

# GOLDSHIELD

## Summaries of Independent Testing Conducted on *Goldshield* Products (NOVEMBER 11, 2020)

### I: PEER REVIEWED PUBLISHED STUDIES OF GOLDSHIELD

- (1) **Vanessa Perez PhD, MS, Kristina D. Mena PhD, MSPH et al.** “Evaluation and quantitative microbial risk assessment of a unique antimicrobial agent for hospital surface treatment” *American Journal of Infection Control* 43 (2015).

{Study was conducted at Oakwood Hospital and Medical Center in Dearborn, Michigan, on high frequency contact surfaces within 18 hospital patient rooms. This study was the first evaluation of a distinctive antimicrobial agent (**Goldshield 5/75**) for hospital surface treatment. 9-month trial; Infection risks were reduced by 4 and 3 logs for gram-positive and gram-negative bacteria respectively. These risk reductions, along with HAI survey studies, suggest that application of **Goldshield** could prevent as many as 5%-10% of HAIs.

- (2) **Katie Fitton DO, Kimberly R. Barber PhD et al.** “Long-acting water-stable organosilane agent and its sustained effect on reducing microbial load in an intensive care unit”. *American Journal of Infection Control* 2017.

{5-month randomized, double-blind controlled study, performed at Genesys Regional Medical Center, a 410-bed community teaching hospital in Grand Blanc, Michigan, in 18 medical intensive care unit rooms. Hard surfaces in all rooms cleaned using same protocol and then treated with **Goldshield 75**. This is the first randomized, double-blind controlled study of an innovative water stable organosilane (WSO) on high-touch hard surfaces at risk for high bioburden. Sustained reductions of bioburden with the monthly application of this unique WSO may be associated with significant reductions in risk of health care associated infections.}

- (3) **Dwayne Baxa PhD, Lynne Shetron-Rama PhD et al.** “*In vitro* evaluation of a novel process for reducing bacterial contamination of environmental surfaces”. *American Journal of Infection Control*, August, 2011.

{Henry Ford Hospital, Detroit, Michigan: Test of **Goldshield 5** product for inhibitory activity against patient isolates of methicillin-resistant *Staphylococcus aureus* (MRSA); *Pseudomonas aeruginosa*; and *Escherichia coli* on fabric and on Formica and stainless-steel surfaces. Found that **Goldshield 5**, on fabric, viability of bacterial isolates was inhibited for 14 days; and also reduced recovery of viable MRSA, PA and EC from Formica and stainless-steel carriers treated with **Goldshield**. Has inhibitory activity and potential utility as part of an infection control process.}

- (4) **Chun-Chieh Tseng, Zih-Ming Pan and Chih-Hui Chang, Department and Graduate Institute of Public Health, Tzu Chi University Hualien, Taiwan.**

“Application of a quaternary ammonium agent on surgical face masks before use for pre-decontamination of nosocomial infection-related bio-aerosols”. ***Aerosol Science and Technology* 2016 VOL. 50, NO. 3.**

{Study of ***Goldshield 5*** by three researchers at Tzu Chi University Hualien, Taiwan and published in ***Aerosol Science and Technology***. Evaluation of ability and durability of a covalently bound antimicrobial surfactant coated onto mask surfaces before use, to reduce bacterial burden upon exposure to aerosols. ***Goldshield*** provided 99.3% efficiency for all three tested bacterial species (*A. baumannii* (ATCC 17978), *E. faecalis* (ATCC 29212); and *S. aureus* (ATCC 29213). The antimicrobial ability of the coated mask maintained efficacy at least one week after coating. For bio-aerosols that came into contact with the mask, the antimicrobial agent reduced the average colony rates by 91.8%. This antimicrobial product (***Goldshield***) has a durable inhibitory activity for the reduction of bacterial burdens on masks.}

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## II: UNITED STATES OF AMERICA STUDIES ON GOLDSHIELD

(5) **Charles P. Gerba PhD., Sheri Maxwell B.S.** “Assessment of Antibacterial Efficacy of Goldshield against MRSA and VRE”. Department of Soil, Water and Environmental Science, the University of Arizona. April 2, 2008.

{The purpose of this study was to demonstrate the efficacy and residual effects of ***Goldshield*** in inactivating Methicillin-resistant *Staphylococcus aureus* (MRSA) and Vancomycin resistant *Enterococcus* (VRE) on stainless steel, plastic, vinyl and ceramic tiles. On all of these surfaces, except vinyl, (86.7%) the study showed **over 98% residual protection**. For example, the test showed that the residual effect 14 days after treatment against MRSA on stainless steel, plastics and tiles, was 99% or more.}

(6) **Dr. Shiyou Li, Research Professor, Director Center for Medicinal Plant Research, Stephen F. Austin University** “Research Paper Virucidal Efficacy of GOLDSHIELD 24 Alcohol-Free Hand Rinse for Inanimate Environmental Surfaces”. February 19, 2010.

**Dr. Shiyou Li, Research Professor, Director Center for Medicinal Plant Research, Stephen F. Austin University** “White Paper on the Science and Efficacy of GOLDSHIELD 24 Comprised of *Benzalkonium Chloride* and an Efficacy Analysis of it Combined with Other Ingredients in Goldshield 24.” March 12, 2010.

{{In vitro study of ***Goldshield 24*** against Influenza A H1N1 virus. Test showed a 2.83 log reduction against this deadly virus.}

(7) **Dr. Shiyou Li, Research Professor, Director Center for Medicinal Plant Research, Stephen F. Austin University.** “Virucidal Efficacy of ***Goldshield 5*** used for Inanimate Environmental Surfaces”. February 19, 2010.

{Utilizing ASTM E1053 protocol; ASTM E1482-04 Standard Test Method for Neutralization of Virucidal Agents in Virucidal efficacy evaluations; and U.S. E.P.A. Pesticide Assessment Guidelines, Subdivision G: Product Performance, Section 91-2(f) and Section 91-30(d), €.  
November, 1982, tested **Goldshield 5** against Influenza A H1N1 virus. Test Results:  
**Goldshield 5** is effective against the H1N1 virus. After virus film was exposed to **Goldshield 5**,  
the reduction of the Influenza A H1N1 virus was a **2.5 log reduction**. After applying the virus on  
the **Goldshield 5** protected surface for one hour, the virus did not show infectivity.}

(8) **Susan S. Blevins, B.S., SM (ASCP) et al.** “Goldshield Hand Sanitizer Project”  
Aerobiology Laboratory Associates, Inc. Consulting Laboratory. March 12, 2010.

{Test by independent laboratory (Aerobiology Laboratory Associates, Inc.) of **Goldshield 24**  
against MRSA, *in vitro*. Test showed significant log reduction in MRSA over 24-hour period,  
including 5.5 and 4.0 log reduction on two of the five samples tested.}

(9) **Nathan L. Alt, B.S. Study Director**, “ISO Closed Patch Sensitization Study:  
Goldshield treated face mask” NAMSA January 18, 2008.

{Study conducted by an independent laboratory (NAMSA) in Norwood, Ohio, to evaluate the  
potential for delayed dermal contact sensitization of **Goldshield 5** treated face mask. Study  
conducted based on requirements of the International Organization for Standardization 10993:  
Biological evaluation of Medical Devices, Part 10: Tests for Irritation and delayed Type  
Hypersensitivity. The test showed no evidence of causing delayed dermal contact sensitization  
over 48 hours.}

(10) **Samantha E. Wildeboer, B.S., M.S., MT. Study Director** “Cytotoxicity Study  
Using the ISO Agarose Overlay Method (Solid): Goldshield treated face mask” NAMSA,  
November 29, 2007.

{Study at independent laboratory (NAMSA) in Norwood, Ohio, based on requirements of the  
International Organization for Standardization (ISO) 10993-5), was conducted on **Goldshield 5**  
treated face mask. To determine the potential for cytotoxicity. The test article met the  
requirements of the ISO since the grade was less than a grade 2 (mild reactivity). The negative  
control and positive control performed as anticipated.}

(11) **Samantha E. Wildeboer, B.S., M.S., MT, Study Director** “ISO Skin Irritation  
Study: Goldshield treated face mask” NAMSA December 6, 2007.

{Study at independent laboratory (NAMSA) in Norwood, Ohio, of **Goldshield 5** treated face  
mask, evaluated for primary skin irritation in accordance with the guidelines of the International  
Organization for Standardization 10993. Result: Very slight erythema and no edema were  
observed on the skin of rabbits. The Primary Irritation Index for the mask was calculated to be  
0.0. The response of the mask was categorized as negligible.}

(12) **Daniel R. Cerven, M.S.** “Acute Inhalation Toxicity/LC 50 in Rats: Goldshield Procedural Mask” **MB Research Laboratories, Spinnerstown, Pennsylvania, 2008.**

{Study by independent GLP-certified laboratory, MB Research Laboratories in Spinnerstown, Pennsylvania, to provide information on health effects which may arise from short term exposure by the inhalation, of an aerosol atmosphere of the extract of Goldshield Procedural Mask at a concentration of 2.1 mg/ for a period of four hours. All of the animals tested appeared to be normal one hour after dosing, to 'day 14' of the test. Study was designed to comply with the standards set forth by EPA Health Effects Test Guidelines, OPPTS 870.1300, final guideline, August, 1998.}

(13) **Alan Levine PhD, BS, MS Physics, BS, PS** “Laboratory Tests of Goldshield Products on Wallboards”. RJ Lee Group, Inc. December 14, 2005.

{Study of **Goldshield 5 and Goldshield 55**, conducted by an independent laboratory, RJ Lee Group, Inc., Monroeville, Pennsylvania. Study designed to provide an initial evaluation of **Goldshield 5** on wallboards. Visual observations showed that within four days a black fungus was the only organism observed and that only the **UNTREATED** sample was contaminated. Showed 99.9% (4-log reduction) reduction in bacteria and fungi on wallboards treated with **Goldshield 5**; 5-log reduction in **Goldshield 55**; compared to 2.5 log reduction for **Comet** treated boards.}

(14) **Li Lieun PhD** “Determining the Antimicrobial Activity of Bound or Incorporated Antimicrobial Agent(s) in Polymeric or Hydrophobic Materials” IBCI Laboratories, Norcross, Georgia, November, 2005.

{Test at independent laboratory (IBCI) in Norcross, Georgia, on polymeric and/or hydrophobic foam materials, treated with **Goldshield 5** against *Staphylococcus aureus* (MRSA). Test showed 94.5-96% reduction with 99.67%-99.72% inhibition of MRSA.}

(15) **Elsa Rozas, B.S., Galina Tuninskaya, M.S. et al.** “Log Reduction of *Staphylococcus aureus* (MRSA) on Ceramic Tiles Residual Antimicrobial Effectiveness Tests on Products”. Applied Consumer Services, Inc., Hialeah Gardens, Florida, July 26, 2005.

{Study by independent laboratory (Applied Consumer Services, Inc.) Hialeah Gardens, Florida, of **Goldshield 5** for log reduction of *Staphylococcus aureus* (MRSA) on ceramic tiles, and residual antimicrobial effectiveness tests on products. Study showed 99.99% reduction for 60 minutes.}

(16) **IBCI Laboratories** “An evaluation of A.P. Goldshield’s Goldshield 5 antimicrobial on treated socks brand (GTB)” Garment Technology, Inc. Gaffney, South Carolina protocol application. November, 2006.

{Study by independent laboratory (IBCI) Norcross, Georgia; an evaluation of Goldshield 5 antimicrobial on treated socks brand GTB. Evaluation to include fifty washes, using nonionic detergent supplied by company (**Goldshield 101**). Tested against *Staphylococcus aureus* (ATCC#6538); *Trichophyton mentagrophytes* (ATCC#9533); and *Aspergillus niger*

(ATCC#16404). Results showed 99.95% reduction in these organisms in unwashed socks treated with **Goldshield 5** at concentration of 5%; and 96.85% reduction in these organisms when socks treated with **Goldshield 5** were subjected to **50 washes** at concentration of 5%.}

(17) **Douglas Kassab, Director, Clinical Support Services, University of Pittsburgh Medical Center** “Goldshield 5 Antimicrobial Test” March 10-April 24, 2008.

{**Goldshield 5** Antimicrobial Test by University of Pittsburgh Medical Center. Sample of wheelchairs, MPU stretchers and tray tables were cleaned and treated with **Goldshield 5**. Objective was to review and evaluate a new cleaning protocol which includes the application of a new long-lasting antimicrobial, **Goldshield 5**. Used ATP Detection Program—system used to detect and record biological contamination on porous and non-porous surfaces. Average of 634 total tests, showed that doing regular cleaning regimen PLUS **Goldshield** had a **dramatic** reduction of bioburden and sustained reductions **over a six-week period!!** – significantly more impact than just a regular cleaning regimen without **Goldshield**.}

(18) **Thomas Pease et al. Gentex Corporation** “AATCC 100-2004 Assessment of antibacterial activity finishes on textile materials” Nelson Laboratory, July, 2005.

{Study done for Department of Defense by independent laboratory (Gentex Corp.) to evaluate Goldshield against *Bacillus atrophaeus* spores (ATCC#9372); *Staphylococcus aureus* (ATCC#6538) and *Bacteriophage* (ATCC#13706-B1). Log reductions of 5.83, 5.84, 5.89, and 5.88 recorded; (99.998% reduction) in bioburdens, using **Goldshield 5** in DoD-supplied textile materials.}

(19) **Dr. Nigel Yarlet, Chair of Chemistry and Physical Sciences, Director of Haskins Laboratories, NY, Pace University; Ms. Mary Morrada** “Goldshield 5 Technology Tested Against MRSA (Methicillin Resistant *Staphylococcus aureus*) to Determine the Ability to Prevent the Formation of the Bacteria on Artificial Grass”. December 10, 2006.

{Study carried out at Haskins Laboratories, Pace University, New York, New York. **Goldshield 5** technology tested against MRSA (Methicillin Resistant *Staphylococcus aureus*) to determine ability to prevent formation of the bacteria on Artificial Grass. Results: 100% reduction in bioburden on treated artificial grass vs. untreated artificial grass samples.}

(20) **Thomas Gentle, PhD. Minntech Corporation** “An Evaluation of Safety and Efficacy of the Procedural Face Mask Treated with Goldshield Anti-Microbial Agent”. April 3, 2008.

{An evaluation of safety and efficacy of **Goldshield**-treated procedural and surgical face masks. Using AATCC method for Antibacterial Finishes on Textile materials: Assessment (Test Method 100-2004) by an independent laboratory. Test organisms were *Staphylococcus aureus*, *Methicillin Resistant Staphylococcus aureus* (MRSA), *Vancomycin-resistant enterococcus* (VRE) and *Candida albicans*. **Goldshield**-treated masks proven effective against all four organisms. Passed all of the safety tests. Reduction over 10 minutes of 99.99% for each of the four organisms. Biocompatibility and cytotoxicity studies indicated Goldshield treated masks are safe to use and kill at least 99% of harmful bacteria tested.}

(21) **Nigel Yarlet, PhD. And Mary Morada, Haskins Laboratory, Pace University** “Evaluation of Goldshield Antimicrobial Treated Masks of Polypropylene Against Methicillin Resistant strain of *Staphylococcus aureus*”. November, 13, 2006.

{Evaluation of **Goldshield 5** Antimicrobial Treated Masks of Polypropylene against Methicillin Resistant Strain of *Staphylococcus aureus* by Haskins Laboratory, Pace University, New York, New York. After two hours of evaluation, showed that the **Goldshield 5** concentrated product resulted in a reduction in bacterial load of 99.05%; and masks treated with 5% solution plus a wetting agent resulted in a 100% reduction. At the 24-hour evaluation, the 5% concentrated product reduced bacterial load by 99.99% and mask treated with 5% solution plus wetting agent, results in 100% reduction.}

(22) **Laura Rafa RN, Infection Control West Virginia Hospital** “Goldshield treatment of surfaces in context of regular cleaning protocols” December 29, 2009.

{Independent confidential test of **Goldshield 5** in combination with cleaning protocol at a West Virginia hospital. Luminometer readings were taken of patient rooms and medical equipment, to determine contamination of such surfaces. Just doing baseline cleaning showed a 50% reduction in week 1; 14% in week 2; and only 4% in week 3. Just applying **Goldshield** once with no routine cleaning: 92% reduction in week 1; 83% in week 2; and 70% in week three. One-time electro static steam application of **Goldshield** then routine cleaning—96% reduction in week 1; 94% in week 2; and 93% in week 3. **Goldshield** wiped on surfaces once then routine cleaning: 97% reduction in week 1; 95% reduction in week 2; and 91% in week 3. And with **Goldshield** wiped on after each test, 98% reduction in week 1; 97% in week 2 and 97% in week 3.}

(23) **Arthur Russell et al. and NY Board of Education Staff** “Use of ATP Detection Process to Evaluate Residual Efficacy of Goldshield on Treated Surfaces in New York City Schools. December 1, 2006.

{Independent valuation of **Goldshield 5** conducted by the New York City Board of Education, using ATP Detection System, at South Shore High School; Public School 253 and Far Rock High School in gymnasiums; weight rooms; classroom desks and sinks; and lockers. Initial testing of 19 of those spaces prior to treatment with **Goldshield**: 32% failure rate due to bacteria. After treatment with Goldshield, 100% PASS RATE with ZERO failures. Protection persisted for **FOUR WEEKS!!!!**}

(24) **Chris Wilkerson, EquipSystems** “Environmental Testing Analysis of Goldshield Antimicrobial on Surfaces and Equipment”, New York Athletic Club. September 12, 2007.

{Independent evaluation of **Goldshield 5** at New York Athletic Club, by EquipSystems. Performed an environmental test using ATP Detection System. 15 samples taken from the gym hotel, wrestling and judo rooms. Surfaces scrubbed, dried and treated with **Goldshield 5**, diluted to 1:4 ration; surfaces left for 10 minutes, wiped clean and re-tested. **Goldshield eliminated 95% of all detected organisms.**}

(25) **Infection Control Department, Oakwood Hospital, HealthCure Inc.**

“Reduction of Bacteria Burden at Oakwood Hospital: An Improved System for Reducing Environmental Bacteria Threats and HAIs”. June 27, 2010.

{Study conducted by HealthCure at Oakwood Hospital in Michigan. Objective was to demonstrate the efficacy of a unique antimicrobial product and improve patient safety; develop an improved system for reducing environmental bacteria threats and Hospital Acquired Infections or HAIs. Selected 4 CVCU rooms for 30-day study; applied **Goldshield 5** after traditional deep cleaning; and reapplied product after patient discharge and deep cleaning. 10 locations in rooms, including key board, door knobs, TV remote, bedside table, visitor chair, nurse and patient faucet handles, curtains, bed rails and phone. Data showed significant sustained benefit after application of **Goldshield** resulted in ‘up to 94% reduction in bacterial burden’ in the rooms on such high touch areas **during 30-day period.**}

**Studies Conducted by Independent Corporations, Unnamed Lab Technicians**

(26) “Antimicrobial Efficacy of Goldshield 5 CLEAR COATING on Metal Surfaces. ASTM Standards E1054, G21, G22, E1428. Bacteria: *Pseudomonas aeruginosa*. Surface metal: Aluminum. January 22, 2007.

{Study of antimicrobial efficacy of **Goldshield 5** on metal surfaces. Methods: ASTM E1054, G21, G22, E1428. Organism tested: *Pseudomonas aeruginosa*. Treatment of aluminum with **Goldshield 5** at 7% concentration was effective in reducing the number of viable microorganisms over a period of 72 hours. 96.15% inhibition and 85.71% reduction. Test showed that treated samples had residual protection against bacteria **for 3 months.**}

(27) “Reduction/Inhibition Percentage Results for Application of **Goldshield 5** in Exhaust on 100% Cotton Samples Against *Staphylococcus aureus*.” Garment Technology Inc. T-Shirts January 22, 2007.

{Independent laboratory test for reduction/inhibition for application of **Goldshield 5** in exhaust on 100% cotton samples against *Staphylococcus aureus*. AATCC Method 100-1993. Test of Cotton Control Jersey T-shirts provided by Garment technology, Inc. 99.99% inhibition and 99.99% reduction of bacteria on treated T shirts.}

(28) “**Goldshield 5** Clear Coating Antimicrobial Efficacy when Incorporated HVAC and Air Systems Metallic Materials”. June 4, 2007.

{Independent test of **Goldshield 5** antimicrobial efficacy when incorporated HVAC and Air Systems Metallic Materials. Test showed 90% reduction of bioburden on aluminum, stainless steel and galvanized metals.}

(29) “Antimicrobial Efficacy when Exhausted on Cotton and Poly-Cotton Materials against *Candida albicans*” August 26, 2007.

{GTT Test Report on KN95 3D respirator mask treated with **Goldshield 5**. Tested against *Staphylococcus aureus*; *Colon bacillus*; and *Candida albicans*. Requirement for inhibition for each was 70%; 70%; and 60% respectively. Each test showed 99% inhibition for KN95 **Goldshield**-treated respirator mask.}

### III: INTERNATIONAL STUDIES ON GOLDSHIELD

(30) **Ms. Kim Morwood BSc, Cbiol MiBiol.; Ms. Claire Crawshaw MbiomedSci**  
“Microbiological Analysis Based on EN1656 (2009) Quantitative suspension test for the evaluation of bactericidal activity of chemical disinfectants and antiseptics used in the veterinary field”. MGS Laboratories, UK: May 23, 2012.

{Microbiological analysis based on EN 1656 (2009) by independent laboratory: MGS Laboratories. **Goldshield 5** tested against *proteus vulgaris*; *enterococcus hirae*; *staphylococcus aureus*; and *pseudomonas aeruginosa*. Test results: 5.34 log reduction for *vulgaris*; 5.03 log reduction for *aureus*; 5.18 log reduction for *aeruginosa*; and 5.24 log reduction for *hirae*.}

(31) **Ms. Claire Crawshaw MbiomedSci, Ms. Kim Morwood BSc, Cbiol MiBiol**  
“Microbiological Analysis Based on EN1657 (2005) Quantitative suspension test for the evaluation of fungicidal or yeasticidal activity of chemical disinfectants and antiseptics used in the veterinary area” MGS Laboratories, UK: May 23, 2012.

{Microbiological analysis based on EN 1657 (2005) by independent laboratory: MGS Laboratories: **Goldshield 5** tested against *candida albicans* and *Aspergillus niger*. Test results: 4.42 log reduction against *niger*; and 4.28 log reduction against *albicans*}.

(32) **Ms. Kim Morwood BSc, Cbiol MiBiol; Ms. Claire Crawshaw MbiomedSci.**  
“Microbiological Analysis Based on EN1656 (2009) Quantitative suspension test for the evaluation of bactericidal activity of chemical disinfectants and antiseptics used in the veterinary field”. MGS Laboratories, UK: May 30, 2012.

{Microbiological analysis based on EN 1656 (2009) by independent laboratory: MGS Laboratories: **Goldshield 24** tested against *proteus vulgaris*, *Enterococcus hirae*, *Staphylococcus aureus*; and *Pseudomonas aeruginosa*. Results: 5.34 log reduction for *vulgaris*; 5.03 log reduction against *aureus*; 5.18 log reduction against *aeruginosa*; and 5.24 log reduction against *hirae*.}

(33) **Ms. Claire Crawshaw MbiomedSci, Ms. Kim Morwood BSc, Cbiol MiBiol**  
“Microbiological Analysis Based on EN 1657 (2005) Quantitative suspension test for the evaluation of fungicidal or yeasticidal activity of chemical disinfectants and antiseptics used in the veterinary areas” MGS Laboratories: July 13, 2012.

{Microbiological Analysis based on EN 1657 (2005) by an independent laboratory: MGS Laboratories: Test of **Goldshield 24** against *Candida albicans* and *Aspergillus niger*. Test results: 3.35 log reduction against *niger*; and 4.28 log reduction against *albicans*.}



(34) **Ms. Kim Morwood BSc, Cbio MiBiol, Ms. Claire Crawshaw MbiomedSci**  
“Microbiological Analysis Based on EN 1650 (2008) Quantitative suspension test for the evaluation of fungicidal activity of chemical disinfectants and antiseptics”. MGS Laboratories, UK: May 23, 2012.

{Microbiological analysis based on EN 1650 (2008) by independent laboratory: MGS Laboratories. Test of **Goldshield 5** against *Candida albicans*; and *Aspergillus niger*. Test results: 3.35 log reduction against *niger*, and 5.18 log reduction against *albicans*.}

(35) **Ms. Helen Duxbury BSc (Hons); Ms. Kim Morwood BSc (Hons) Cbiol MiBiol**  
“Microbiological Analysis based on EN1276 (2009) Quantitative suspension test for the evaluation of bactericidal activity of chemical disinfectants and antiseptics”. MGS Laboratories, UK: November 22, 2011.

{Microbiological analysis based on EN 1276 (2009) by independent laboratory: MGS Laboratories: Test of **Goldshield 24** against *Escherichia coli*; *Enterococcus hirae*; *Staphylococcus aureus*; and *Pseudomonas aeruginosa*. Test results: 5.03 log reduction against *aeruginosa*; 5.03 log reduction against *E. coli*; 5.11 log reduction against *aureus*; and 5.25 log reduction against *hirae*.}

(36) **Ms. Claire Crawshaw MbiomedSci, Laboratory Manager; Ms. Emma Newton BSc (Hons)** “Microbiological Analysis Based on EN1276 (2009) Quantitative suspension test for the evaluation of bactericidal activity of chemical disinfectants and antiseptics”. MGS Laboratories, UK: June 21, 2012.

{Microbiological analysis based on EN 1276 (2009) by independent laboratory: MGS Laboratories: **Goldshield 5** tested against *Escherichia coli*; *Enterococcus hirae*; *Staphylococcus aureus*; and *Pseudomonas aeruginosa*. Test results: 4.90 log reduction against *aeruginosa*; 5.09 against *aeruginosa*; 5.16 against *aeruginosa*; and 5.18 against *E. Coli*; 5.23 log reduction against *aureus*; and 5.27 against *hirae*.}

(37) **Dr. Chris Woodall, Director, BluTest Laboratories Ltd. Glasgow, UK**  
“EN14476 2013 Chemical disinfectants and antiseptics- Virucidal quantitative suspension test for chemical disinfectants and antiseptics used in human medicine- Test method and requirements” BluTest Laboratories Ltd. August 18, 2015. (**Ebola test**)

{Study of **Goldshield 24** by independent laboratory, BluTest Laboratories Ltd. In UK, against respiratory syncytial virus ATCC VR 26 Long strain/Hep 2 cells- Ebola Virus. Test results: at least a 4-log reduction against the Ebola virus strain. Shows residual log reduction against Ebola virus strain for at least 60 minutes.}

(38) **Ms. Emma Newton BSc (Hons); and Ms. Kim Morwood BSc (Hons) Cbiol MiBiol** “Microbiological Analysis Based on EN1500 (1997) Chemical disinfectants and antiseptics—Hygienic handrub” MGS Laboratories, UK: June 8, 2012.

{Microbiological analysis based on EN1500 (1997) by an independent laboratory MGS Laboratories: Test of **Goldshield 24** against *Escherichia coli* K12 using hand rub for 30 and 60 seconds. Test results: Mean log reduction of 2.59 among five participants rubbing **Goldshield 24** on their hands vs. E. Coli.}

(39) **Grant Crawshaw, Lead Infection Prevention Nurse, Ipswich Hospital, UK** “Assessment of microbiological reduction and residual performance of a Goldshield antimicrobial in clinical training areas”. October, 2015.

{Microbiological study carried out in a clinical training area at Ipswich Hospital in United Kingdom. Normal cleaning in the area was carried out and then **Goldshield 75** was applied to a number of high-touch areas, including table tops; computer key board; computer mouse; door handle; exit button; light switches; window ledge; a conduit; and telephone. Test results: Study shows that Goldshield technology is capable of reducing environmental contamination even after 2-3 days after application and normal hospital cleaning taken place. Normal hospital cleaning is a daily activity and 24-hour protection would be advantageous, but **Goldshield exceeds this**. The 2 to 3-day residual activity could also provide microbiological defense over weekend periods where cleaning activity is reduced.}

(40) **Mark Phelps, Company Microbiologist** “Microbiological results from a test on a LU train after applying **Goldshield** technology”.

{Microbiological results from a test on a LU train after applying **Goldshield 5** technology: Surfaces were first tested microbiologically before application of Goldshield; surfaces were then cleaned using **Goldshield** cleaner disinfectant using microfiber; **Goldshield** was then applied using a combination of spraying application and microfiber then allowed to dry; and treated train was brought back for re-testing **after 3 weeks in service**.}

High touch areas on trains were tested for bacterial contamination. Test results: **Dramatic** reduction in bacteria sustained **over 3 weeks** in whole train, including on grab rails and seats.}

#### **IV: AGRICULTURE STUDIES**

(41) **Parker et al U.S Department of Agriculture** “Goldshield Report effect on citrus canker bacteria *in vitro* and *in vivo*” June, 2016.

{Utilization of standard microbiological and plant pathological procedures including inoculation of susceptible citrus with *Xanthomonas citri* subsp. *Citri* (Xcc), and subsequent assessment of symptoms of citrus canker that developed to establish whether there was a significant effect of **Goldshield 5** in reducing the incidence or severity of citrus canker on seedlings of grapefruit, and on survival of bacteria of the pathogen *in vitro*. Test results: Goldshield is toxic to bacteria of Xcc. All concentrations tested, except the control, resulted in complete death of the bacterium and time period was not significant, suggesting death of the bacterium was rapid.}

*In vivo tests:* The plant inoculations show that there was a significant difference in the incidence and severity of infection when plants were sprayed with **Goldshield**, either immediately before or after applying inoculum. Less disease developed on the treated plants compared to the inoculated, positive control after 30 days of growth in a greenhouse.}

(42) **Steven Williams, Pesticide Laboratory Manager, Scientific Analysis Laboratories Ltd.** “Certificate of Analysis: Impact of Quaternary Ammonium Compounds on citrus canker.” May 1, 2015.

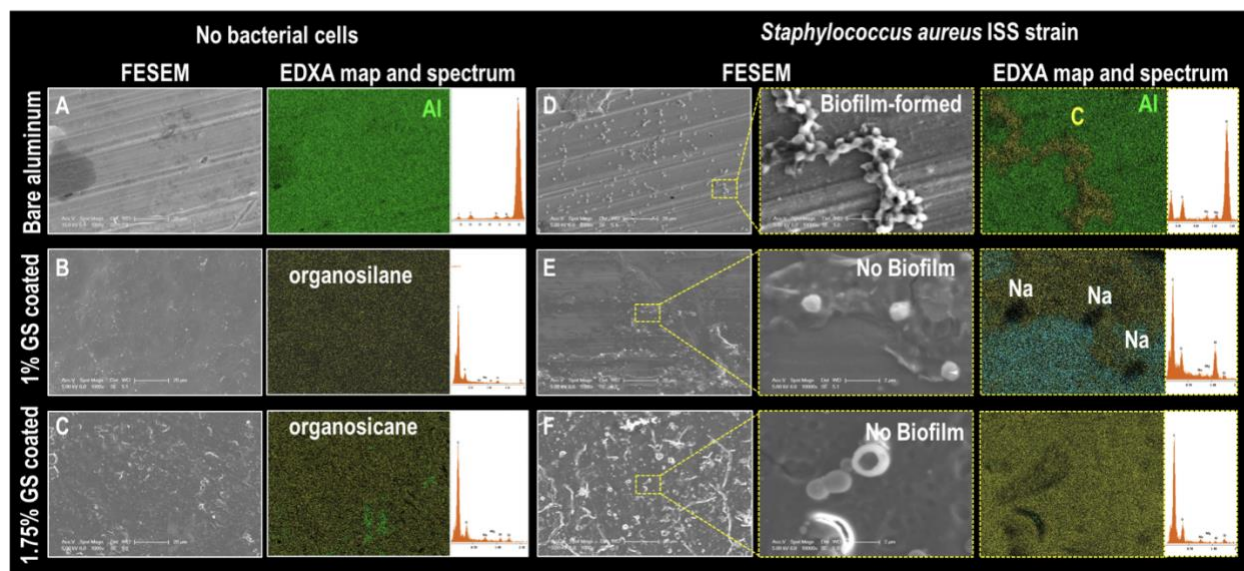
{Independent laboratory (Scientific Analysis Laboratories Ltd. UK, tested **Goldshield 24** against citrus canker in orange grove in UK. Benzalkonium chloride, key component of **Goldshield 24** is effective against citrus canker.}

(43) **Andrew Payne and D. Cawdron, Packaging Group Manager, Campden BRI Group UK** “Overall migration from food contact materials”. May 16, 2014.

{Test of **Goldshield 5** overall migration from food contact materials, using four test specimens in each overall migration test performed with food stimulants to ensure that a minimum of three valid test results are obtained. Results: On sunflower oil; Acetic Acid in an aqueous solution and 50% ethanol in an aqueous solution, there was minimal migration of **Goldshield**.}

## V: OTHER INDEPENDENT STUDIES OF GOLDSHIELD

(44) **Dr. Kasthuri Venkateswaran, Senior Research Scientist, California Institute of Technology, Jet Propulsion Laboratory Biotechnology and Planetary Protection Group, M/S 89-2.** “Assessment of water stable organosilane (**Goldshield**) antimicrobial to prevent bio-film on space and International Space Station substrates”. 2019 (Confidential)



{**Goldshield 5** was tested on several different metals utilized in the International Space Station. Testing was done by the California Institute of Technology, Jet Propulsion Laboratory. Although the final detailed results of this test are confidential, the results showed **100% reduction of bioburden over protracted period of time**—bioburden that was problematic in ISS. Other testing is ongoing with NASA for other purposes.}

(45) **Microchem Laboratory, Round Rock, Texas.** “Antimicrobial Efficacy of Treated Medical Masks Modified for Viruses” (NG6983) April 28, 2016.

{An independent laboratory, Microchem Laboratory in Round Rock, Texas, using AATCC 100 test methodology, tested surgical masks treated with **Goldshield 5** against Influenza A (H1N1) virus; human coronavirus 229E(HcoV) ATCC VR-740; and Poliovirus 1 (PV1) ATCC VR-1562.

Test results: For H1N1, 99.68% reduction at first application and 99% at 10 minutes; for poliovirus 1, 82.22% at first application and 82.22% at 10 minutes; and for human coronavirus 229E HcoV, 94.38% at first application and 90.0% at 10 minutes}

(46) **UK Laboratory Assessment of the Residual Properties of Goldshield Antimicrobial Technology July 2-August 8, 2015.** Testing against *Staphylococcus aureus* bacteria on surfaces over 7-day period under *in vitro* conditions.

{UK laboratory assessment of the residual properties of **Goldshield 85** antimicrobial technology. Test against *Staphylococcus aureus* bacteria on surfaces over a 7-day period under *in-vitro* laboratory condition. Test findings: **Goldshield 85** demonstrated that at low in-use concentrations provided a 99.9% reduction in the number of bacteria applied even after 7 days. This residual activity will provide antimicrobial defense when applied to surfaces or equipment in any environment over extended periods.}

(47) **Andrew Payne, Microbiological Solutions Limited, UK** “Quantitative suspension test for evaluation of virucidal activity in the medical area” Testing of **Goldshield 86** against viruses, including *Vaccinia Ankara*. May 3, 2018.

{Testing of **Goldshield 86** by independent laboratory, Microbiological Solutions Limited, UK, against *Vaccinia Ankara* (MVA), ATCC VR-1508. Applying rigorous European Standard for tests against viruses and applied to areas and situations where disinfection is medically indicated, for example, in hospitals, in community medical facilities and in dental institutions; in clinics of schools, of kindergartens and of nursing homes, and elsewhere in the workplace, and in the home. **Goldshield 86** was tested for virucidal activity against enveloped viruses only. Must show at least a 4-log reduction in the infectivity titre.}

Results: **Goldshield 86** passed the test, showing a 4-log reduction.

(48) **Andrew Payne, Microbiological Solutions Limited, UK** “Chemical disinfectants and antiseptics- Quantitative test method for the evaluation of bactericidal and yeasticidal activity on non-porous surfaces with mechanical action employing wipes in the medical area (4-field test)” Tested **Goldshield 86** against *Staphylococcus aureus* NCTC 10788. November 7, 2017.

{Test of **Goldshield 86** against *Staphylococcus aureus* NCTC 10788 (ATCC 6538) on non-porous surfaces with mechanical action employing wipes in the medical field. The European Standard applies to products that are used in the medical area for disinfecting non-porous surfaces including surfaces of medical device by wiping. Test Results: **Goldshield 86** passed the test against *Staphylococcus aureus*.}

(49) **Jiangsu Guojian Testing Technology Com. Ltd. Test Report 2020: KN95 3D Mask, Ho Dun Goldshiele (Shanghai) Ltd.** March 30, 2020

{Test Report/Evaluation of KN95 3D respirator mask treated with **Goldshield 5**. Passed test for filter efficiency and respiratory resistance.}

(50) **Reduction/Inhibition Percentage Results for Application of Goldshield 5 in Exhaust on 100% Polyester Samples Against *Trichophyton Mentagrophytes*.**

{Test of **Goldshield 5** against *Trichophyton Mentagrophytes* on polyester materials. Test results: 99.99% reduction and inhibition.}

(51) **Ms. Elsa Rozas, B.S., Ms. Galina Tuninskaya, M.S. et al.** “Antimicrobial Properties of Fabric Materials”. Applied Consumer Services, Inc. April 20, 2015.

(Test of **Goldshield 75** to determine the antimicrobial properties of fabric materials as per American Association of Textile Chemists and Colorists protocol 30 Part 3. Testing against *Aspergillus niger* (ATCC 6275) on agar plate over 7 days. Test Results: **Goldshield 75** shows ability to prevent growth of *Aspergillus niger* after 7 days, as per protocol AATCC 30 Part 3.

(52) **Dr. Nitán Chavan**, Coordinator Pathology, Lilavati Hospital and Research Centre, Microbiology Department, Bandra, Mumbai, India “Goldshield Disinfectant Efficacy”. June 29, 2020.

Tested **Goldshield 5 and 86** at 1<sup>st</sup> Floor Nursing Station; Microbiology testing area; 10<sup>th</sup> Floor Pediatric wards; swab collection and screening area. **Goldshield 5** used in 1:5 dilution and **Goldshield 86** without dilution. Tested on high touch areas including door handles, lift buttons, lift walls, ICU curtains. Tested against *Staphylococcus aureus*; *Candida albicans*; *Enterococcus Species*; and *Bacillus species*. Test Results: Ongoing test to continue to test residual protection: No growth of any of these bacteria over 4-5 days after initial pre-disinfection. Plans to continue colony suspension method testing until July 6<sup>th</sup> to observe continued residual efficacy.

(53) **Wuhan Virus Research Institute, Chinese Academy of Sciences**

“Effectiveness test report of antiviral-treated medical rubber glove against new coronavirus (SARS-CoV-2)”. May-June 2020.

Tested **Goldshield 5** against COVID 19 virus on medical rubber gloves. Test Results: The virus inactivation rate of antiviral gloves was 94.87% compared to the non-treated glove control group.

(54) **Wuhan Virus Research Institute, Chinese Academy of Sciences**

“Effectiveness test report of antiviral-treated medical mask against new coronavirus (SARS-CoV-2)”. May-June 2020.

Tested **Goldshield 5** against COVID 19 virus on medical masks. Test Results: the virus inactivation rate of antiviral masks is 99.88% compared to the non-treated medical mask control group.

(55) **Haffkine Institute for Training, Research and Testing** “*In vitro* Antibacterial and Antifungal Stability Testing of Disinfectant Sample Labeled as “Goldshield 5” Surface Disinfectant” by Percentage Killing Method on 1<sup>st</sup>, 7<sup>th</sup>, and 14<sup>th</sup> Day of Activation.” August 13, 2020.

RESULTS: Sample solution labelled as "Goldshield 5 Surface disinfectant" on 1<sup>st</sup> day of activation in diluted form showed 99.999% killing/inactivation of the test Bacterial species Escherichia coli (ATCC-10148), Salmonella typhi (NCTC- 786), MRSA [Methicillin resistant Staphylococcus aureus (ATCC-25923)], Bacillus cereus (ATCC 11778) and Pseudomonas aeruginosa (Fisher's Immunotype IV) as well as Fungal species Candida albicans (ATCC-10231) and Aspergillus niger (ATCC-16404) in 5 min.

RESULTS: Sample solution labelled as "Goldshield 5 Surface disinfectant" on 7<sup>TH</sup> day of activation in diluted form showed 99.999% killing/inactivation of the test Bacterial species Escherichia coli (ATCC-10148), Salmonella typhi (NCTC- 786), MRSA [Methicillin resistant Staphylococcus aureus (ATCC-25923)], Bacillus cereus (ATCC 11778) and Pseudomonas aeruginosa (Fisher's Immunotype IV) as well as Fungal species Candida albicans (ATCC-10231) and Aspergillus niger(ATCC-16404) in 5 min.

RESULTS: Sample solution labelled as "Goldshield 5 Surface disinfectant" on 14<sup>th</sup> day of activation in diluted form showed 99.999% killing/inactivation of the test Bacterial species Escherichia coli (ATCC-10148), Salmonella typhi (NCTC- 786), MRSA [Methicillin resistant Staphylococcus aureus (ATCC-25923)], Bacillus cereus (ATCC 11778) and Pseudomonas aeruginosa (Fisher's Immunotype IV) as well as Fungal species Candida albicans (ATCC-10231) and Aspergillus niger(ATCC-16404) in 5 min.

(56) **Haffkine Institute for Training, Research and Testing** “*In vitro* Antibacterial and Antifungal Efficacy Testing of Disinfectant Sample Labeled as “Goldshield 86” Surface Disinfectant by Percentage Killing Method”. August 13, 2020.

RESULTS: Sample solution labelled as "Goldshield 86 Surface disinfectant" in Undiluted form showed 99.999% killing/inactivation of the test Bacterial species Escherichia coli (ATCC-10148), Salmonella typhi (NCTC-786), MRSA [Methicillin resistant Staphylococcus aureus (ATCC-25923)], Bacillus cereus (ATCC 11778) and Pseudomonas aeruginosa (Fisher's Immunotype IV) as well as Fungal species Candida albicans (ATCC-10231) and Aspergillus niger (ATCC-16404) in 5min.

(57) **Haffkine Institute for Training, Research and Testing** “*In vitro* Antibacterial and Antifungal Efficacy Testing of Disinfectant Sample Labeled as “Goldshield 24 Hand Sanitizer” by Percentage Killing Method”. August 13, 2020.

RESULTS: Sample solution labelled as "Goldshield 24 Hand Sanitizer" In Undiluted form showed 99.999% killing/inactivation of the test Bacterial species Escherichia coli (ATCC-10148), Salmonella typhi (NCTC-786), MRSA [Methicillin resistant Staphylococcus aureus (ATCC-25923)], Bacillus cereus (ATCC 11778) and Pseudomonas aeruginosa (Fisher's Immunotype IV) as well as Fungal species Candida albicans (ATCC-10231) and 99.998 % of the test fungal species Aspergillus niger (ATCC-16404) in 5 min.

(58) **Dubai Central Laboratory Department, Government of Dubai.** “*Detergents and Disinfectants: Test of Goldshield 24 Hand Sanitizer*”. September 28, 2020.

RESULTS: Quantitative Suspension Test for Evaluation of Bactericidal Activity of Chemical Disinfectants and antiseptics (BS EN 1276): 99.99% kill rate in 1 minute at 20-degree C under clean condition. Identical results against *Enterococcus hirae* ATCC 10541; *Staphylococcus aureus* ATCC 6538; *Escherichia coli* K12 NCTC 10538; and *Pseudomonas aeruginosa* ATCC 15442.

(59) **Microbac Laboratory, Sterling, Virginia:** Preliminary Results: Virucidal Hard-Surface Efficacy Test – Severe Acute Respiratory Syndrome-related Coronavirus 2 (SARS-CoV-2) (COVID-19 Virus): **GS 86**. November, 2020.

RESULTS: Tested Goldshield 86 against the SARS CoV 2 virus isolate. Log reduction of virus: 3.50.

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