Evaluation of Decontaminated N95 Respirators

NPPTL
National Personal Protective Technology Laboratory

Date Tested: 9/22/2020

Respirator Model(s): 3M 8200

Tests: Filtration with NaCl (modified version of STP-0059) and Strap Integrity with Tensile Testing

Decontamination Method: Chlorine Dioxide; Each N95 FFR was sealed in its own Tyvek envelope and placed in its own 2 L glass jar with 1/3 of a paper towel and a 10 mL glass beaker. 100 µL saturated aqueous solution of technical grade sodium chlorite (80% by mass $NaClO_2$, 18% NaCl) and 100 µL saturated aqueous sodium hydrogen sulfate were added as separate drops to the bottom of the 10 mL beaker. The jar was sealed with a metal screw-on lid with Luer lock feedthrus and stop cocks. The jar was tipped to mix solutions and begin chlorine dioxide generation. After 120 minutes, 10 mL saturated aqueous sodium sulfite was added by syringe needle through a feedthru to wet the paper towel. After another 120 minutes, the FFR was removed from the Tyvek envelope. This process was repeated for a total of 4 cycles for each FFR. The total dose of chlorine dioxide to each FFR was approximately 4 x 2,500 ppm-hours, as measured by gas sampling through the feedthrus and measurement of the optical absorbance at 351 nm.

Decontamination Cycles: 4 cycles

While decontamination and reuse of FFRs are not consistent with standard and approved usage, these options may need to be considered when FFR shortages exist. This assessment was developed to quantify the filtration efficiency and manikin fit factor[1] of an N95 respirator that has been decontaminated. This assessment is not to determine the effectiveness of the decontamination procedure at killing pathogenic microorganisms. The results provided in this report are specific to the subset of samples that were provided to NPPTL for evaluation. These results may be used to update the CDC guidance for Crisis Capacity Strategies (during known shortages).

Eight respirators that were unworn and not subjected to any pathogenic microorganisms were submitted for evaluation. This included 4 respirators that were subjected to 4 cycles of the chlorine dioxide decontamination process and an additional 4 respirators that served as controls. Figure 1 photos document the procedures used. The samples were tested using a modified version of the NIOSH Standard Test Procedure (STP) TEB-APR-STP-0059 to determine particulate filtration efficiency. The TSI, Inc. model 8130 using sodium chloride aerosol was used for the filtration evaluation. Additionally, tensile strength testing of the straps was performed to determine changes in strap integrity. The Instron® 5943 Tensile Tester was used for this evaluation. The full assessment plan can be found here.

Filtration Efficiency Results: All respirators (4 control and 4 decontaminated) measured greater than 95%. See Table 1.

Strap Integrity Results: Visual degradation of the straps was observed during testing, with small pieces of the elastomer straps flaking off as stretching occurred. Both the top (-11.55%) and bottom (-7.09%) straps showed decreases in recorded force. See Table 2.

Other notes: The nosepiece foam on the 3M 8200 decontaminated samples were discolored (yellow/brown color, whereas control was grey). The straps on the 3M 8200 decontaminated samples were also discolored (yellow/brown color, whereas control was white).

Figure 1. Laboratory Test Photos

Fig. 1A TSI 8130 Filter Tester

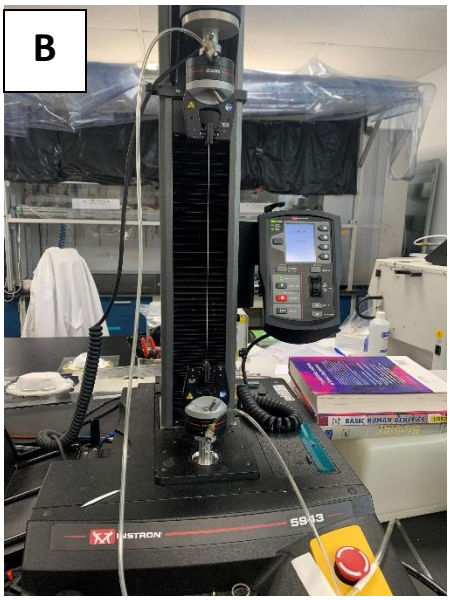

Fig. 1B Instron 5943 Tensile Tester

Table 1. Filter Efficiency Evaluation

Respirator Model, Decon Method, # of cycles	Treated Sample #	Flow Rate (Lpm)	Initial Filter Resistance (mmH_2O)	Initial Percent Leakage (%)	Maximum Percent Leakage (%)	Filter Efficiency (%)
3M 8200, Control	**Control 1**	85	11.4	0.609	0.609	99.39
	Control 2	85	10.9	0.495	0.556	99.44
	Control 3	85	10.4	1.11	1.17	98.83
	Control 4	85	11.8	0.661	0.661	99.34
3M 8200, Chlorine Dioxide, 4 cycles Min Fil Eff: 99.39% Max Fil Eff: 99.59%	**1**	85	12.2	0.601	0.610	99.39
	2	85	11.7	0.537	0.543	99.46
	3	85	11.6	0.554	0.567	99.43
	4	85	11.6	0.402	0.414	99.59

Notes:

- The test method utilized in this assessment is not the NIOSH standard test procedure that is used for certification of respirators. Respirators assessed to this modified test plan do not necessarily meet the requirements of STP-0059, and therefore cannot be considered equivalent to N95 respirators that were tested to STP-0059.

Table 2. Strap Integrity Evaluation

Tensile Force in Respirator Straps of Decontaminated N95s (recorded force values are at 150% strain)			
Respirator Model, Decon Method, # of cycles	**Straps from Treated Sample #**	**Force in Top Strap (N)**	**Force in Bottom Strap (N)**
3M 8200, Control	**Control 1**	3.730	3.525
	Control 2	3.734	3.556
	Control 3	3.716	3.640
	Control 4	3.747	3.432
	Control Strap Average	3.732	3.538
3M 8200, Chlorine Dioxide, 4 cycles	**1**	3.324	3.242
	2	3.414	3.257
	3	3.253	3.391
	4	3.211	3.256
	Decontaminated Strap Average	3.301	3.287
	% Change ((Deconned – Controls)/ Controls)	-11.55%	-7.09%