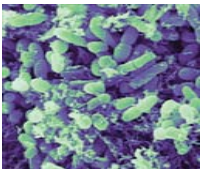
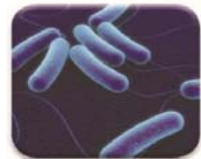
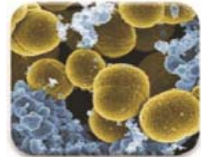


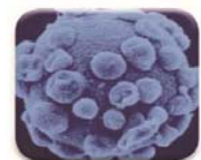
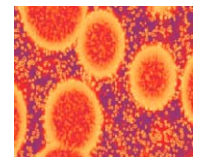
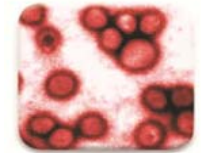
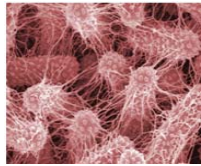
# Independent Laboratory Testing



## REPRESENTATIVE ORGANISMS



Test Organism	Carrier Type	Exposure Time	Percent Reduction	Log <sub>10</sub> Reduction	Organism Significance
Aspergillus niger (ATCC 16404)	Stainless Steel	48 hrs	>99.9%	3.5	Aspergillus niger is considered one of the most resilient fungal strains and is identified by the EPA as a "reference organism" for testing purposes pertaining to the Mold group.
		72 hrs	>99.99%	4.4	
		96 hrs	>99.99%	>4.4	
	Cotton Fabric	48 hrs	97.00%	1.52	
		72 hrs	98.50%	1.81	
		96 hrs	99.60%	2.37	
Staphylococcus aureus (ATCC 6538)	Stainless Steel	4 hrs	93.90%	1.21	Antimicrobial efficacy against Staphylococcus aureus is frequently required by the US EPA and is identified as a "reference bacterium" for Gram positive bacterium for testing purposes.
		8 hrs	>99.8%	2.84	
		12 hrs	>99.999%	>5.1	
	Cotton Fabric	4 hrs	>99.9%	>3.5	
		8 hrs	>99.9%	>3.5	
		12 hrs	>99.9%	>3.5	
Escherichia coli (ATCC 11229)	Stainless Steel	4 hrs	>99.99%	>4.2	In the food processing sector, another important representative pathogen is the Gram negative bacterium Escherichia coli.
		8 hrs	>99.99%	>4.2	
		12 hrs	>99.99%	>4.2	
	Cotton Fabric	4 hrs	>99.9	>3.4	
		8 hrs	>99.9	>3.4	
		12 hrs	>99.9	>3.4	
Pseudomonas aeruginosa (ATCC 15442)	Stainless Steel	4 hrs	>99.999%	>5.1	Pseudomonas aeruginosa is frequently required by the US EPA as a representative pathogen of clinical importance. This bacterium is often associated with hospital-acquired infections. Pseudomonas aeruginosa is a "reference bacterium" for Gram negative bacterium testing purposes.
		8 hrs	>99.999%	>5.1	
		12 hrs	>99.999%	>5.1	
	Cotton Fabric	4 hrs	>99.9%	>3.5	
		8 hrs	>99.9%	>3.5	
		12 hrs	>99.9%	>3.5	
Salmonella enterica serotype typhimurium (ATCC 23564)	Stainless Steel	1 hr	36.90%	0.20	Gram-negative rod-shaped bacteria. This is one of the most common causes of food poisoning in the United States. An estimated 1.2 million cases occur annually; of these, approximately 42,000 are laboratory-confirmed cases reported to CDC. There are currently 2,463 serotypes of Salmonella.
		3 hrs	88.50%	0.94	
		5 hrs	94.20%	1.24	
		8 hrs	>99.99%	>4.41	
	Cotton Fabric	1 hr	78.60%	0.67	
		3 hrs	92.80%	1.14	
		5 hrs	96.00%	1.40	
		8 hrs	>99.999%	>5.87	



Test Organism	Carrier Type	Exposure Time	Percent Reduction	Log <sub>10</sub> Reduction	Organism Significance
CRE – <i>Klebsiella pneumoniae</i> (CDC 1000527)	Stainless Steel	4 hrs	67.60%	0.49	Gram-negative bacteria that can cause different types of healthcare-associated infections, including pneumonia, bloodstream infections, wound or surgical site infections, and meningitis. Increasingly, <i>Klebsiella</i> bacteria have developed resistance, most recently to the class of antibiotics known as carbapenems.
		8 hrs	69.70%	0.52	
		12 hrs	89.80%	0.99	
	Cotton Fabric	4 hrs	99.40%	2.21	
		8 hrs	>99.9%	>3.46	
		12 hrs	>99.99%	>4.19	
Influenza A virus (ATCC VR-544)	Glass	3 hrs	99.98%	3.7	Representative Organism Influenza type A viruses are the most dangerous human pathogens among the influenza types and cause the most severe disease. Influenza epidemics result in 250,000 to 500,000 deaths globally each year.
		6 hrs	≥99.997%	≥4.5	
	Cotton Fabric	3 hrs	99.999%	5.25	
		6 hrs	≥99.9997%	≥5.5	
<i>Listeria monocytogenes</i> (ATCC 19111)	Stainless Steel	4hrs	94.7%	1.27	<i>Listeria monocytogenes</i> is a gram-positive, rod-shaped bacterium responsible for listeriosis, a lethal food-borne infection that has a devastating fatality rate of 25% ( <i>Salmonella</i> , in comparison, has less than 1% mortality rate). It is incredibly hardy and able to grow in temperatures ranging from 39°F (4°C) to 99°F (37°C)
	Cotton Fabric	4hrs	98.6%	1.87	
<i>Clostridium difficile</i> (ATCC 700792)	Stainless Steel	48 hrs	>99.8%	>2.8	<i>C. difficile</i> is a spore-forming, gram-positive bacillus that causes potentially life-threatening colitis. Its spores can survive outside the human body for months on surfaces including bedrails, commodes, bedpans, thermometers, wheelchairs, endoscopes, bathing tubs, and the hands of health care workers.
		72 hrs	>99.8%	>2.8	
		96 hrs	>99.8%	>2.8	
	Cotton Fabric	48 hrs	>98.2%	>1.7	
		72 hrs	>98.2%	>1.7	
		96 hrs	>98.2%	>1.7	
Murine Norovirus (Washington University – St. Louis, MO)	Stainless Steel	3 hrs	73.1%	0.57	Norovirus is a genus of genetically diverse single-stranded RNA, non-enveloped virus in the Caliciviridae family. Known viruses in the genus are all considered to be the variant strains of a single species called Norwalk virus. The virus are transmitted by contaminated food or water, by person-to-person contact, and via aerosolization.
		6 hrs	93.2%	0.87	
	Cotton Fabric	3 hrs	86.5%	1.17	
		6 hrs	98.6%	1.85	
PRRS Porcine Respiratory & Reproductive Syndrome virus (Strain NVSL)	Glass	3 hrs	49.9%	0.30	A small, enveloped RNA virus that causes a disease of pigs. This economically important pandemic causes reproductive failure in breeding stock and respiratory tract illness. The PRRS virus cost the US swine industry in excess of \$560 million in losses each year.
		6 hrs	97.90%	1.68	

Antiviral and Antimicrobial efficacy of Odorox® Mobile Disinfection Unit (MDU™) Hydroxyl Generator

## Kill rates of various organisms when subjected to Odorox<sup>®</sup> device atmospheric hydroxyls

This document was developed to provide a useful perspective relative to the efficacy data produced by ATS Labs for the Odorox<sup>®</sup> Mobile Disinfection Unit™ (MDU™) hydroxyl generator.

Anti-microbial activity requires the development of efficacy data against specific reference organisms. The term antimicrobial activity is broadly used to describe the reduction or elimination of microorganisms. To achieve broad spectrum bacterial efficacy, both classes of bacteria (Gram positive and Gram negative which are differentiated by cell wall physiologies) are evaluated. *Aspergillus niger* was evaluated to demonstrate fungicidal efficacy against a common and robust fungal organism

‘Representative Organism’ – Characteristic of the traits of this group of organisms. Kill rates effected upon this type of designated organism would be typical if applied to the rest of the organisms within that group.

When HGI Industries undertook the challenge of defining the ability of atmospheric hydroxyls to neutralize pathogens, there was a need to test the Odorox<sup>®</sup> technology against the heartiest of biological groups. This would include bacteria, virus and fungi. Since *Salmonella* has approximately 2,500 sub species, it was decided to evaluate kill rates involving the most difficult to neutralize; *Salmonella enterica*.

Of the acknowledged fungal groups, which number between 5-6 million, we sought to test Odorox<sup>®</sup> technology against the most resistant fungal specie. *Aspergillus niger* requires a 330,000 UV dose to achieve a 2Log reduction (99%). By comparison, *Aspergillus flavus* requires a dosing of 99,000 UV dose. Bacteria and virus typically require far lower dosages in order to achieve deactivation, usually between a 8,000-14,000 UV dose.

Hard and Soft Surfaces Tested – This is a remarkable achievement. Traditionally, chemicals work well on hard surfaces and tend to weaken or destroy fabrics. Odorox<sup>®</sup> technology proved equally successful on hard or soft surfaces without negative effects to fabrics.

### Summary

‘While making specific claims against specific organisms requires the specific efficacy data to support these claims, the Odorox<sup>®</sup> Mobile Disinfection Unit™ (MDU™) hydroxyl generator demonstrated that it was effective against the key representative organisms discussed above’. - Douglas G. Anderson – President, ATS Labs

**NOTE:** Only bacteria (Gram-negative/positive) and fungi can claim status as having representative organisms. All virus must be tested individually so as to demonstrate efficacy.

**NOTE:** Only Odorox<sup>®</sup> technology can lay claim to these above specific benefits. Any competing technologies must produce their own data as the patented Odorox<sup>®</sup> process cannot be copied.

**Ryerson Innovative Enterprises, RIE LLC is a distributor for Odorox products in California**

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