



## Bacterial Filtration Efficiency (BFE) and Differential Pressure (Delta P) Final Report

Test Article: Product Name: Non-woven Face mask  
LOT No.: CMA4714  
Study Number: 1088913-S01  
Study Received Date: 23 Aug 2018  
Testing Facility: Nelson Laboratories, LLC  
6280 S. Redwood Rd.  
Salt Lake City, UT 84123 U.S.A.  
Test Procedure(s): Standard Test Protocol (STP) Number: STP0004 Rev 15  
Deviation(s): None

**Summary:** The BFE test is performed to determine the filtration efficiency of test articles by comparing the bacterial control counts upstream of the test article to the bacterial counts downstream. A suspension of *Staphylococcus aureus* was aerosolized using a nebulizer and delivered to the test article at a constant flow rate and fixed air pressure. The challenge delivery was maintained at  $1.7 - 2.7 \times 10^3$  colony forming units (CFU) with a mean particle size (MPS) of  $3.0 \pm 0.3 \mu\text{m}$ . The aerosols were drawn through a six-stage, viable particle, Andersen sampler for collection. This test method complies with ASTM F2101-14, EN 14683:2014, Annex B, and AS4381:2015.

The Delta P test is performed to determine the breathability of test articles by measuring the differential air pressure on either side of the test article using a manometer, at a constant flow rate. The Delta P test was designed to comply with MIL-M-36954C, Section 4.4.1.2 and complies with EN 14683:2014, Annex C and AS4381:2015.

All test method acceptance criteria were met. Testing was performed in compliance with US FDA good manufacturing practice (GMP) regulations 21 CFR Parts 210, 211 and 820.

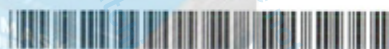
Test Side: Inside  
BFE Test Area:  $\sim 40 \text{ cm}^2$   
BFE Flow Rate: 28.3 Liters per minute (L/min)  
Delta P Flow Rate: 8 L/min  
Conditioning Parameters:  $85 \pm 5\%$  relative humidity (RH) and  $21 \pm 5^\circ\text{C}$  for a minimum of 4 hours  
Test Article Dimensions:  $\sim 177 \text{ mm} \times \sim 158 \text{ mm}$   
Positive Control Average:  $2.5 \times 10^3$  CFU  
Negative Monitor Count:  $< 1$  CFU  
MPS:  $3.1 \mu\text{m}$



  
Study Director

Janelle R. Bentz, M.S.

10 Sep 2018  
Study Completion Date



1088913-S01

**Results:**

Test Article Number	Percent BFE (%)	Delta P (mm H <sub>2</sub> O/cm <sup>2</sup> )	Delta P (Pa/cm <sup>2</sup> )
1	99.8	3.6	35.2
2	99.9	3.6	35.6
3	99.7	3.7	35.9
4	>99.9 <sup>a</sup>	3.4	33.5
5	99.9	3.8	36.8

<sup>a</sup> There were no detected colonies on any of the Andersen sampler plates for this test article.

The filtration efficiency percentages were calculated using the following equation:

$$\% \text{ BFE} = \frac{C - T}{C} \times 100$$

C = Positive control average

T = Plate count total recovered downstream of the test article

Note: The plate count total is available upon request



## Synthetic Blood Penetration Resistance Final Report

Test Article: Product Name: Non-woven Face mask  
LOT #CMA4714  
Study Number: 1088912-S01  
Study Received Date: 23 Aug 2018  
Testing Facility: Nelson Laboratories, LLC  
6280 S. Redwood Rd.  
Salt Lake City, UT 84123 U.S.A.  
Test Procedure(s): Standard Test Protocol (STP) Number: STP0012 Rev 08  
Deviation(s): None

**Summary:** This procedure was performed to evaluate surgical facemasks and other types of protective clothing materials designed to protect against fluid penetration. The purpose of this procedure is to simulate an arterial spray and evaluate the effectiveness of the test article in protecting the user from possible exposure to blood and other body fluids. The distance from the target area surface to the tip of the cannula is 30.5 cm. A test volume of 2 mL of synthetic blood was employed using the targeting plate method.

This test method was designed to comply with ASTM F1862 and ISO 22609 (as referenced in EN 14683:2014 and AS4381:2015) with the following exception: ISO 22609 requires testing to be performed in an environment with a temperature of  $21 \pm 5^\circ\text{C}$  and a relative humidity of  $85 \pm 10\%$ . Instead, testing was performed at ambient conditions within one minute of removal from the environmental chamber held at those parameters.

All test method acceptance criteria were met. Testing was performed in compliance with US FDA good manufacturing practice (GMP) regulations 21 CFR Parts 210, 211 and 820.

Number of Test Articles Tested: 32  
Number of Test Articles Passed: 30  
Test Side: Outside  
Pre-Conditioning: Minimum of 4 hours at  $21 \pm 5^\circ\text{C}$  and  $85 \pm 5\%$  relative humidity (RH)  
Test Conditions:  $18.8^\circ\text{C}$  and 32% RH

**Results:** Per ASTM F1862 and ISO 22609, an acceptable quality limit of 4.0% is met for a normal single sampling plan when  $\geq 29$  of 32 test articles show passing results.

Test Pressure: 120 mmHg (16.0 kPa)

Test Article Number	Synthetic Blood Penetration
1-18, 20-26, 28-32	None Seen
19, 27	Yes

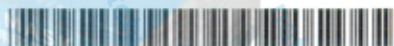
Study Director

*Janelle Benz* for  
Brandon L. Williams

Brandon L. Williams

Study Completion Date

10 Sep 2018



1088912-S01

## Microbial Cleanliness (Bioburden) of Medical Masks Final Report

Test Article: Product Name: Non-woven Face mask  
LOT #CMA4714  
Study Number: 1111909-S01  
Study Received Date: 22 Oct 2018  
Testing Facility: Nelson Laboratories, LLC  
6280 S. Redwood Rd.  
Salt Lake City, UT 84123 U.S.A.  
Test Procedure(s): Standard Test Protocol (STP) Number: STP0036 Rev 14  
Customer Specification Sheet (CSS) Number: 201805306 Rev 01  
Deviation(s): None

**Summary:** The testing was conducted in accordance with EN 14683:2014, with the exception of approximate volumes of eluent used when performing the extraction procedure and a temperature range of 30-35°C used for aerobic incubation.

When bioburden results are calculated using a software program, manual calculations may differ slightly due to rounding. The counts determined on products are colony forming units and may not always reflect individual microorganisms. The sponsor performs any statistical analysis and determines the acceptable limits. Testing was performed in compliance with US FDA good manufacturing practice (GMP) regulations 21 CFR Parts 210, 211 and 820.

### Results:

Unit Number	Weight (g)	Aerobic	Fungal	Total Bioburden (CFU/mask)	Total Bioburden (CFU/g)
1	3.3	<3	<3	<6.3	<1.9
2	3.3	<3	<3	<6.1	<1.8
3	3.5	<3	<3	<6.4	<1.8
4	3.5	<3	<3	<6.1	<1.7
5	3.4	<3	<3	<6.0	<1.8
Recovery Efficiency		UTD <sup>a</sup>			

< = No Organisms Detected

UTD = Unable to determine

Note: Sample positive testing was performed using *Bacillus atrophaeus*. The test article was not inhibitory using this test method.

Note: The results are reported as colony forming units (CFU) per mask.

<sup>a</sup> UTD due to zero count on the first rinse. An alternate method or inoculated product recovery efficiency is recommended.



Robert Putnam electronically approved  
Study Director

Robert Putnam

13 Nov 2018 18:39 (+00:00)  
Study Completion Date and Time

801-290-7500 | [nelsonlabs.com](http://nelsonlabs.com) | [sales@nelsonlabs.com](mailto:sales@nelsonlabs.com)

**Test Method Acceptance Criteria:** If applicable, anaerobic controls are acceptable for the bioburden test results. The number of masks to be tested shall be a minimum of 5 or more to meet an acceptable quality level of 4%. The bioburden of the medical mask shall be < 30 cfu/g tested.

**Procedure:**

- Positive Controls/Monitors: *Bacillus atrophaeus*
- Extract Fluid: Peptone Tween® with Sodium Chloride
- Extract Fluid Volume: ~300 mL
- Extract Method: Orbital Shaking for 5 minutes at 250 rpm
- Plating Method: Membrane Filtration
- Agar Medium: Tryptic Soy Agar  
Sabouraud Dextrose Agar with Chloramphenicol
- Recovery Efficiency: Exhaustive Rinse Method
- Aerobic Bacteria: Plates were incubated 3 days at 30-35°C, then enumerated.
- Fungal: Plates were incubated 7 days at 20-25°C, then enumerated.



