benefit the first responder.

FITHIAN, W.: **Comment:** This should be rejected in its entirety.

The manufacturer's helmet positioning index (HPI) is a reliable and repeatable means of positioning each model helmet on the test headform. The manufacturer should be determining the HPI, not the testing facility. ASTM, ANSI, CPSC and other standards use the manufacturer's HPI for drawing the test line and positioning the helmet for testing. Many current structural fire fighting helmets do not have horizontal lines on the brim; there is a downward tilt to the rear. This may create a situation whereby the testing facility will be forced to make a subjective decision regarding positioning of the helmet, which is certainly not repeatable between testing facilities or even within each testing facility. The newer style helmets (¾ motorcycle type) may not have horizontal lines that can be used, so without an HPI it will be subjective from year to year. Using the proposed horizontal method will be design restrictive for the manufacturers. There may need to be different HPI values for the different headforms (ISO J and EN168) if the distance from the crown to the basic plane is different and the head sizes and/or shapes are different.

MELIA, D.: I cannot make a judgement because I think there is missing information in the positioning of helmet. Section 8.1.x does not exist. I appreciate what the committee is doing in trying to standardize the helmet testing.

RIHN, J.: This proposal to redefine the Horizontal Positioning Index (HPI) for helmets is unnecessary and attempts to rehabilitate an issue of enforcement rather than performance. Test labs are required to obtain from the manufacturer specific HPI references for each helmet tested. Currently manufacturers determine HPI's based on the helmets design as a complete system comprised of a shell, impact liner, suspension and headband. No two helmets are the same and therefore no two HPI's are the same. This proposal could cause helmets which are in use today to be tested in a position in which the manufacturer never intended it to be worn.

This proposal requires “the helmet shall be positioned on the headform such that the alignment of the brim is parallel with the horizontal to within 3 degrees.” A helmet is designed as an integrated system of components. “The brim” is a style feature certainly not consistent from one helmet to the next. By designating “the brim” as a key positioning element of performance leaves room for interpretation by the respective lab and would jeopardize the acceptance of many helmets worn today. Also, helmets are designed to be worn with other PPE by the firefighter such as goggles and facepieces. These devices have shown that a helmets brim angle can be measured to as much as 10 - 15 degs. relative to this measurement method.

ROUSSE, S.: I am voting negative on this log because after speaking with many helmet manufacturers, it appears that specifying a helmet position for testing that is different than the recommended position for use, may result in false failures.

STULL, J.: Insufficient information has been provided for the conduct of this test (there is no 8.1.X). The creation of a standardized helmet positioning index is contrary to manufacturer practice for specifying the helmet position on the firefighter's head and does not account for varying wearing configurations.

1971-125 Log #CP35 FAE-SPF Final Action: Accept
(8.1, 6.4, 6.5, and 8.6)

TCC Action: The TCC directs the Technical Committee on Structural and Proximity Fire Fighter Protective Clothing and Equipment to review the "accept" final action on 1971-125 Log CP 35. The proposed language may be design restrictive in that it would prohibit helmet designs where the faceshield is designed to be rotated to the rear of the helmet.

Submitter: Technical Committee on Structural and Proximity Fire Fighting Protective Clothing and Equipment,

Recommendation: Revise text to read as follows:

8.1.14 Faceshield/Goggle Component Stowed Position

8.1.14.1 The stowed position of externally mounted faceshields shall be the one of the following that occurs first:

a.) The point at which any resistance is met when the faceshield is pushed up and back from the deployed position, such as coming into contact with the helmet or any helmet attachments.

b.) The point at which the horizontal centerline of the faceshield is directly over the coronal plane of the headform being used.

******Insert New Figure 8.1.14.1 Here******

8.1.14.2 The stowed position of internally mounted faceshields shall be in the fully retracted position.

8.1.14.3 The stowed position of goggles shall be such that the bottom of the goggle is adjacent to and above the brimline centered at the front of the helmet.

Revise text as follows:

6.4.6 The helmet faceshield or the faceshield/goggle component in the stowed position as described in Section 8.1.X shall provide peripheral vision clearance of at least 94 degrees to each side.

6.5.3.1 A minimum of 2580 mm^2 (4 $in.^2$) of the retroreflective and fluorescent trim shall be visible above the reference plane when the helmet, with the faceshield/goggle component in the stowed position as described in Section 8.1.14, is viewed at the following positions:

(1) Left intersection of the coronal and reference planes at a distance of 2.4 m (8 ft)

(2) Right intersection of the coronal and reference planes at a distance of 2.4 m (8 ft)

(3) Rear intersection of the midsagittal and reference planes at a distance of 2.4 m (8 ft)

6.5.3.2 A minimum of 2580 mm^2 (4 $in.^2$) of the retroreflective and fluorescent trim shall be visible when the helmet, with the faceshield/goggle component in the stowed position as described in Section 8.1.14, is viewed at the intersection of the midsagittal plane and the coronal plane at a distance of 2.4 m (8 ft).

8.6.12.3 Helmets with ear covers deployed and with the faceshield/goggle component in the stowed position as described in Section 8.1.14 shall be seated on the nonconductive test headform specified in Figure 8.6.12.3 and shall be positioned according to the helmet positioning index. The headform with helmet attached shall be placed in the center of the test oven with the centerline of the front of the helmet facing the airflow. Only one helmet specimen shall be tested at a time.

Substantiation: For some helmets the stowed position is debatable and it is not clear how far to push the faceshield back. The stowed position can determine passing or failing performance.

Committee Meeting Action: Accept

Number Eligible to Vote: 30

Ballot Results: Affirmative: 23 Negative: 4

Ballot Not Returned: 3 Davis, R., Doan, S., Scianna, M.

Explanation of Negative:

CURTIS, P.: Based on the new information provided in the responses submitted by others I respectfully change my vote from the affirmative to the negative.

FANNING, D.: Proposal 1971-125 #CP35 is design restrictive. Defining the stowed position based on the majority of faceshield designs on the market today is shortsighted, and could restrict future eye and face protection advancements that may better protect the first responder. In addition, this change could possibly eliminate or adversely impact many faceshields currently on the market (we are unaware of any testing that was communicated to the Committee). In Technical Committee and Task Group discussions, I do not recall discussion of a driving need for this change.

FITHIAN, W.: **Comment:** This should be rejected in its entirety.

The faceshield and/or goggle stowed position has always been determined by the manufacturer. The manufacturers have established the intended design of their products and components. Therefore, instructions provided by the manufactures should be used for testing. Additionally, a method specified faceshield and/or goggle stowed position requirement will be design restrictive. The manufacturer should be required to describe the stowed position in the user information for each faceshield and goggle applicable for each model.

RIHN, J.: This proposal is design restrictive. This proposal needs to take into consideration as part of it's interpretation that faceshields and goggles are treated equally in the standard and therefore would limit the storage of goggles to the front and top of the helmet and not the rear. Dictating the stowed position of a faceshield/design which has been in use for decades without the supporting data to substantiate the reason for change sets a bad precedent.

1971-182 Log #85 FAE-SPF Final Action: Reject
(8.67)

TCC Action: **The TCC instructs the Technical Committee on Structural and Proximity Fire Fighting Protective Clothing and Equipment to consider information provided by the task group for CBRN Test Methods to update the permeation resistance test method in 8.67 in NFPA 1971 consistent with the latest research and laboratory test practices by undertaking the following actions:**

a) Remove the reference to ASTM F 739

b) Base revised test procedures on recommendations provided in Technical Support Working Group (TSWG) report, *Risk-Based Protective Clothing Material Permeation Criteria*, dated March 31, 2010, in the following table.

********Insert Table 1971_L85_Tb_TCC Note Here********

Submitter: Jeffrey O. Stull, International Personnel Protection, Inc.

Recommendation: Modify Chemical Permeation Resistance Test consistent with proposed changes for NFPA 1994, Class 2 in terms of test chemical selection, test conditions, test apparatus, procedures, report, and interpretation criteria.

Substantiation: Optional CBRN performance was based on parallel criteria established in NFPA 1994, Class 2 for SCBA use. This relationship should be maintained with the difference in the specification of material conditioning for extended service life.

Committee Meeting Action: Reject

Committee Statement: The technical committee rejected the proposal because no changes to the relative Class 2 performance requirements in NFPA 1994, Standard on Protective Ensembles for First Responders to CBRN Terrorism Incidents, were included.

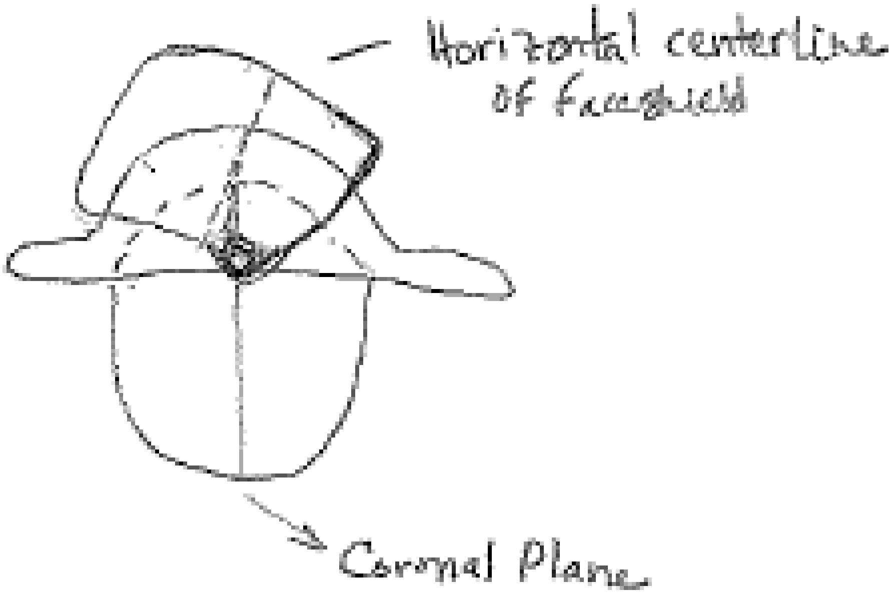
Number Eligible to Vote: 30

Ballot Results: Affirmative: 26 Abstain: 1

Ballot Not Returned: 3 Davis, R., Doan, S., Scianna, M.

Explanation of Abstention:

STULL, J.: A separate TCC task group has been established to harmonized CBRN requirements, including chemical permeation resistance among all affected standards, including NFPA 1971.



F2011_1971_CP35_Fig 8.1.14.1_R

NFPA Technical Correlating Committee on
Fire and Emergency Service Protective Clothing and Equipment

NFPA 1971
Table for Log 85

Table of Recommended Changes to Permeation Resistance Test Method

Test Parameter	**Current Specification**	**Proposed Change**
Referenced standards	ASTM F 739	ASTM D 1777 for thickness measurement; ASTM D 3776 for unit area weight measurement
Test environment	None; however, testing to be performed at 32 ±1°C	All testing to be performed in separate test chamber that will be maintained at test conditions; specimens, chemicals, and test apparatus will be placed in chamber and required to be in place 24 hrs prior to testing
Test cell	Per ASTM F 739, alternative test cells permitted; no requirements for determining equivalency	Modified TOP 8-2-501 test cell with drawing specification for modified specimen plate to accommodate control of exposed surface area in saturated surface exposure tests; test cap to contain fitting for measuring integrity of test cell after specimen is mounted
Air flow requirements in collection side	Filtered air at rate of 1 ±0.1 Lpm at 80 ±5% RH	Balance air flow with challenge side for consistency and absence of pressure drop; measure temperature and relative humidity at test cell inlet; principal air flow system to be positioned inside environmental chamber
Specimen size	Varies with test cell	Standardized for TOP 8-2-501 test cell
Permeation specimen conditioning	21 ±3°C and 65 ±5% RH (standard textile conditioning)	32 ±1°C and 80 ±5% RH to be conducted inside test chamber; tolerance on temperature to be relaxed to ±2°C
Test cell sealing	None	Alternative gasketing material to be specified; O-rings and fittings must be assessed for compatibility with test chemical; Specific torque to be applied in sealing test cell

Test Parameter	Current Specification	Proposed Change
Test cell integrity check	None	Using fitting in test line cap, test cell to be pressurized with air to 2 psig with specimen in place with pressure drop measured after 1 minute (only 10% pressure drop permitted)
Liquid challenge conditions	Liquid applied at surface density of 10 g/m^2 using appropriate number of 1-μL droplets uniformly dispensed on material specimen surface	For each liquid chemical (including chemical warfare agents), nine (9) 1-μL droplets will be applied in specific pattern on exposed specimen surface; time of 30 seconds will be required for opening test cell cap, dispensing droplets, and closing test cell cap.
Air flow on challenge side for open top test cell configuration	Filtered air at rate of 0.3 ±0.03 Lpm at 80 ±5% RH	Filtered air at rate of 0.3 ±0.03 Lpm at 80 ±5% RH, temperature conditioning with environmental chamber
Volatile liquid toxic industrial chemical challenge	None	Chemicals with vapor pressures of 5 mm Hg or greater at 25°C will be tested as vapors at the corresponding gas concentration in the respective standard
Collection technique	Combination of analytical technique and collection medium shall be selected to maximize sensitivity for the detection of the test chemical and represent actual occupational conditions as closely as possible	Test system collection efficiency evaluated using procedure to determine total test chemical collected; evaluation must be performed for each test chemical and verified periodically by laboratory
Analytical sensitivity	Test system must have detection limit that is one order of magnitude lower than prescribed permeation end point	Specification to be based on each individual chemical; good laboratory practice standards will be referenced for correct analytical procedures
Results reported	Breakthrough time Permeation rate (optional) Test parameters as part of report	Cumulative permeation Test parameters as part of report
Interpretation of results	Average of all results	Average of all results; however, if one or two test cells show no cumulative permeation, the standard-defined minimum detection limit will be used for no detectable permeation test results for purposes of averaging results