Microbiological Efficacy Summary

Tristel ULT is a high level disinfectant foam intended for reprocessing ultrasound probes.

As a high level disinfectant Tristel ULT was tested for efficacy against mycobacteria, viruses, fungi and bacteria with a contact time of 2 minutes.

Tristel ULT is proven to be effective against clinically relevant organisms. It inactivates Human papillomavirus (HPV) type 16 and type 18. Tristel ULT is also efficacious against *Chlamydia trachomatis*, *Neisseria gonorrhoeae*, Carbapenem resistant *Klebsiella pneumoniae* (CRKP), Extended-Spectrum beta-lactamase (ESBL) producing *Escherichia coli*, *Streptococcus agalactiae*, *Candida albicans*, Duck Hepatitis B virus (DHBV), and Human immunodeficiency virus (HIV).

To gain marketing authorization, Tristel has submitted a data set meeting the requirements laid out in the FDA '*Guidance Content and Format of Premarket Notification [510(k)] Submissions for Liquid Chemical Sterilants/High Level Disinfectants*' (Issued January 2000), and the Health Canada guidance '*Safety and Effectiveness Requirements for High-Level Disinfectants and Sterilants for use on Reusable Semi-Critical and Critical Medical Devices* (2018).'

In line with regulatory guidance, Tristel ULT was subjected to a three-tier efficacy testing programme:

POTENCY TESTS are conducted to demonstrate the broad spectrum of efficacy of the high level disinfectant against a list of FDA and Health Canada mandatory test organisms and specific additional efficacy claims.

SIMULATED-USE TESTS are conducted to determine the penetrating capability of a high level disinfectant used on representative medical devices. A test germicide should be able to kill at least 10^6 inoculated mycobacteria under the recommended contact time.

IN-USE TESTS are conducted to confirm the results of Simulated-Use testing and to evaluate high level disinfectant performance in clinical use conditions. The aim of testing is to confirm efficacy under strenuous conditions (i.e. persistence and resistance of ambient bioburden, such as biofilms, including "wild type" bacteria, fungi and other unforeseen factors) that could occur in the clinical setting.

Potency Tests Summary

POTENCY TESTS			
ORGANISM	**TEST METHOD**	**TEST TYPE**	**RESULTS**
SPORES			
Bacillus subtilis	AOAC 966.04	Carrier	No positive primary or secondary subculture tubes demonstrating a total kill in all 720 carriers tested
Clostridium sporogenes			
MYCOBACTERIA			
Mycobacterium terrae	Ascenzi et al., 1987/ASTM E2315	Suspension	>6.01 log_{10} reduction
FUNGI			
Trichophyton interdigitale	AOAC 955.17	Suspension	No positive culture tubes demonstrating a total kill
Candida albicans	AOAC Use Dilution Method	Carrier	
VIRUSES			
Poliovirus Type 1	ASTM E1053	Surface	≥4 log_{10} reduction with no residual virus detected
Herpes Simplex Virus (HSV) Type 1			
Adenovirus Type 5			
Human Norovirus Surrogate Feline Calicivirus			
Human Immunodeficiency Virus (HIV) Type 1			
Hepatitis B Virus Surrogate Duck Hepatitis B Virus			
BACTERIA			
Staphylococcus aureus	AOAC 955.15	Carrier	No positive culture tubes demonstrating a total kill
Pseudomonas aeruginosa	AOAC 964.02	Carrier	
Salmonella enterica	AOAC 955.14	Carrier	
Chlamydia trachomatis	AOAC Use Dilution Method	Carrier	
Neisseria gonorrhoeae			
Streptococcus agalactiae			
Carbapenem-resistant *Klebsiella pneumoniae*			
Extended Spectrum Beta-Lactamases *Escherichia coli*			

Simulated-Use Tests Summary

The devices tested by Tristel in Simulated-Use tests represent a comprehensive variety of ultrasound probes used and provide a robust validation of Tristel ULT as a high level disinfectant.

The ultrasound probes tested include endocavity ultrasound probes used in obstetrical, gynecological (OB/GYN), prostrate, and urological clinical applications and exams. In addition, skin surface ultrasound probes used in abdomen, obstetrics, gynecology, pediatric, small parts (breast), vascular and musculoskeletal clinical applications and exams have also been tested.

Probes tested incorporate configurations that impede cleaning and penetration of germicides including indentations, ridges and biopsy connector ports.

Tristel worked with leading ultrasound device manufacturers to identify the representative ultrasound probes for the simulated-use testing. The criteria for device selections were set as:

- worst case devices with difficult to penetrate design features like ridges, crevices or indentations,
- different shapes and materials of construction,
- probe models used in North America.

The microbial challenge applied to the probes consisted of at least 10^6 Colony Forming Units (CFU) of *Mycobacterium terrae*. To further challenge the germicide efficacy of Tristel ULT, organic and inorganic substances were incorporated into the test inoculum. 5% bovine serum albumin (BSA) and AOAC hard water at 400ppm calcium carbonate were used in testing.

Patient and user contacting portions of the probes were immersed in the microbial and inorganic/organic inoculum. This technique ensures a complete and thorough microbial challenge had been applied to each probe.

Following immersion, the probes were dried for at least one hour before performing the Tristel ULT high level disinfection procedure according to Tristel ULT user instructions.

After high level disinfection the probes were submerged in the recovery/neutralization fluid to recover viable microorganisms remaining on the probes. The recovery/neutralization fluid was filtered through membrane filters and placed on Middlebrook Agar (MBA) plates. All plates were incubated for 21 days at 37 ± 2 °C.

Controls and validations included positive (inoculum and growth), negative, neutralization validation, low-level inoculum and media sterility controls. Each test probe was tested in triplicate to provide statistical significance in the test results.

Simulated-Use Tests Summary

MYCOBACTERIUM TERRAE SIMULATED-USE TESTS		
DEVICE MANUFACTURER AND MODEL	APPLICATION AREA	RESULTS (Log_{10} Reduction)
GE Healthcare RAB6-D	Abdominal Obstetrics Gynecological	7.4
GE Healthcare 4C-RS	Abdominal Obstetrical Gynaecology Vascular, Urology Thoracic/Pleural Hip, Spine, Bladder Musculoskeletal	7.7
GE Healthcare 3S-SC	Abdominal Cardiac Transcranial	6.8
Philips L15-7io	Vascular, Musculoskeletal Small Parts Superficial Surgical	7.4
Canon Medical Systems PLI-1205BX	Small parts (breast) Musculoskeletal Peripheral vascular	7.2
Canon Medical Systems PVT-745BTH	Intraoperative Abdominal Small parts	7.7
GE Healthcare RIC5-9-D	Obstetrical Gynaecological Urological	7.1
Philips C10-3v	Obstetrical Gynaecological Urological	7.6
Siemens Healthineers 9EVF4	Obstetrical Gynaecological Urological	7.7
BK Medical 8818	Transrectal Transvaginal Urology	6.9
Samsung Healthcare EA2-11AR	Endocavity Obstetrics Gynaecology Urology	7.3
Samsung Healthcare EV2-10A	Endocavity Obstetrics Gynaecology Urology	7.6
Clarius EC7 - HD	Early Obstetrical IVF, Pelvic Prostate	7.5

HUMAN PAPILLOMAVIRUS TYPES 16 & 18 SIMULATED-USE TESTS		
DEVICE MANUFACTURER AND MODEL	APPLICATION AREA	RESULTS (Log_{10} Reduction)
Siemens Healthineers EC9-4	Endocavity Obstetrics Gynaecology Urology	4.9 log_{10} reduction in HPV Type 16
		4.1 log_{10} reduction in HPV Type 18

In-Use Tests Summary

STUDY 1

The hospital where the study was conducted uses BK Medical endocavity ultrasound probes for prostate biopsies. The study was performed on four days. On the days of the Tristel In-Use study the hospital had two ultrasound probes in use:

- BK Medical E14CL4b S/N - 3134937
- BK Medical E14CL4b S/N - 3132348

The BK Medical ultrasound probes used at the hospital are representative of other endocavity ultrasound probes used in gynecological and urological clinical applications and exams. Probes tested incorporate configurations that may impede cleaning and penetration of disinfectant including indentations and ridges.

After use with a patient, the hospital personnel cleaned the ultrasound probe following the hospital's standard procedure using a detergent wipe. The probe was transported to a designated decontamination room. The hospital personnel then used Tristel ULT to high level disinfect the probe according to Tristel ULT user instructions. After the contact time of 2 minutes the probe was wiped with the Tristel ULT Wipe to remove residue of the Tristel ULT Foam and then handed over to the laboratory technicians for microbial sampling.

A total of 20 samples was collected in the study: two positive control samples on the probes post clinical use and cleaning, before high level disinfection and 18 samples after the high level disinfection cycle with Tristel ULT.
The patient contaminated BK Medical endocavity ultrasound probes were tested for wild type bacteria and for fungi. Immersion in extraction fluid was the same technique as the method used in the Simulated-Use studies and allows access to the entire device for surviving bioburden.

To differentiate under non-selective conditions, one set of 10 probes were extracted and the extraction media plated under conditions favorable to bacterial growth, Trypticase Soy Agar (TSA) and incubation at 30–35 °C. An independent set of 10 probes were extracted and plated under conditions favorable to fungal growth, Sabauroud Dextrose Agar (SDA) and incubation at 30–35 °C.

Bacterial plates were incubated for three to five days and fungal enumeration plates for five to seven days.

The study success criteria are defined as no evidence of growth of wild type bacteria or fungi recovered from the patient-contaminated ultrasound probes following disinfection with Tristel ULT.

RESULTS OF THE IN-USE STUDY

The baseline control (not disinfected) for bacterial recovery demonstrated bacterial recovery of 92 CFU.

No bacteria were recovered from disinfected probes.

Microorganisms were recovered from the baseline positive control (not disinfected) fungal agar plates.
The observed microorganisms were bacterial (88 CFU), no yeast or fungi were recovered.

No yeast or fungi were recovered from disinfected probes.

Study 1 results demonstrate that Tristel ULT, when used according to label contact time conditions of 2 minutes, meets the requirements for a high level disinfectant under in-use conditions.

In-Use Tests Summary

STUDY 2

The study was conducted with two types of endocavity ultrasound probes that were used in daily clinical service at the test facility:

- RIC5-9-D endocavity ultrasound probe by GE Healthcare
- V5-9 endocavity ultrasound probe by Samsung Healthcare

Both types of probes are representative of other endocavity ultrasound probes used in gynecological and urological clinical applications and exams. Probes tested incorporate configurations that impede cleaning and penetration of disinfectant including indentations and ridges.

The tested endocavity probes were used through the daily clinic for transvaginal examination of patients. After the use on the patient the protective sheath was removed from the probe and a paper towel was used to wipe off the ultrasound gel. The hospital ultrasound operator performed cleaning in accordance with the hospital standard operating procedure.

After cleaning, the probe was handed over for high level disinfection with Tristel ULT. After the disinfection cycle and observation of the contact time of 2 minutes, swabs were used to sample the medical device and enumeration of these swabs took place to measure presence of bacterial or fungal contamination.

The four sample sites included the probe tip, the insertion tube, insertion tube indentation, and handle. The selected swab sites are areas of the endocavity probe that are patient contacting, most difficult to disinfect and are therefore, at the highest risk of becoming contaminated. The handle of endocavity probes can harbor contamination as it is a high touch area of the device.

A total of 12 post high level disinfection samples were collected.

Following the disinfection cycle, the devices were swabbed to recover any surviving wild type bacteria or fungi.
A sterile swab was dipped into 10 mL of recovery/neutralization fluid and used to thoroughly scrub the sample sites. The tip of the swab was cut into 10 mL of appropriate recovery/neutralization fluid, and this is repeated with a second swab.

This recovery step was repeated for each sample area of the probe using one tube of 10 mL recovery/neutralization fluid and two swabs for each area. All eight swab heads were recovered into the same 10 mL of recovery/neutralization fluid.
The study success criteria are defined as no evidence of growth of wild type bacteria or fungi recovered from the patient-contaminated ultrasound probes following disinfection with Tristel ULT.

RESULTS OF THE IN-USE STUDY

No bacteria, yeast or fungi were recovered from probes disinfected with Tristel ULT.

Study 2 results demonstrate that Tristel ULT, when used according to label contact time conditions of 2 minutes, meets the requirements for a high level disinfectant under in-use conditions.