

# Ambulance disinfection using ultraviolet germicidal irradiation (UVGI): effects of fixture location and surface reflectivity

## Supplemental Material

### Contents

**Drawing & photographs of UVGI fixture**

**Ambulance patient compartment interactive schematic**

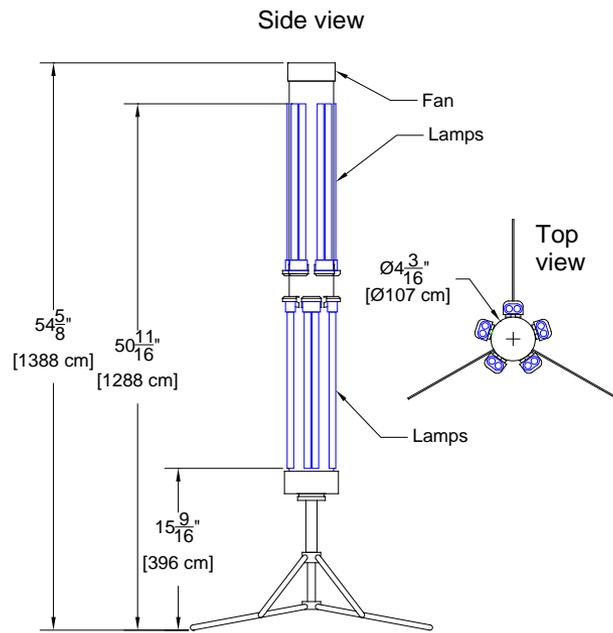
**Ambulance patient compartment photographs showing the sensor locations**

**Protocol for *Bacillus subtilis* spore production**

**Irradiance measurement results for all experiments**

***Bacillus subtilis* spore survival vs. UV dose**

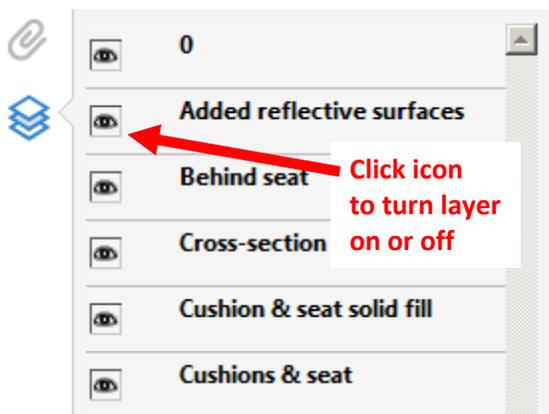
# UVGI fixture



# Ambulance patient compartment schematic

The ambulance patient compartment schematic is arranged using layers for the different components in the drawing. All layers are initially turned on when the document is opened. Each layer can be turned on and off by clicking on the eye icon to the left of the layer name in order to reduce clutter and allow you to focus on particular items of interest, such as the UV sensors, the UVGI light, or the reflective material.

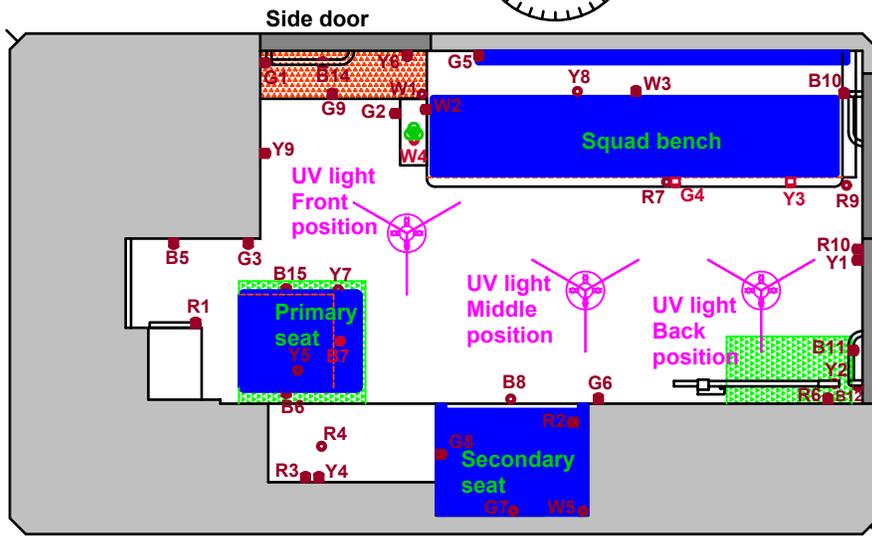
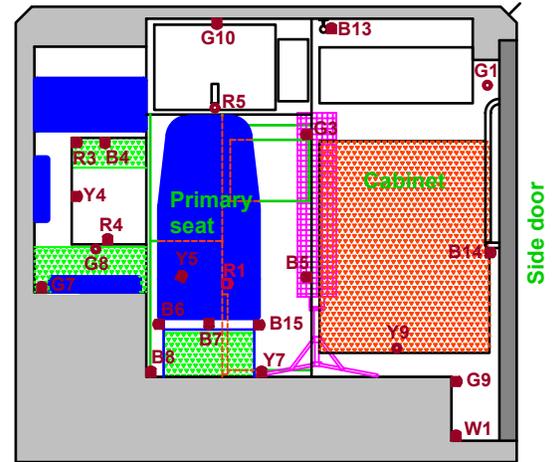
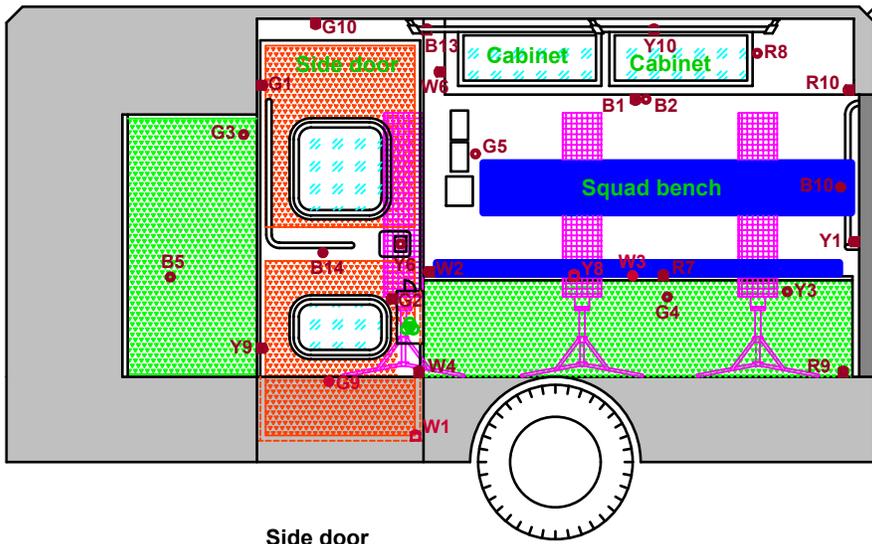
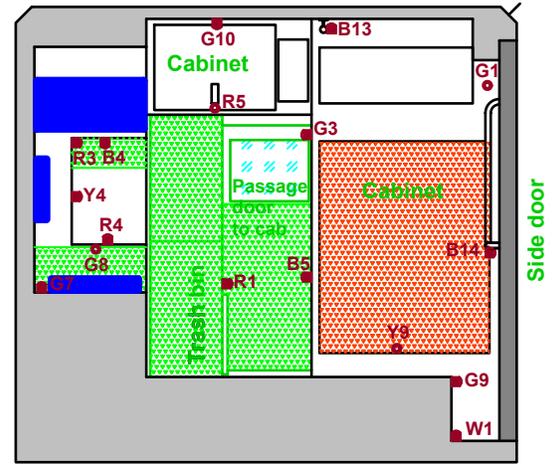
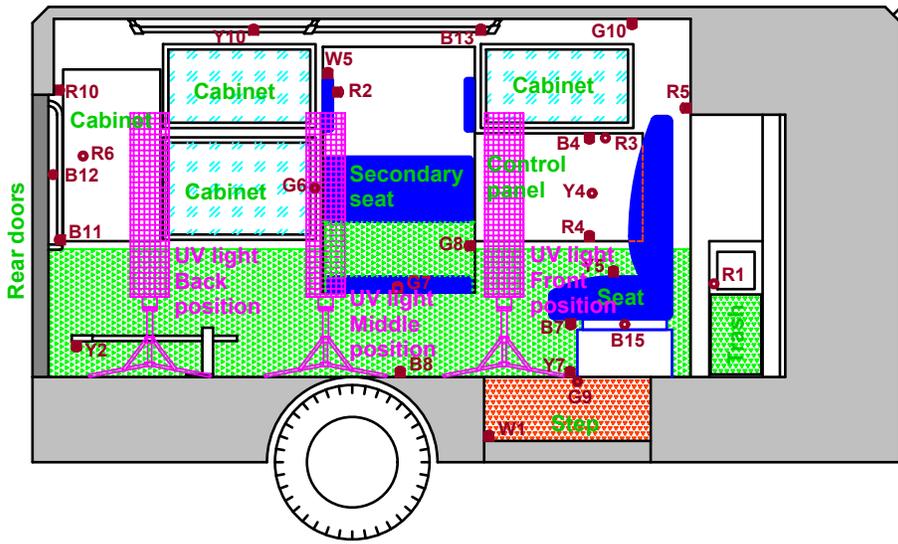
If the layer menu shown below is not visible, go to the “View” pull-down menu, select “Show/hide”, select “Navigation panes”, and then select “Layers”. Click on the + box to the left of “Ambulance schematic” to expand the layer menu.



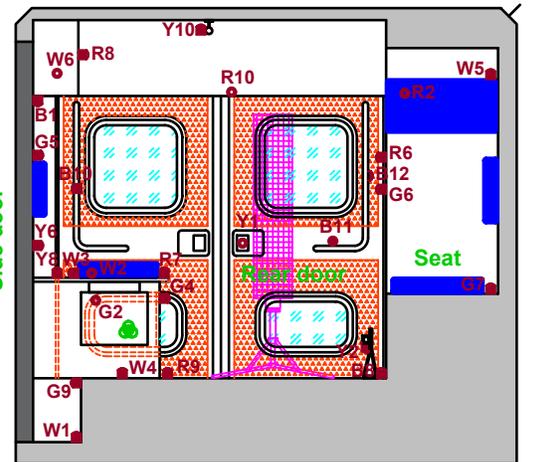
The contents of the layers are:

<i>Layer name</i>	<i>Color</i>	<i>Description of content</i>
0	Black	Ambulance body, doors, cabinets, floor, walls and hand rails
Added reflective surfaces	Green	Aluminum sheets added to walls and floor of ambulance interior in order to increase reflection of UV light from interior surfaces
Behind seat	Dark green	Cabinet and walls located behind primary patient care seat when looking forward
Cross-section	Light grey	Solid fill to indicate the doors and ambulance body in cross-sectional views
Cushion & seat solid fill	Blue	Solid blue color indicating seat cushions
Cushions & seat	Blue	Outline drawings of seats and cushions
Doors	Dark grey	Side and rear exterior entry doors for patient compartment
Glass & clear plastic	Cyan	Window glass and clear plastic doors on cabinets
Hidden	Red	Dashed lines indicate objects that are concealed behind other objects such as seats or benches
Labels	Green	Annotation to mark seats, benches, cabinets, doors, etc.

Orig reflective surfaces	Red	Aluminum surfaces that were in the original ambulance configuration as supplied by the manufacturer
Sensor labels	Brown	Labels indicating coding for ultraviolet light sensors
Sensors	Brown	Ultraviolet light sensors. A round sensor with a white center indicates the sensor is facing out of the page. A round sensor with a dark center indicates the sensor is facing into the page. A square sensor is facing parallel to the page in the direction indicated by the rounded dome on the sensor.
Sensors hidden	Red	Ultraviolet light sensor that is behind another object, such as a step, seat, or bench.
Sensors hidden labels	Red	Labels indicating coding for ultraviolet light sensors that are behind other objects.
UV light	Magenta	Ultraviolet germicidal light fixture, shown in the three positions used in the experiments.



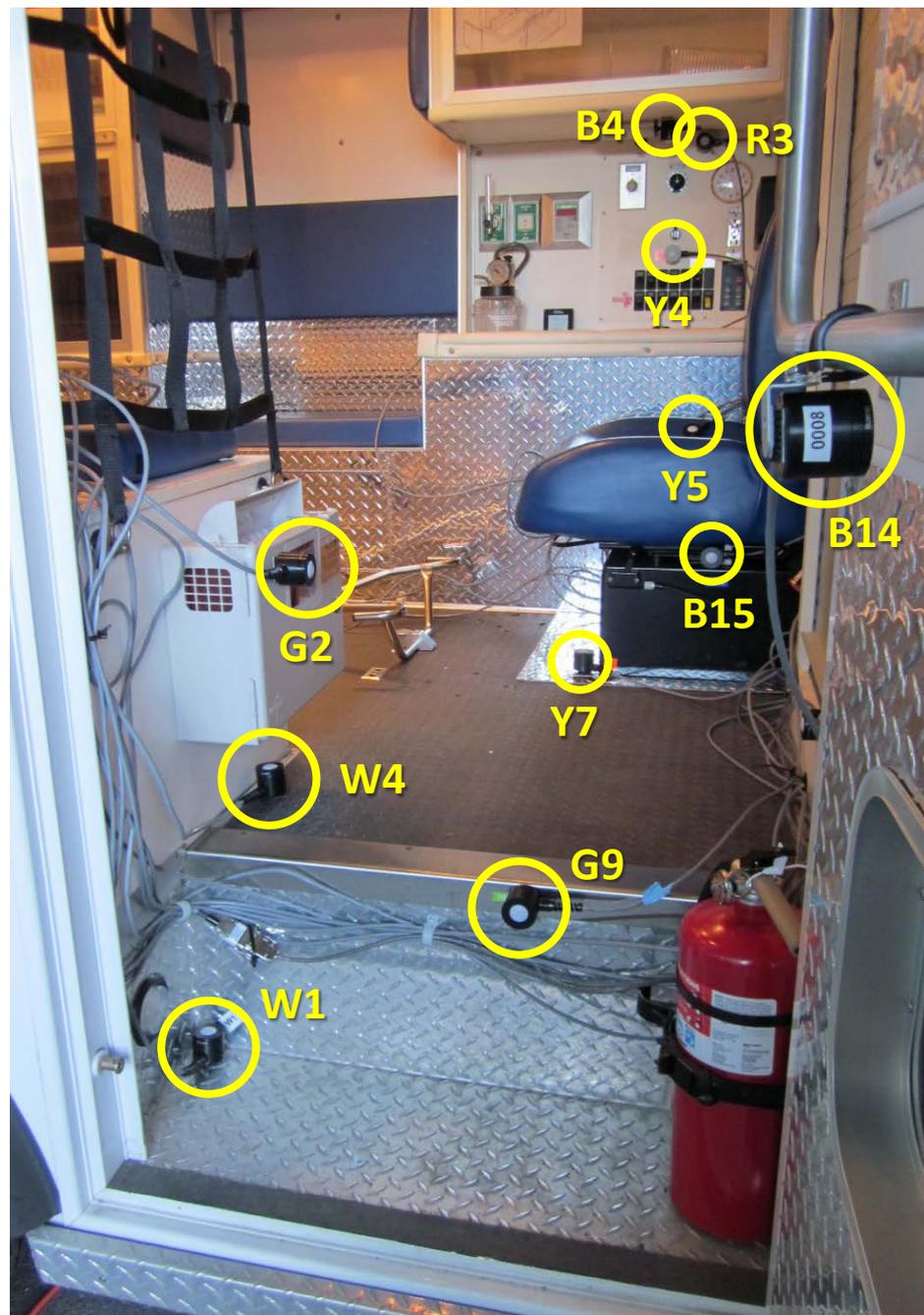
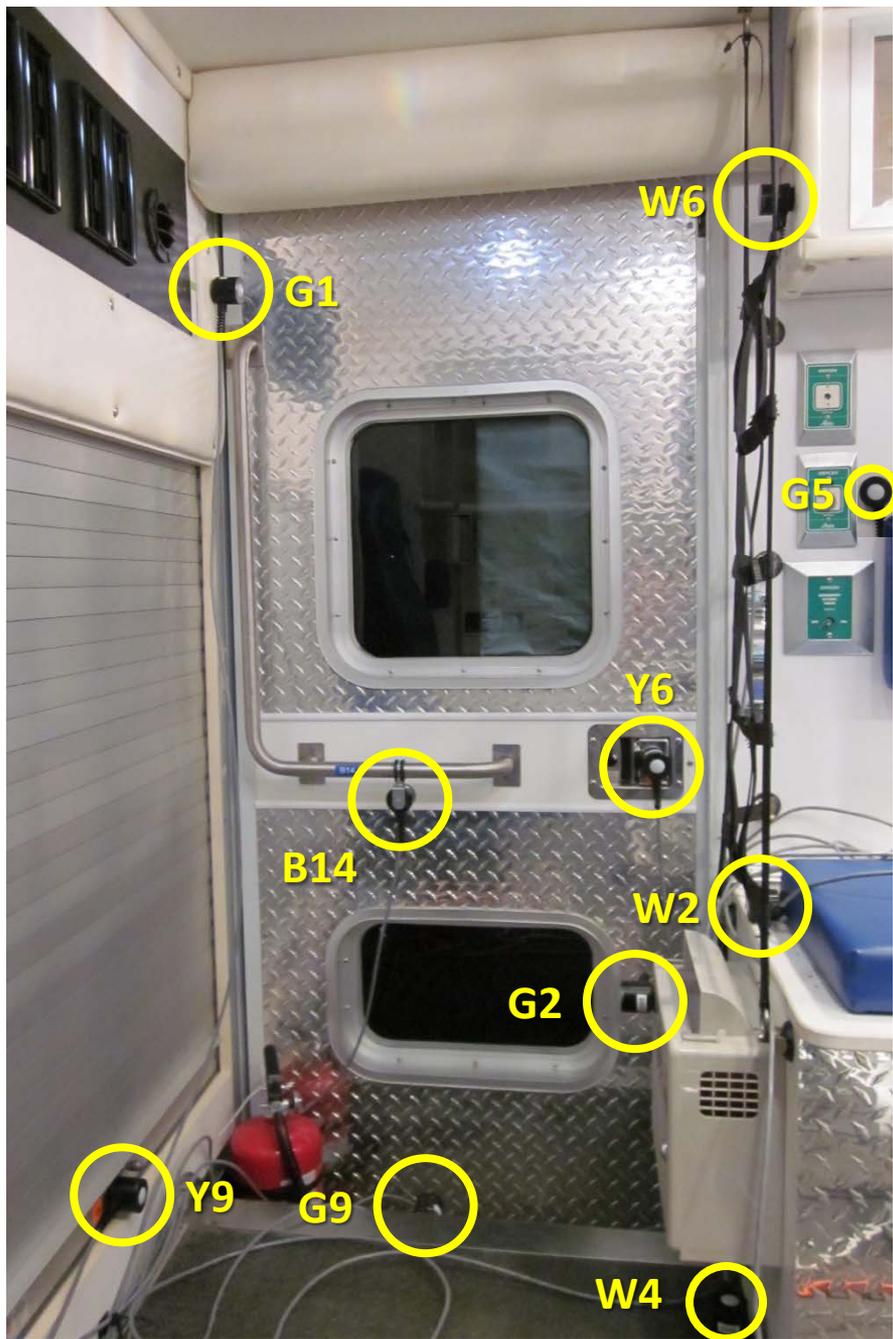
UV light  
Front  
position

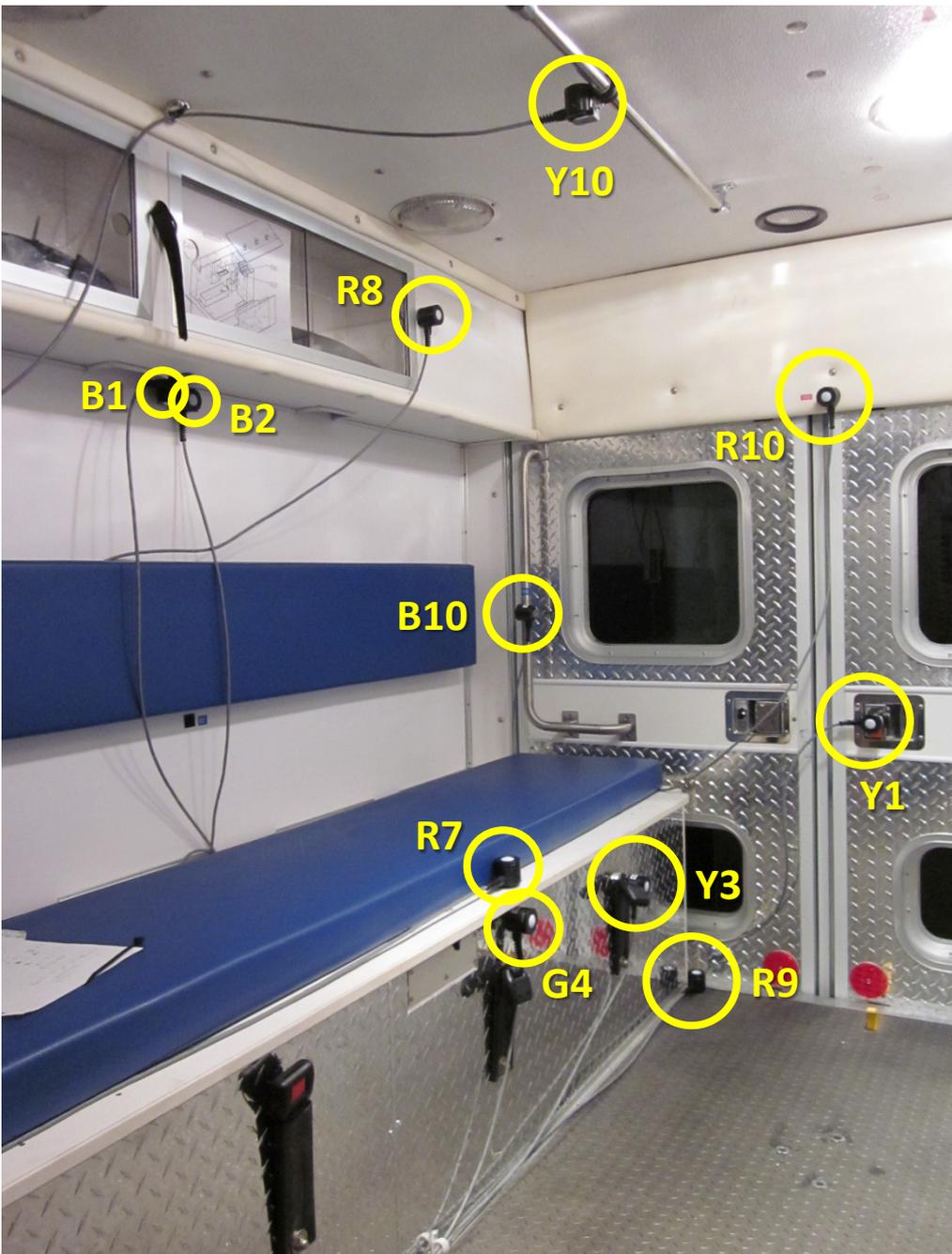
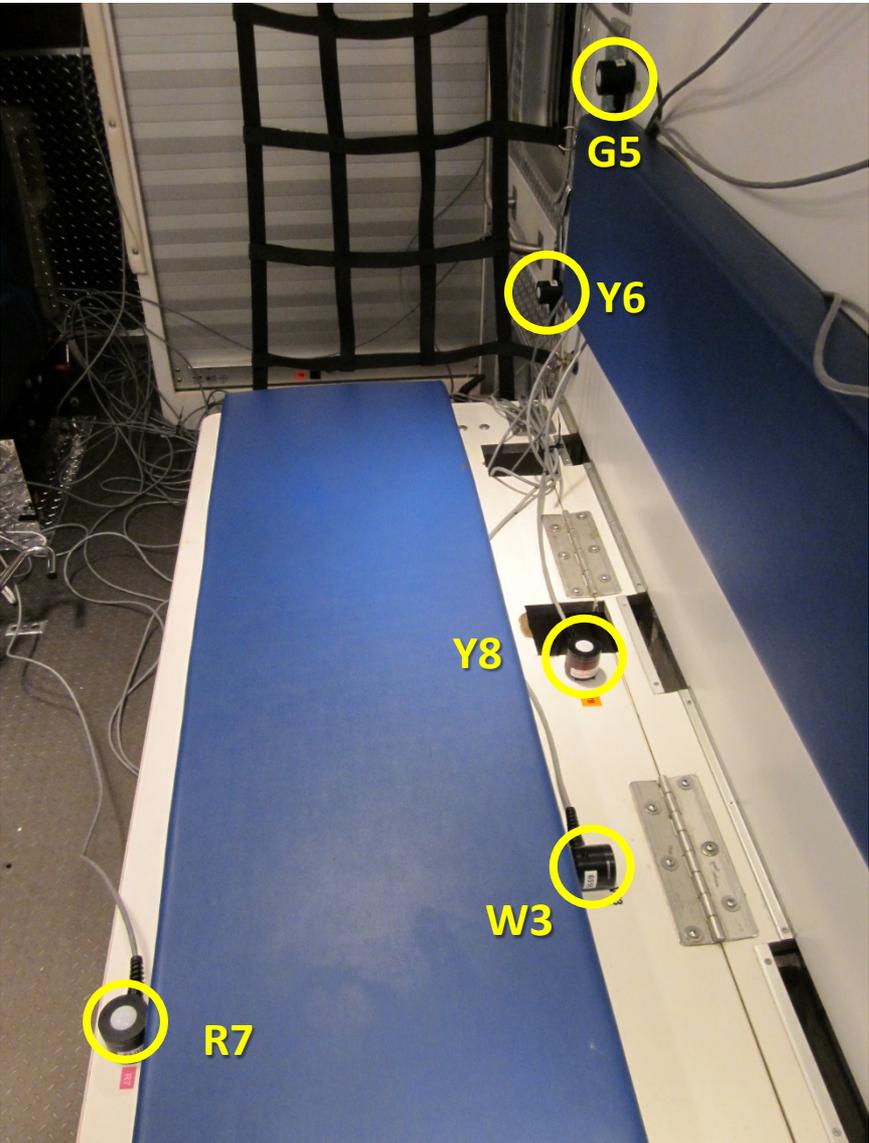


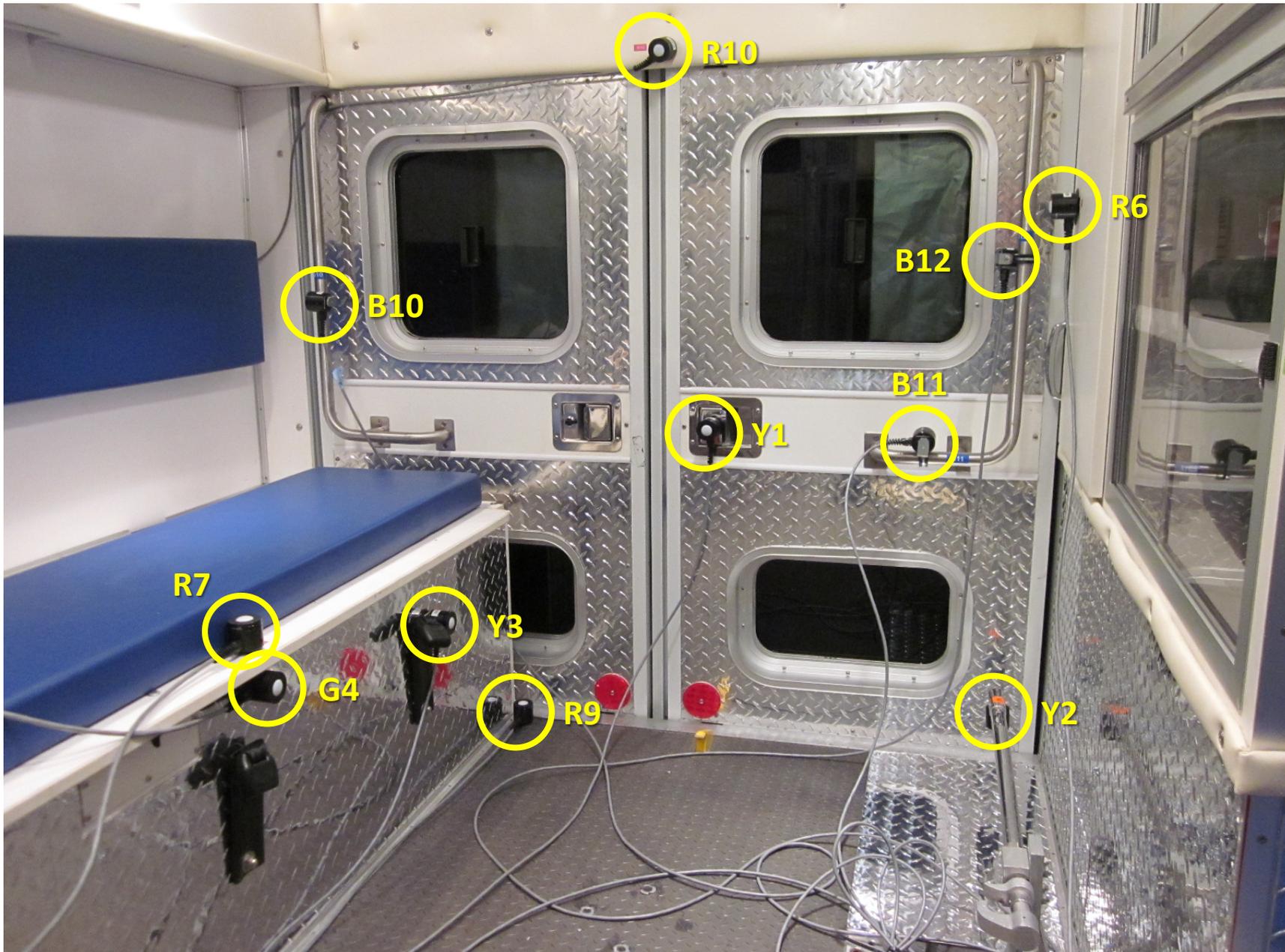
Rear doors

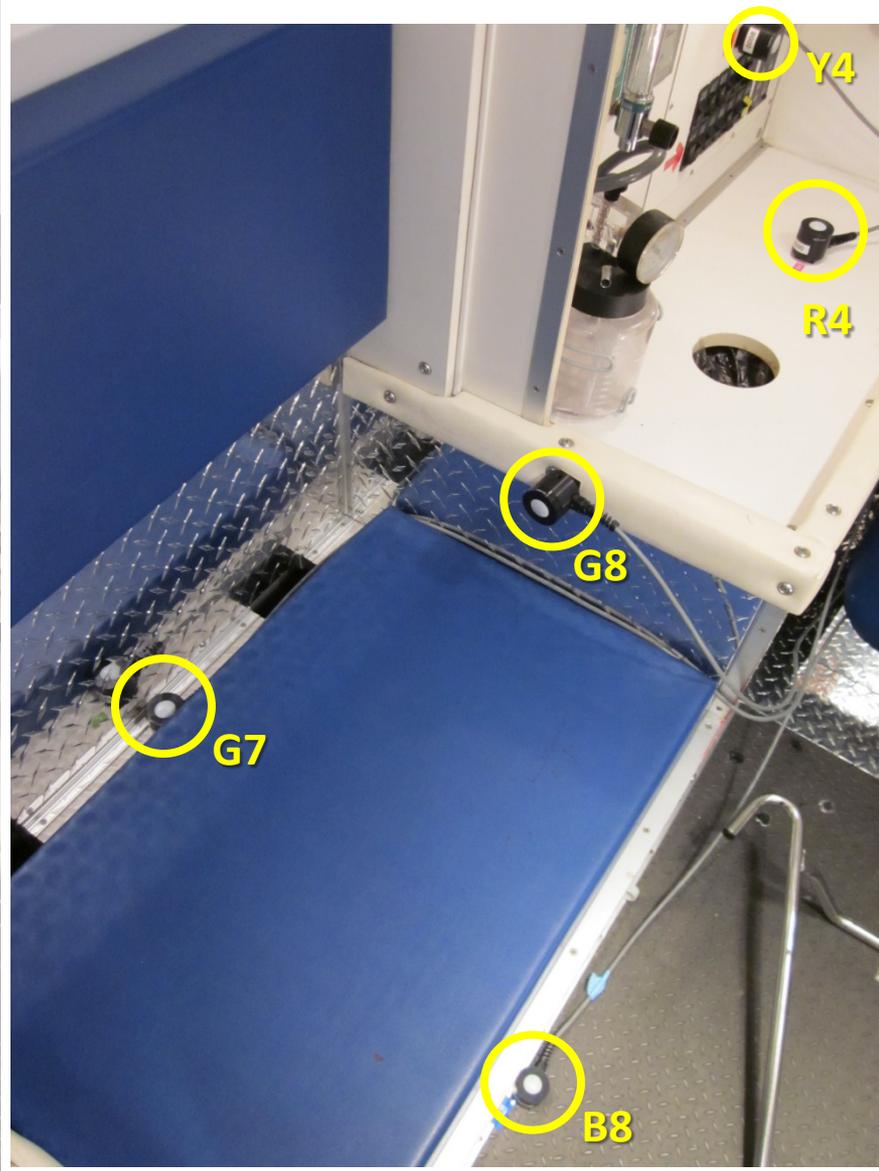
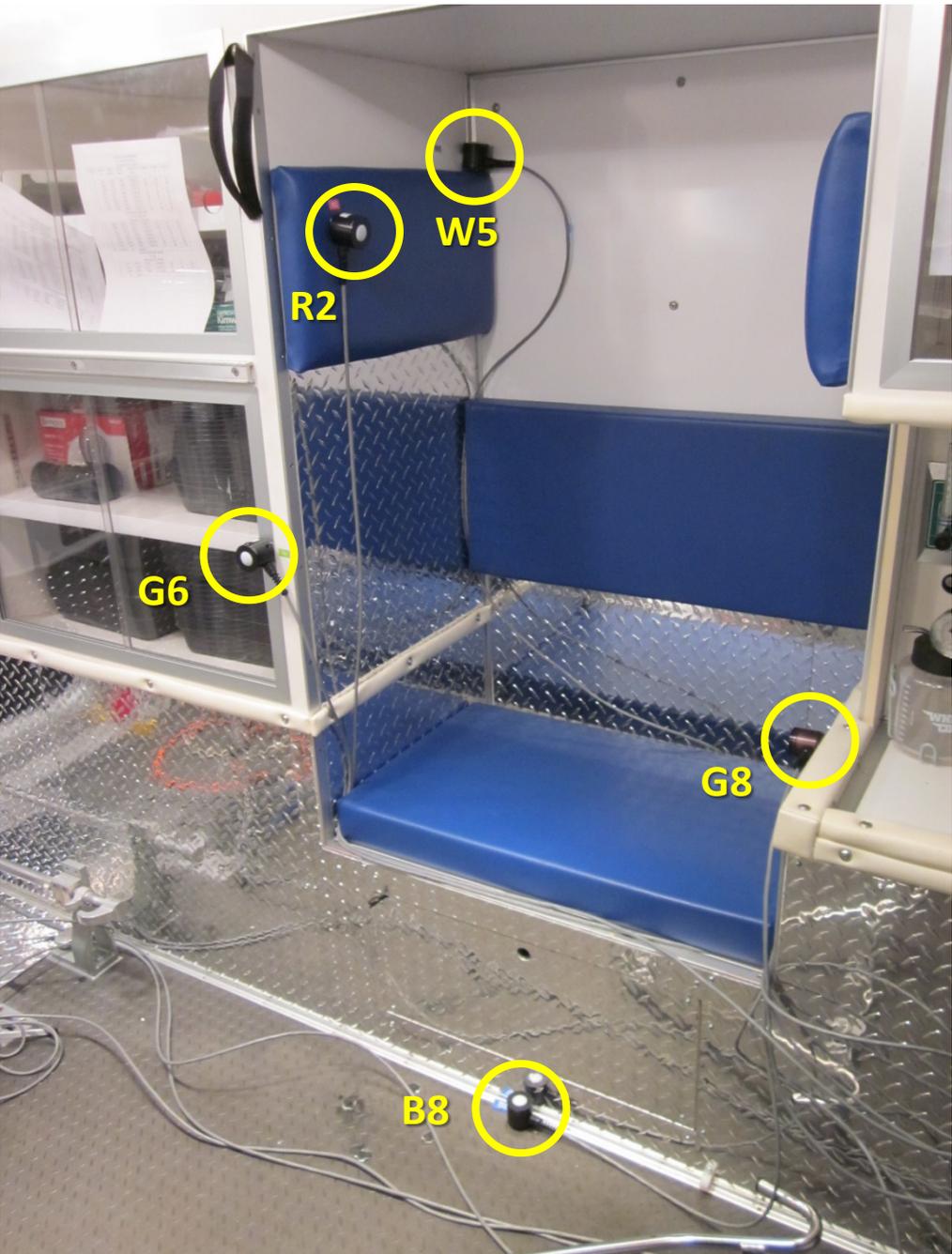
Side door

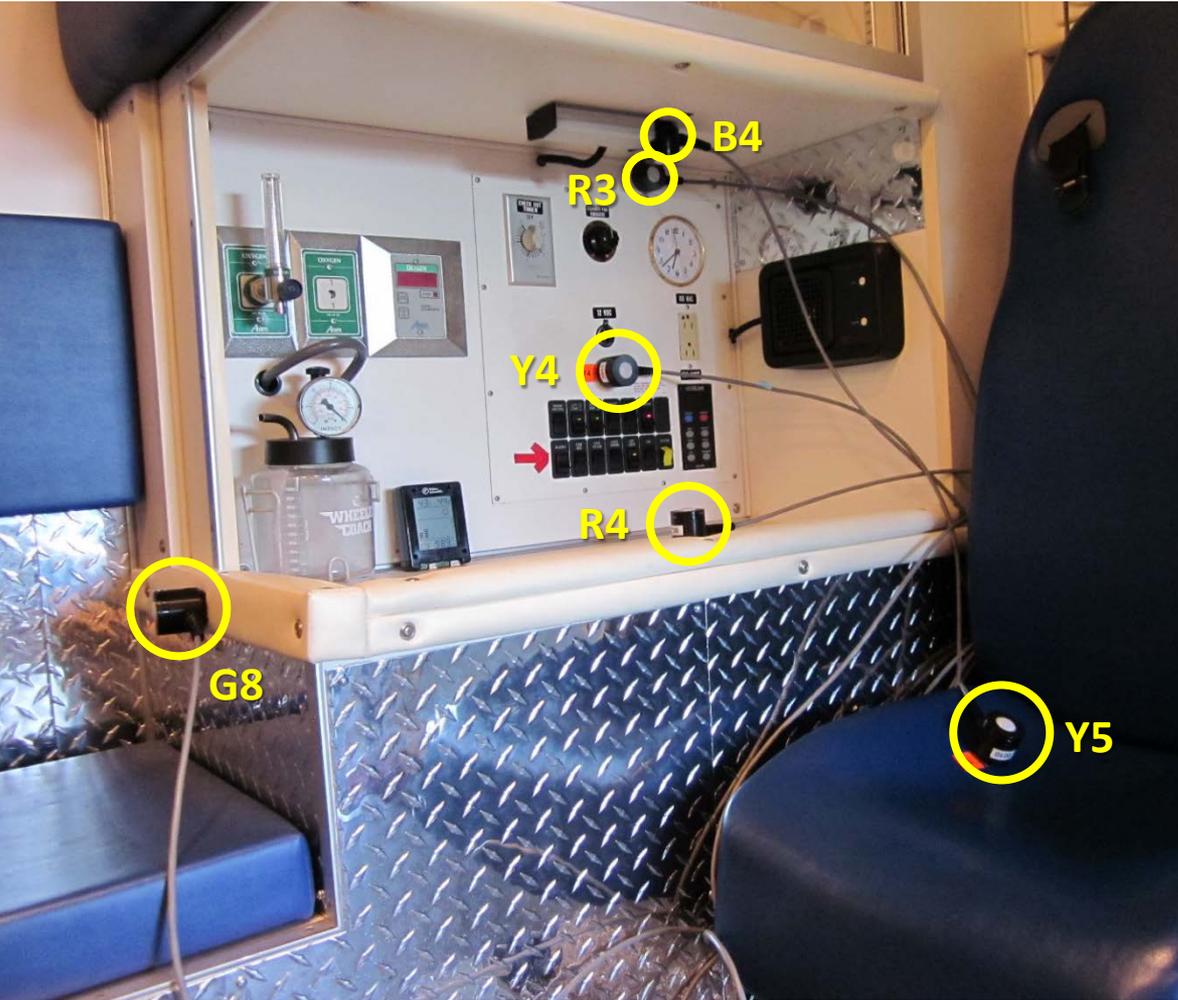
# Ambulance Sensor Locations

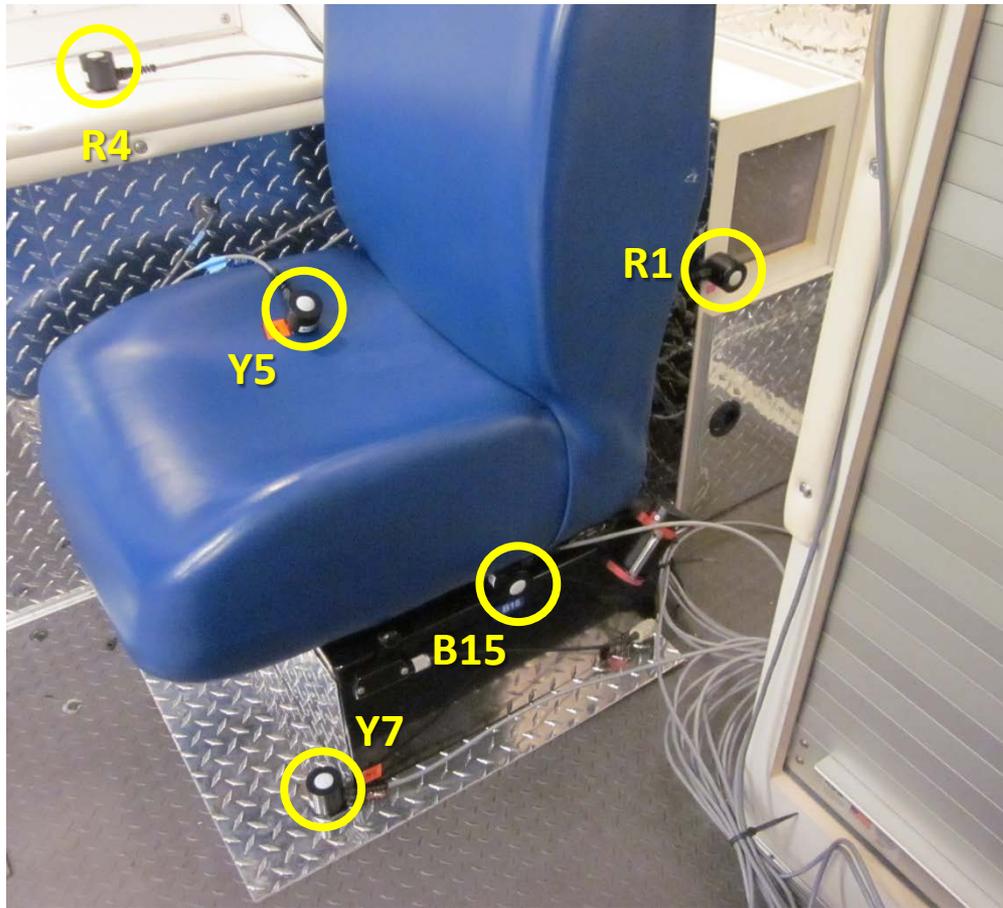


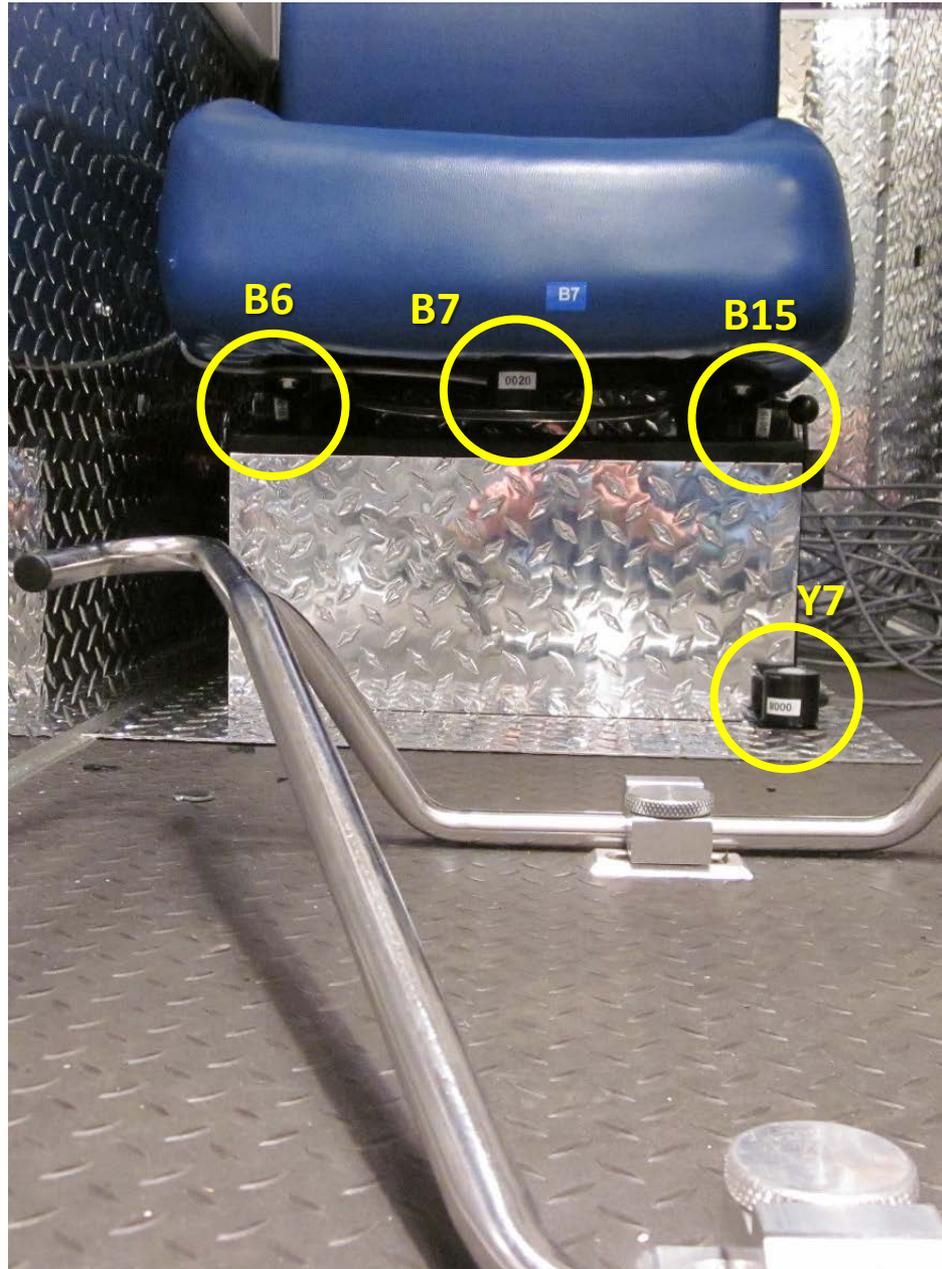
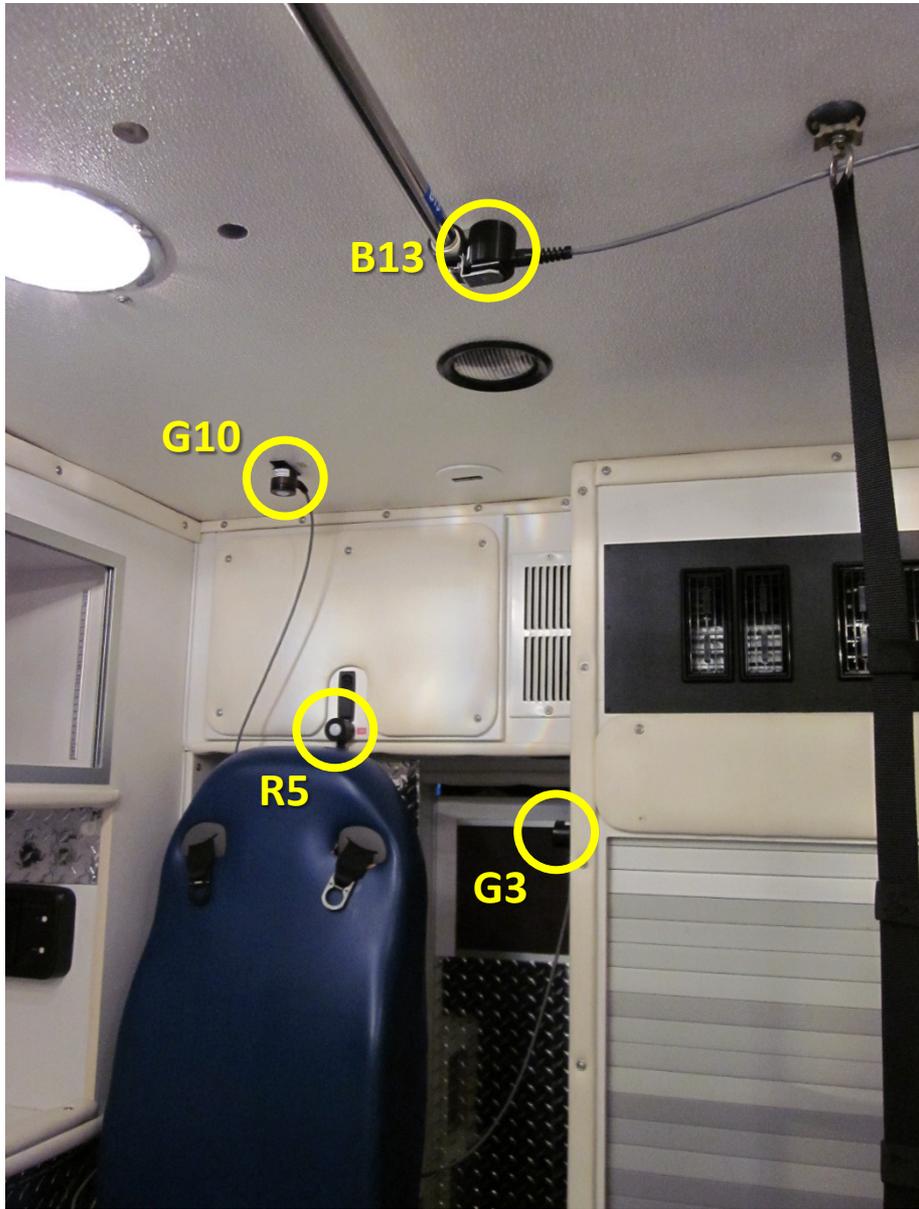












# Preparation of *Bacillus subtilis* spores

This protocol is based on European Standard EN 14347:2005, “Chemical disinfectants and antiseptics — Basic sporicidal activity — Test method and requirements (phase 1, step 1)”. The staining protocol is based on “Techniques in Microbiology. A Student Handbook” by John M. Lammert.

## Preparation of sporulation flasks

### Supplies

Peptone (BD Bacto Peptone #211677)

Yeast extract (Sigma Yeast Extract, # Y1625-250g)

Manganese sulfate (Sigma-Aldrich Manganese sulfate monohydrate, # M8179-100g)

Agar (Fisher BioReagents, Agar, BP1423-500)

Deionized (MilliQ) water

Six 225 cm<sup>2</sup> cell culture flasks (Corning 431082)

### Procedure

Prepare 1000 mL of sporulation agar by mixing the following in an Erlenmeyer flask:

- 10 g Peptone
- 2 g yeast extract
- 40 mg Manganese sulfate
- 15 g Agar
- 950 mL MilliQ water
- Magnetic stir bar

Heat and stir the mixture until it is boiling and all materials are dissolved.

Autoclave the sporulation agar at 121°C on the liquid cycle for 30 minutes (takes about 1 hour).

Let the agar cool to about 65°C, which takes about 1 hour. You can also place the agar in a 65°C water bath.

Pipet 150 mL of agar into each of six 225 cm<sup>2</sup> cell culture flasks. Carefully add the agar along the bottom to avoid foaming.

Let the flasks cool overnight. They can be left at room temperature for a few days, or sealed and refrigerated. If they are refrigerated, let them warm to room temperature overnight before using them.

## Preparation of *Bacillus subtilis* culture

### Supplies

*Bacillus subtilis* glycerol stock (ATCC-6633)

Sterile 125 mL Erlenmeyer flask

Brain-heart infusion broth

### Procedure

Put 75  $\mu$ L of *Bacillus subtilis* glycerol stock in a sterile 125 mL Erlenmeyer flask.

Add 75 mL of brain-heart infusion broth

Place the suspension in a shaking incubator at 150 rpm and 36°C and let it incubate overnight.

Take the 600 nm OD the next day when ready to inoculate the sporulation flasks.

## Inoculating the sporulation flasks

### Supplies

Six sporulation flasks prepared as described above

60 mL sterile glass 4 mm beads

### Procedure

Add 10 mL of sterile 4 mm glass beads to each flask.

Pipet 10 mL of culture broth into each flask. Use the glass spheres to roll around on the surface of the agar and spread the culture broth as evenly as possible.

If the flasks have a plug seal cap, make sure the cap is slightly loose to allow air exchange.

Incubate the flasks for 2 days at 36°C and then for 21 days at 30°C.

## Isolating spores

The isolation procedure takes about 9 hours, so be sure to prepare everything the day before.

### Supplies

Sterile gauze

Sterile forceps

Sterile glass funnel

Ring stand for funnel

Holder for 250 mL conical bottles

Sterile 250 mL conical bottles

Sterile 50 mL centrifuge tubes

3 liters sterile deionized (MilliQ) water

200 mL sterile 65% 2-propanol

### Procedure

For each flask:

- 1) Put 10 mL of sterile, distilled water into each flask of spores. Roll glass beads around on surface of agar to dislodge spores from agar surface.
- 2) Remove each spore suspension and place it in a sterile, 50 mL centrifuge tube.
- 3) Repeat Step 1 two (2) more times for each spore flask.

Place sterile gauze pads in a sterile glass funnel using sterile forceps.

Wet the gauze with sterile water.

Gravity filter the spore suspension through the gauze pads and catch the filtrate into a new sterile, 250 mL conical bottle.

Vortex the spore suspension thoroughly.

Split the spore suspension evenly into six 50 mL centrifuge tubes.

Centrifuge the suspension for 30 minutes at 3000 g and 10-15°C.

Remove the liquid from each tube, leaving only the spore pellet.

Add 20 mL of sterile 65% 2-propanol to each tube. Vortex or shake to resuspend the pellet in the alcohol.

Allow the tubes to sit for 3 hours at room temperature.

Add 20 mL of sterile deionized water to each tube and vortex.

Centrifuge the suspension for 30 minutes at 3000 g and 10-15°C.

Remove the liquid from each tube, leaving only the spore pellet.

Perform the following steps five times:

- 1) Add 20 mL of sterile deionized water to each tube.

- 2) Vortex the tube to resuspend the spore pellet.
- 3) Centrifuge the suspension for 30 minutes at 3000 g and 10-15°C.

After the final centrifugation, resuspend the spore pellets in each tube in 10 mL of sterile, distilled water. Vortex thoroughly to resuspend the pellet in the water.

Combine the spore suspensions from each 50 mL centrifuge tube into one sterile, 250 mL conical bottle.

Store the spores for at least four (4) weeks prior to use.

Plate the spore suspension onto tryptic soy agar plates to determine the spore concentration. Typical yields are between  $1 \times 10^8$  and  $1 \times 10^9$  spores/mL.

The bacterial spore suspensions can be stored for years at 2-8°C

## Checking purity of spore suspension

The suspension should contain less than 20% vegetative bacteria (usually few vegetative cells will be seen). To check the suspension, prepare and examine slides as follows.

### Supplies

Malachite green prepared stain or powder  
Safranin O prepared stain or powder  
Glass slides  
Slide warmer or dry block heater set to 60°C.  
Bibulous paper

### Procedure

Prepare malachite green solution by dissolving 0.5 g of malachite green in 100 mL of distilled water. This can be stored for 1 year at room temperature.

Prepare safranin solution by dissolving 2.5 g of safranin O in 100 mL of 95% (v/v) ethanol. This also can be stored for 1 year at room temperature.

For each slide to be prepared, cut a piece of 1" x 1.5" bibulous paper.

Smear 50 µl of spore suspension onto a glass slide.

Allow the slide to air dry.

Place the slide on a slide warmer or dry block heater at 60° for 10 minutes to fix the smear.

Place the slide on wire mesh over a beaker of boiling distilled water. Make sure slide is level so that stain won't run off.

Lay the bibulous paper on top of the smear on the slide. Don't let the paper hang over the edge of the slide—it will wick the stain off of the slide and into the water.

Add drops of malachite green stain so that the bibulous paper is thoroughly soaked. Add more stain as necessary to keep the paper wet. Continue this for 5-6 minutes.

Remove the slide from above the boiling water.

Remove the bibulous paper and allow the slide to cool.

Thoroughly rinse the slide with water for 30 seconds to remove excess malachite green stain.

Cover the smear with safranin stain for 60-90 seconds.

Rinse the slide to remove excess stain.

Gently blot the water from the slide using bibulous paper. Be careful not to remove the smear.

Inspect the slide under a microscope. Spores should appear green while vegetative cells should be pink. If the spores are too dense to see clearly, prepare a new slide by smearing 50 µL of a 10X dilution of the spore suspension and repeat the staining procedure.

# Ambulance UVGI Experimental Data

### **Sensor locations in ambulance patient compartment**

B01	Under center of high white cabinet on right side of ambulance, facing down
B02	Above center of back cushion on right-side bench seat, facing out
B03	Not used
B04	On light switch under cabinet by rear-facing jump seat, sensor facing down
B05	On right wall behind rear-facing jump seat facing left, straight across from R1
B06	Underneath right side of rear-facing jump seat between seat and wall, facing wall
B07	Under front edge of rear-facing jump seat, facing floor.
B08	On floor centered in front of CPR bench, facing ceiling
B09	Not used
B10	Handle on right rear door, facing right wall
B11	Horizontal handle on left rear door, facing door
B12	Vertical handle on left rear door, facing door
B13	Front of overhead grab bar, facing ceiling
B14	Horizontal handle of side door, facing door
B15	Underneath left side of rear-facing jump seat, facing side door
G01	Forward of side door, facing back
G02	On biohazard box, facing forward
G03	High on right side of passageway, facing left
G04	Next to middle seat belt buckle on front of right-side bench, facing left
G05	Next to oxygen connections on right wall beside side door, facing left
G06	Left wall beside cabinet doors, facing right
G07	Behind horizontal cushion on CPR bench, facing up
G08	On left side of CPR bench alcove, facing back
G09	On side door step, facing door
G10	On ceiling above rear-facing jump seat, facing floor
R01	Next to door of bin in passageway, facing right
R02	On upper right cushion in alcove for CPR bench, facing forward
R03	Top of control panel next to rear-facing jump seat, facing right
R04	Work surface in front of control panel and next to rear-facing jump seat, facing up
R05	On latch of storage bin above rear-facing jump seat, facing back
R06	On latch of rearmost cabinet on left side, facing right
R07	In front of cushion for right-side bench seat, facing up
R08	Next to rear-most upper cabinet on right side, facing left
R09	Morgantown: On floor in front of right-side bench seat, next to rear door, facing up
R10	On wall above rear doors, facing front
W01	Bottom step of side door, back left corner, facing up
W02	On bench above biohazard box facing forward
W03	Center of back surface of right bench cushion, facing right wall
W04	On floor below biohazard box, 7.5" from right edge of bench, facing up
W05	On top of left vertical cushion above CPR bench, back corner, facing up
W06	Center of end of right upper cabinet, facing forward
Y01	On latch of left rear door, facing forward
Y02	On handle of gurney floor lock, facing floor
Y03	Next to rear-most seat belt buckle on front of right-side bench, facing left
Y04	Above control switches on control panel next to rear-facing jump seat, facing right
Y05	On horizontal cushion of rear-facing jump seat

- Y06 On latch of side door, facing left
- Y07 Under right corner of rear-facing jump seat, facing ceiling
- Y08 Behind cushion for right-side bench seat, facing up
- Y09 Next to latch for roll-up door on front right storage cabinet, facing back
- Y10 On back of overhead grab bar, facing ceiling

**UV irradiance with original interior surfaces**

Sensor position	Light in front		Light in middle		Light in back	
	Average (W/cm2)	Std dev (W/cm2)	Average (W/cm2)	Std dev (W/cm2)	Average (W/cm2)	Std dev (W/cm2)
B01	0.000169556	3.01E-06	2.43E-04	1.16E-05	2.51E-04	1.40E-05
B02	0.000272603	1.84E-05	6.25E-04	3.93E-05	6.04E-04	2.77E-05
B04	0.000224944	2.9E-05	9.26E-05	9.07E-06	3.51E-05	5.93E-06
B05	3.59429E-05	9.02E-06	3.31E-05	2.61E-06	1.61E-05	1.55E-06
B06	9.13315E-07	1.98E-07	4.11E-06	5.90E-07	6.35E-06	6.83E-07
B07	1.68676E-05	1.02E-06	1.58E-05	1.02E-06	7.61E-06	5.94E-07
B08	0.000357557	1.22E-05	5.84E-04	2.06E-05	2.31E-04	1.82E-05
B10	1.72681E-05	4.37E-06	2.46E-05	3.72E-06	4.29E-05	3.89E-06
B11	1.2971E-05	8.56E-07	2.96E-05	1.37E-06	1.16E-04	8.42E-06
B12	1.24908E-05	2.1E-06	3.13E-05	4.20E-06	1.23E-04	9.92E-06
B13	9.77375E-06	1.04E-06	1.82E-05	7.93E-07	9.13E-06	5.70E-07
B14	6.30964E-05	3.63E-06	1.38E-05	2.44E-07	6.52E-06	3.71E-07
B15	0.000343196	4.12E-05	2.40E-05	3.81E-06	1.69E-05	2.32E-06
G01	0.000512611	3.31E-05	2.93E-04	9.93E-06	1.72E-04	9.56E-06
G02	0.000155916	1.27E-05	4.88E-05	1.76E-06	3.02E-05	1.81E-06
G03	6.21071E-05	1.43E-05	5.57E-05	7.07E-06	2.28E-05	3.11E-06
G04	8.18015E-05	1.6E-05	1.06E-03	3.86E-05	1.10E-03	9.02E-05
G05	0.001000964	8.47E-05	6.04E-04	2.02E-05	2.40E-04	9.48E-06
G06	0.000468652	3.71E-05	2.64E-03	4.83E-05	5.82E-04	4.02E-05
G07	5.42084E-05	6.3E-06	1.25E-04	5.85E-06	3.95E-06	2.98E-07
G08	1.01177E-05	6.51E-07	5.44E-04	2.43E-05	3.43E-04	2.00E-05
G09	0.000103163	2.51E-06	5.15E-06	3.50E-07	1.58E-06	9.26E-08
G10	0.000404256	2.28E-05	1.52E-04	8.22E-06	5.73E-05	3.22E-06
R01	1.12186E-05	3.21E-07	4.50E-06	4.01E-07	3.23E-06	2.19E-07
R02	0.000370421	2.56E-05	7.10E-05	1.52E-05	8.17E-06	6.03E-07
R03	0.000547478	1.64E-05	1.61E-04	3.19E-06	5.20E-05	3.02E-06
R04	0.000140348	5.83E-06	7.54E-05	2.75E-06	2.94E-05	5.72E-07
R05	0.000490706	4.78E-05	3.26E-04	1.23E-05	2.05E-04	4.61E-06
R06	8.33962E-05	5.1E-07	2.17E-04	1.52E-05	1.53E-03	3.67E-05
R07	0.000138485	1.93E-05	5.01E-04	4.94E-05	5.44E-04	1.53E-05
R08	9.53505E-05	3.19E-06	3.59E-04	1.23E-05	6.58E-04	1.53E-05
R09	9.32887E-05	4.08E-06	2.28E-04	1.31E-05	6.01E-04	4.63E-05
R10	0.000242092	8.62E-06	4.91E-04	1.20E-05	1.23E-03	9.07E-05
W01	2.71626E-05	8.74E-07	5.03E-06	4.76E-07	2.23E-06	2.78E-07
W02	0.000319354	6.18E-05	4.32E-05	1.17E-06	2.69E-05	8.48E-07
W03	1.831E-05	1.23E-06	2.75E-05	2.28E-06	2.45E-05	2.67E-06
W04	0.000111075	3.84E-06	1.29E-05	8.77E-07	7.55E-06	7.12E-07
W05	2.1933E-05	7.79E-07	1.03E-05	9.99E-07	9.87E-07	1.33E-07
W06	0.000144193	1.39E-05	2.07E-05	1.53E-07	1.14E-05	2.69E-07
Y01	0.000287561	1.38E-05	6.56E-04	3.01E-05	3.37E-03	4.49E-04
Y02	1.29238E-05	5.2E-07	2.84E-05	1.71E-06	4.86E-05	5.34E-06
Y03	5.14246E-05	5.61E-06	3.26E-04	2.27E-05	1.59E-03	1.43E-04
Y04	0.000674713	1.09E-05	2.41E-04	7.35E-06	8.12E-05	2.73E-06
Y05	0.000808672	7.52E-05	1.66E-04	1.62E-05	5.66E-05	6.52E-06
Y06	0.001188196	9.26E-05	3.86E-04	4.59E-05	7.71E-05	1.05E-05
Y07	0.000628411	2.68E-05	2.22E-04	6.48E-06	7.99E-05	4.67E-06
Y08	0.000130956	6.17E-06	1.48E-04	8.87E-06	9.80E-05	7.95E-06
Y09	0.000528969	5.85E-06	2.70E-04	3.05E-06	1.81E-04	1.68E-06
Y10	2.54435E-05	1.31E-06	2.50E-05	2.36E-06	2.52E-05	2.58E-06

**UV irradiance with reflective aluminum sheets added**

Sensor position	Light in front (W/cm <sup>2</sup> )		Light in middle (W/cm <sup>2</sup> )		Light in back (W/cm <sup>2</sup> )	
	Average	Std dev	Average	Std dev	Average	Std dev
B01	1.64E-04	2.64E-05	2.41E-04	2.92E-05	2.23E-04	1.46E-05
B02	2.78E-04	5.43E-05	6.63E-04	1.10E-04	6.14E-04	7.52E-05
B04	2.20E-04	3.90E-05	1.16E-04	1.56E-05	4.41E-05	7.23E-06
B05	5.55E-05	6.33E-06	5.21E-05	7.44E-06	2.52E-05	1.14E-06
B06	5.69E-06	6.86E-07	1.64E-05	5.27E-07	2.31E-05	3.30E-06
B07	1.55E-04	3.05E-06	8.15E-05	6.01E-06	3.28E-05	1.16E-06
B08	4.86E-04	8.47E-05	8.86E-04	1.46E-04	3.48E-04	7.21E-05
B10	1.12E-05	2.05E-06	2.06E-05	3.40E-06	3.79E-05	4.50E-06
B11	1.42E-05	3.37E-06	3.50E-05	7.94E-06	1.22E-04	2.10E-05
B12	5.54E-05	1.07E-05	1.44E-04	2.57E-05	2.65E-04	4.39E-05
B13	1.22E-05	3.08E-06	2.01E-05	3.00E-06	9.93E-06	8.96E-07
B14	5.40E-05	6.83E-06	1.11E-05	3.00E-06	7.32E-06	1.38E-06
B15	4.36E-04	2.77E-05	5.65E-05	7.72E-06	3.50E-05	4.19E-06
G01	5.32E-04	8.39E-05	3.21E-04	5.07E-05	1.92E-04	3.30E-05
G02	1.49E-04	1.59E-05	4.69E-05	3.40E-06	2.76E-05	1.81E-06
G03	6.88E-05	1.39E-05	6.27E-05	7.70E-06	2.54E-05	3.76E-06
G04	1.19E-04	2.42E-05	1.24E-03	1.67E-04	1.21E-03	1.73E-04
G05	9.54E-04	2.74E-04	6.28E-04	1.16E-04	2.53E-04	5.94E-05
G06	4.79E-04	1.14E-04	2.92E-03	3.98E-04	6.31E-04	7.02E-05
G07	7.42E-05	7.22E-06	1.41E-04	2.22E-05	1.20E-05	1.02E-06
G08	5.34E-05	5.19E-06	6.13E-04	4.26E-05	3.16E-04	1.84E-05
G09	1.05E-04	1.13E-05	8.41E-06	6.73E-07	1.86E-06	6.33E-07
G10	4.29E-04	9.38E-05	1.73E-04	2.85E-05	6.32E-05	8.06E-06
R01	6.50E-05	7.13E-06	1.60E-05	2.91E-06	1.05E-05	1.80E-06
R02	3.69E-04	1.03E-04	7.22E-05	3.30E-05	8.64E-06	7.82E-07
R03	6.63E-04	1.23E-04	2.11E-04	4.05E-05	7.43E-05	1.28E-05
R04	1.41E-04	1.85E-05	7.37E-05	9.54E-06	2.58E-05	1.60E-06
R05	5.17E-04	1.03E-04	3.05E-04	4.61E-05	2.03E-04	2.90E-05
R06	9.19E-05	1.44E-05	2.42E-04	3.94E-05	1.71E-03	3.13E-04
R07	1.41E-04	2.65E-05	4.71E-04	3.68E-05	4.74E-04	5.71E-05
R08	9.90E-05	2.35E-05	3.74E-04	7.46E-05	6.60E-04	1.26E-04
R09	1.42E-04	2.33E-05	3.84E-04	4.89E-05	9.25E-04	8.57E-05
R10	2.64E-04	7.86E-05	5.46E-04	1.55E-04	1.53E-03	5.93E-04
W01	2.77E-05	3.53E-06	4.96E-06	6.73E-07	2.19E-06	2.50E-07
W02	2.53E-04	3.55E-05	4.24E-05	5.25E-06	2.68E-05	3.37E-06
W03	2.18E-05	5.05E-06	3.18E-05	5.08E-06	2.88E-05	2.58E-06
W04	1.21E-04	2.63E-05	1.40E-05	1.67E-06	7.26E-06	6.09E-07
W05	2.10E-05	2.19E-06	1.16E-05	1.48E-06	9.66E-07	2.71E-07
W06	1.63E-04	2.14E-05	2.21E-05	2.68E-06	1.23E-05	1.87E-06
Y01	2.93E-04	4.18E-05	6.93E-04	8.88E-05	3.03E-03	1.72E-04
Y02	8.37E-05	6.53E-06	2.18E-04	4.16E-06	3.72E-04	3.96E-05
Y03	6.47E-05	1.10E-05	4.35E-04	7.43E-05	1.66E-03	1.97E-04
Y04	7.17E-04	1.46E-04	2.65E-04	3.88E-05	8.71E-05	1.46E-05
Y05	8.57E-04	7.40E-05	1.69E-04	2.01E-05	5.80E-05	6.11E-06
Y06	1.29E-03	2.44E-04	4.67E-04	7.94E-05	1.06E-04	2.66E-05
Y07	6.75E-04	6.93E-05	3.95E-04	6.16E-05	1.50E-04	2.15E-05
Y08	1.35E-04	3.47E-05	1.58E-04	3.02E-05	1.09E-04	1.67E-05
Y09	5.34E-04	8.08E-05	2.79E-04	4.53E-05	2.02E-04	3.15E-05
Y10	2.71E-05	4.52E-06	2.91E-05	3.86E-06	2.86E-05	4.48E-06

**UV irradiance with UV reflective paint added**

Sensor position	Light in front		Light in middle		Light in back	
	Average (W/cm <sup>2</sup> )	Std dev (W/cm <sup>2</sup> )	Average (W/cm <sup>2</sup> )	Std dev (W/cm <sup>2</sup> )	Average (W/cm <sup>2</sup> )	Std dev (W/cm <sup>2</sup> )
B01	0.000253	6.82E-06	0.000404	2.5E-05	0.000398	5.87E-05
B02	0.000382	1.99E-05	0.000858	6.22E-05	0.00082	6.61E-05
B04	0.00034	1.32E-05	0.000165	1.43E-05	6.61E-05	4.74E-06
B05	0.000121	8.06E-06	6.54E-05	8.63E-06	3.62E-05	4.38E-06
B06	7.5E-06	4.02E-07	1.81E-05	7.28E-07	1.87E-05	5.37E-07
B07	0.000101	4.73E-06	4.42E-05	2.86E-06	1.97E-05	1.65E-06
B08	0.000531	3.35E-05	0.000835	3.52E-05	0.000381	3.87E-05
B10	4.4E-05	6.39E-06	8.31E-05	9.64E-06	0.000131	1.61E-05
B11	8.98E-05	1.64E-05	0.000212	3.92E-05	0.000768	0.000127
B12	3.33E-05	1.48E-06	7.96E-05	2.56E-06	0.000373	2.64E-05
B13	0.000104	7.05E-06	0.00015	1.07E-05	7.16E-05	1.93E-06
B14	0.000248	1.52E-05	6.75E-05	4.86E-06	2.87E-05	1.97E-06
B15	0.000567	6.21E-05	7.26E-05	7.9E-06	4.19E-05	4.81E-06
G01	0.00071	4.41E-05	0.000414	1.78E-05	0.000243	8.61E-06
G02	0.000224	3.02E-05	7.58E-05	8.78E-06	4.53E-05	4.61E-06
G03	0.000155	1.78E-05	0.000112	1.04E-05	4.51E-05	3.35E-06
G04	0.000149	1.09E-05	0.001299	0.000214	0.001455	0.000192
G05	0.001261	0.000192	0.000801	6.27E-05	0.000342	2.13E-05
G06	0.000634	2.54E-05	0.003454	3.57E-05	0.000871	2.58E-05
G07	0.00015	1.1E-05	0.000215	1.43E-05	3.18E-05	2.88E-06
G08	0.000109	6.62E-06	0.000668	6.85E-05	0.000409	3.27E-05
G09	0.000128	8.99E-06	1.39E-05	1.62E-06	4.91E-06	6.5E-07
G10	0.000576	2.75E-05	0.000226	1.11E-05	8.96E-05	3.12E-06
R01	8.65E-05	6.97E-06	4.38E-05	2.86E-06	2.43E-05	2.32E-06
R02	0.000515	7.43E-05	0.000204	4.8E-05	5.04E-05	7.15E-06
R03	0.000711	7.04E-05	0.000244	2.29E-05	9.37E-05	1.12E-05
R04	0.000292	4.66E-05	0.000166	3.12E-05	6.86E-05	1.27E-05
R05	0.000694	0.000102	0.000443	4.81E-05	0.000263	2.73E-05
R06	0.000145	3.36E-06	0.000357	1.39E-05	0.002109	5.87E-05
R07	0.000262	1.84E-05	0.00072	4.64E-05	0.000693	0.000143
R08	0.000173	5.66E-06	0.000538	3.24E-05	0.000952	8.25E-05
R09	0.000164	1.11E-05	0.000386	3.31E-05	0.000958	8.09E-05
R10	0.000346	2.76E-05	0.000712	7.94E-05	0.001853	0.000198
W01	4.5E-05	7.89E-06	1.14E-05	2.22E-06	5.29E-06	1.04E-06
W02	0.000358	9.71E-05	7.03E-05	7.43E-06	4.29E-05	4.21E-06
W03	9.79E-05	1.18E-05	0.000159	1.97E-05	0.000147	2.19E-05
W04	0.000137	8.55E-06	2.81E-05	1.63E-06	1.47E-05	8.67E-07
W05	0.000123	3.22E-06	6.3E-05	2E-06	8.54E-06	2.58E-07
W06	0.000244	2.36E-05	5.13E-05	4.64E-06	2.74E-05	2.08E-06
Y01	0.00038	3.11E-05	0.00086	6.85E-05	0.003724	0.000164
Y02	9.87E-05	1.44E-05	0.000239	3.59E-05	0.000448	4.86E-05
Y03	0.000107	1.29E-05	0.000498	4.77E-05	0.002021	0.000205
Y04	0.000905	3.14E-05	0.000372	1.66E-05	0.000138	6.61E-06
Y05	0.001096	2.42E-05	0.000277	1.86E-05	0.000109	9.38E-06
Y06	0.00164	7.91E-05	0.000598	3.48E-05	0.000115	2.12E-05
Y07	0.000765	3E-05	0.000323	2.81E-05	0.000128	1.75E-05
Y08	0.000291	1.39E-05	0.000357	2.36E-05	0.000255	1.13E-05
Y09	0.000634	4.74E-05	0.000351	4.01E-05	0.000242	2.44E-05
Y10	0.000136	5.25E-06	0.00019	7.25E-06	0.000232	1.12E-05

## Bacillus survival tests in UV exposure box

Dose (mJ/cm <sup>2</sup> )	Coupon	Survival fraction
16	A	12.878%
16	B	10.474%
16	C	12.240%
32	A	1.045%
32	B	1.420%
32	C	1.840%
64	A	0.422%
64	B	0.121%
64	C	0.117%
128	A	0.021%
128	B	0.088%
128	C	0.046%
8	A	21.718%
8	B	28.896%
8	C	28.160%
16	A	6.828%
16	B	13.564%
16	C	14.337%
32	A	1.145%
32	B	0.922%
32	C	1.257%
64	A	0.117%
64	B	0.123%
64	C	0.089%
128	A	0.014%
128	B	0.064%
128	C	0.219%
8	A	40.000%
8	B	44.634%
8	C	44.146%
16	A	8.366%
16	B	11.220%
16	C	6.902%
32	A	1.441%
32	B	1.868%
32	C	1.056%
64	A	0.346%
64	B	0.103%
64	C	0.100%
128	A	0.012%
128	B	0.015%
128	C	0.024%
8	A	36.567%

8	B	34.249%
8	C	46.094%
16	A	9.476%
16	B	11.717%
16	C	14.987%
32	A	2.529%
32	B	1.792%
32	C	2.961%
64	A	0.273%
64	B	0.541%
64	C	0.223%
128	A	0.014%
128	B	0.058%
128	C	0.123%

### Bacillus survival tests in ambulance

Surfaces	Date	Position	Dose (mJ/cm <sup>2</sup> )	Survival fraction	LOQ
Reflective	8/30/2016	W05	41.72	0.09%	0.50%
Reflective	8/30/2016	B06	21.28	11.68%	0.50%
Reflective	8/30/2016	B14	158.81	0.14%	0.50%
Reflective	8/30/2016	B05	166.00	2.08%	0.50%
Reflective	8/30/2016	B10	101.80	0.04%	0.50%
Reflective	8/30/2016	W03	98.48	0.17%	0.50%
Reflective	8/30/2016	R01	171.57	0.88%	0.50%
Reflective	8/30/2016	Y10	111.88	2.49%	0.50%
Reflective	8/30/2016	B13	52.39	1.71%	0.50%
Reflective	8/30/2016	W01	75.22	4.48%	0.50%
Reflective	8/31/2016	W05	45.88	0.68%	0.40%
Reflective	8/31/2016	B06	60.62	0.03%	0.40%
Reflective	8/31/2016	B14	156.66	0.36%	0.40%
Reflective	8/31/2016	B05	143.79	3.22%	0.40%
Reflective	8/31/2016	B10	100.20	0.21%	0.40%
Reflective	8/31/2016	W03	97.38	2.24%	0.40%
Reflective	8/31/2016	R01	173.12	0.08%	0.40%
Reflective	8/31/2016	Y10	119.46	0.57%	0.40%
Reflective	8/31/2016	B13	50.52	0.01%	0.40%
Reflective	8/31/2016	W01	71.29	0.25%	0.40%
Reflective	9/1/2016	W05	43.47	0.01%	0.76%
Reflective	9/1/2016	B06	56.52	0.03%	0.76%
Reflective	9/1/2016	B14	136.50	0.43%	0.76%
Reflective	9/1/2016	B05	146.34	0.00%	0.76%
Reflective	9/1/2016	B10	103.40	0.00%	0.76%
Reflective	9/1/2016	W03	101.27	0.00%	0.76%
Reflective	9/1/2016	R01	170.22	0.00%	0.76%
Reflective	9/1/2016	Y10	114.24	0.01%	0.76%
Reflective	9/1/2016	B13	49.03	0.00%	0.76%
Reflective	9/1/2016	W01	81.66	0.03%	0.76%
Original	10/6/2016	B05	95.37	0.00%	0.47%
Original	10/6/2016	B06	10.37	30.93%	0.47%
Original	10/6/2016	B07	46.90	0.00%	0.47%
Original	10/6/2016	B13	38.74	0.00%	0.47%
Original	10/6/2016	R01	28.72	0.21%	0.47%
Original	10/6/2016	W01	73.17	0.00%	0.47%
Original	10/6/2016	W03	86.23	0.00%	0.47%
Original	10/6/2016	W05	51.60	0.60%	0.47%
Original	10/6/2016	Y02	112.19	0.00%	0.47%
Original	10/6/2016	Y10	104.43	0.58%	0.47%
Original	10/11/2016	B05	67.81	0.01%	0.31%
Original	10/11/2016	B06	10.43	16.53%	0.31%
Original	10/11/2016	B07	49.45	1.30%	0.31%

Original	10/11/2016 B13	39.01	4.56%	0.31%
Original	10/11/2016 R01	30.44	1.62%	0.31%
Original	10/11/2016 W01	73.66	0.05%	0.31%
Original	10/11/2016 W03	90.02	0.02%	0.31%
Original	10/11/2016 W05	54.03	0.16%	0.31%
Original	10/11/2016 Y02	122.60	0.01%	0.31%
Original	10/11/2016 Y10	109.74	0.00%	0.31%
Original	10/12/2016 B05	60.99	0.15%	0.26%
Original	10/12/2016 B06	7.81	3.74%	0.26%
Original	10/12/2016 B07	48.43	0.17%	0.26%
Original	10/12/2016 B13	40.27	0.38%	0.26%
Original	10/12/2016 R01	30.18	0.31%	0.26%
Original	10/12/2016 W01	75.51	0.00%	0.26%
Original	10/12/2016 W03	86.79	0.00%	0.26%
Original	10/12/2016 W05	53.20	0.14%	0.26%
Original	10/12/2016 Y02	119.06	0.04%	0.26%
Original	10/12/2016 Y10	104.87	0.12%	0.26%
Original	10/18/2016 B05	32.66	0.27%	0.29%
Original	10/18/2016 B06	5.47	18.82%	0.29%
Original	10/18/2016 B07	14.52	3.56%	0.29%
Original	10/18/2016 B13	12.63	9.19%	0.29%
Original	10/18/2016 R01	8.78	11.54%	0.29%
Original	10/18/2016 W01	21.44	1.38%	0.29%
Original	10/18/2016 W03	29.68	4.69%	0.29%
Original	10/18/2016 W05	14.59	2.59%	0.29%
Original	10/18/2016 Y02	40.88	0.14%	0.29%
Original	10/18/2016 Y10	35.60	0.29%	0.29%
Original	10/19/2016 B05	32.74	1.31%	0.19%
Original	10/19/2016 B06	5.43	12.84%	0.19%
Original	10/19/2016 B07	14.46	5.39%	0.19%
Original	10/19/2016 B13	12.52	1.90%	0.19%
Original	10/19/2016 R01	8.98	12.84%	0.19%
Original	10/19/2016 W01	21.15	4.39%	0.19%
Original	10/19/2016 W03	29.28	0.34%	0.19%
Original	10/19/2016 W05	14.04	3.76%	0.19%
Original	10/19/2016 Y02	41.34	0.04%	0.19%
Original	10/19/2016 Y10	35.73	0.06%	0.19%
Original	10/20/2016 B05	34.53	1.28%	0.32%
Original	10/20/2016 B06	5.31	21.92%	0.32%
Original	10/20/2016 B07	15.41	0.00%	0.32%
Original	10/20/2016 B13	13.64	3.12%	0.32%
Original	10/20/2016 R01	9.57	15.89%	0.32%
Original	10/20/2016 W01	21.53	3.95%	0.32%
Original	10/20/2016 W03	30.04	0.40%	0.32%
Original	10/20/2016 W05	14.61	0.02%	0.32%
Original	10/20/2016 Y02	43.65	0.00%	0.32%
Original	10/20/2016 Y10	37.52	0.00%	0.32%

UV Paint	12/1/2016 W01	34.79	2.22%	0.31%
UV Paint	12/1/2016 W04	96.30	0.01%	0.31%
UV Paint	12/1/2016 B13	100.75	0.00%	0.31%
UV Paint	12/1/2016 G09	84.87	0.06%	0.31%
UV Paint	12/1/2016 B06	18.79	0.41%	0.31%
UV Paint	12/1/2016 B05	88.78	0.01%	0.31%
UV Paint	12/1/2016 B10	103.38	0.02%	0.31%
UV Paint	12/1/2016 W05	111.47	0.03%	0.31%
UV Paint	12/1/2016 B07	88.03	0.01%	0.31%
UV Paint	12/1/2016 R01	65.01	0.01%	0.31%
UV Paint	12/5/2016 W01	33.22	0.37%	0.38%
UV Paint	12/5/2016 W04	101.15	0.03%	0.38%
UV Paint	12/5/2016 B13	101.69	0.01%	0.38%
UV Paint	12/5/2016 G09	89.51	0.01%	0.38%
UV Paint	12/5/2016 B06	22.17	0.74%	0.38%
UV Paint	12/5/2016 B05	95.72	0.01%	0.38%
UV Paint	12/5/2016 B10	103.14	0.01%	0.38%
UV Paint	12/5/2016 W05	112.71	0.03%	0.38%
UV Paint	12/5/2016 B07	82.79	0.02%	0.38%
UV Paint	12/5/2016 R01	64.82	0.09%	0.38%
UV Paint	12/6/2016 W01	20.03	3.07%	0.22%
UV Paint	12/6/2016 W04	153.48	0.00%	0.22%
UV Paint	12/6/2016 B13	143.66	0.00%	0.22%
UV Paint	12/6/2016 G09	48.26	0.19%	0.22%
UV Paint	12/6/2016 B06	21.55	0.10%	0.22%
UV Paint	12/6/2016 B05	100.59	0.00%	0.22%
UV Paint	12/6/2016 B10	108.66	0.00%	0.22%
UV Paint	12/6/2016 W05	144.54	0.00%	0.22%
UV Paint	12/6/2016 B07	62.59	0.03%	0.22%
UV Paint	12/6/2016 R01	66.02	0.02%	0.22%