

**510(k) SUBSTANTIAL EQUIVALENCE DETERMINATION  
DECISION SUMMARY  
DEVICE ONLY TEMPLATE**

**A. 510(k) Number:**

k040006

**B. Analyte:**

Linezolid 0.25 – 32 µg/mL Gram-Positive AST

**C. Type of Test:**

Antimicrobial Susceptibility Test (Quantitative) colorimetric oxidation-reduction, growth-based

**D. Applicant:**

Becton, Dickinson & Company

**E. Proprietary and Established Names:**

BD Phoenix™ Automated Microbiology System – Linezolid Gram Positive Panel

**F. Regulatory Information:**

1. Regulation section:  
21 CFR 866.1645 Fully Automated Short-Term Incubation Cycle  
Antimicrobial Susceptibility System
2. Classification:  
Class II
3. Product Code:  
LON
4. Panel:  
83

**G. Intended Use:**

1. Intended use(s):  
BD Phoenix™ Automated Microbiology System:  
The BD Phoenix™ Automated Microbiology System is intended for *in vitro* quantitative determination of antimicrobial susceptibility by minimal inhibitory concentration of gram-negative aerobic and facultative anaerobic bacteria belonging to the family *Enterobacteriaceae* and non – *Enterobacteriaceae* and gram-positive bacteria belonging to the genera *Staphylococcus* and *Enterococcus*.

The BD Phoenix™ GP Panel:

The BD Phoenix™ Automated Microbiology System is intended for the *in vitro* rapid identification (ID) and quantitative determination of antimicrobial susceptibility by minimal inhibitory concentration (MIC) of gram-positive aerobic and facultative anaerobic bacteria belonging to the genera *Staphylococcus* and *Enterococcus*.

2. Indication(s) for use:

This submission is for the addition of the antibiotic linezolid at concentrations of 0.25 – 32 µg/mL to the gram positive susceptibility panel.

3. Special condition for use statement(s):  
Prescription use only
4. Special instrument Requirements:  
Not applicable

#### **H. Device Description:**

The BD Phoenix™ Automated Microbiology System includes instrumentation and software, sealed and self-inoculating molded polystyrene trays with 136 micro-wells containing dried reagents, and specific inoculum broth formulations for ID and AST Indicator. The organism to be tested must be a pure culture and be preliminarily identified as gram positive or gram negative. Colonies are then suspended in broth, and equated to a 0.5 McFarland with the recommendation to use the BD CrystalSpec™ Nephelometer. A further dilution is made into an AST broth, which contains an AST indicator, prior to inoculating the panel. The AST broth is a cation-adjusted formulation of Mueller-Hinton broth containing 0.01% Tween 80. After adding the indicator solution to the AST inoculum the color is blue and after inoculation and incubation goes to pink to colorless as reduction in the panel well proceeds. Inoculated panels are barcode scanned and loaded into the BD Phoenix™ Automated Microbiology System instrument where the panels are continuously incubated at 35°C. The AST has a final inoculum of  $5 \times 10^5$  CFU/ml. The instrument incubates, reads and records the results of the biochemical substrates and antimicrobial agents and interprets the reactions to give an ID of the isolate and MIC value and category interpretation of the antimicrobial agents. Organisms growing in the presence of a given antimicrobial agent reduce the indicator, signaling organism growth and resistance to the antimicrobial agent. Organisms killed or inhibited by a given antimicrobial do not cause reduction of the indicator and therefore do not produce a color change. Additional interpretation is done using software driven “EXPERT” System using rules derived from the NCCLS standards.

Readings are taken every 20 minutes with an ID result available between 2-12 hours and an AST result available between 4-16 hours. This is only an autoread result; there are no manual readings possible.

#### **I. Substantial Equivalence Information:**

1. Predicate device name(s):  
VITEK® System
2. Predicate K number(s):  
N50510
3. Comparison with predicate:

Similarities		
Item	Device	Predicate
1.	Isolated colonies from culture used	Isolated colonies from culture used
2.	Report results as minimum inhibitory concentration (MIC) and categorical interpretation (SIR)	Report results as minimum inhibitory concentration (MIC) and categorical interpretation (SIR)
3.	<16 hours	<16 hours
Differences		
Item	Device	Predicate
1.	Results are determined from serial twofold dilutions of antimicrobial agents	Results are determined from extrapolation of doubling dilutions
2.	Inoculum density equated to 0.5 McFarland standard	Inoculum density equated to 1.0 McFarland standard
3.	Automated growth based enhanced by use of a redox indicator (colorimetric oxidation-reduction) to detect organism growth.	Automated growth based with detection using an attenuation of light measured by an optical scanner.

**J. Standard/Guidance Document Referenced (if applicable):**

“Class II Special Controls Guidance Document: Antimicrobial Susceptibility Test (AST) Systems; Guidance for Industry and FDA”; NCCLS M7 (M100-S14)  
“Methods for Dilution Antimicrobial Susceptibility Tests for Bacteria That Grow Aerobically; Approved Standard.”

**K. Test Principle:**

The system employs conventional, colorimetric, fluorogenic and chromogenic substrates to identify the genus and species of the isolate. The AST portion of the BD Phoenix™ Automated Microbiology System is a broth based microdilution method that utilizes a redox indicator (colorimetric oxidation-reduction) to enhance detection of organism growth. The MIC is determined by comparing growth in wells containing serial two-fold dilutions of an antibiotic to the growth in “growth control wells” which contain no antibiotic.

**L. Performance Characteristics (if/when applicable):**

1. Analytical performance:

a. *Precision/Reproducibility:*

Forty three isolates were evaluated for site to site and inter site reproducibility demonstrating >95% reproducibility. The ten isolate study described in the guidance document was used (10 organisms tested 3 times on 3 days at 3 sites).

b. *Linearity/assay reportable range:*  
Not applicable

c. *Traceability (controls, calibrators, or method):*

The recommended QC isolate was tested a sufficient number of times with acceptable results with the reference method. The Phoenix results demonstrate that the system can produce QC results in the recommended range.

<b>ORGANISM</b>	<b>conc.</b>	<b>Reference</b>	<b>Phoenix</b>
<i>E. faecalis</i> ATCC 29212 Expected Range: 1 – 4 µg/mL	1	1	
	2	138	124
	4	1	12
<i>S. aureus</i> ATCC 29213 Expected Range: 1 – 4 µg/mL	1	5	44
	2	62	95
	4	72	

All results are in the expected range but the BD Phoenix™ is trending one more well susceptible than the reference method for *S. aureus*. This is also observed in the clinical data.

Inoculum density control: The organism suspension density of the ID broth was equivalent to a 0.5 McFarland standard using the BBL™ CrystalSpec™ Nephelometer which was verified each day of testing. Internal data was used to demonstrate that the use of the BBL™ CrystalSpec™ Nephelometer would produce reproducible results. Five different instruments were used.

d. *Detection limit:*  
Not applicable

e. *Analytical specificity:*  
Not applicable

f. *Assay cut-off:*  
Not applicable

2. Comparison studies:

a. *Method comparison with predicate device:*

The NCCLS recommended broth dilution reference panel was

prepared according to the NCCLS standards. Clinical testing was performed at four sites. The testing included both fresh clinical isolates and stock isolates along with a challenge set with known results. The test device had a growth rate of 99.3%. A comparison was provided to the reference method with the following agreement.

	EA Tot	EA N	EA %	Eval EA Tot	Eval EA N	Eval EA %	CA N	CA %	#R	min	maj	vmj
<b>Clinical</b>	<b>1363</b>	<b>1235</b>	<b>90.6</b>	<b>1355</b>	<b>1235</b>	<b>91.1</b>	<b>1294</b>	<b>94.9</b>	<b>2</b>	<b>66</b>	<b>1</b>	<b>0</b>
<b>Challenge</b>	<b>91</b>	<b>90</b>	<b>98.9</b>	<b>90</b>	<b>89</b>	<b>98.9</b>	<b>91</b>	<b>100.0</b>	<b>1</b>	<b>0</b>	<b>0</b>	<b>0</b>
<b>Combined</b>	<b>1454</b>	<b>1325</b>	<b>91.1</b>	<b>1445</b>	<b>1324</b>	<b>91.6</b>	<b>1385</b>	<b>95.3</b>	<b>3</b>	<b>66</b>	<b>1</b>	<b>0</b>

**EA**-Essential Agreement

**maj**-major discrepancies

**CA**-Category Agreement

**vmj**-very major discrepancies

**R**-resistant isolates

**min**- minor discrepancies

Essential agreement (EA) is when the BD Phoenix™ panels agree with the reference test panel results exactly or within one doubling dilution of the reference method. Category agreement (CA) is when the BD Phoenix™ panel result interpretation agrees exactly with the reference panel result interpretation.

*b. Matrix comparison:*  
Not applicable

3. Clinical studies:

*a. Clinical sensitivity:*  
Not applicable

*b. Clinical specificity:*  
Not applicable

*c. Other clinical supportive data (when a and b are not applicable):*  
Not applicable

4. Clinical cut-off:

Not applicable

5. Expected values/Reference range:

*Enterococcus spp.* ≤2 (S), 4(I), ≥8 (R)

*Staphylococcus spp.* ≤4 (S)

The expected value range, interpretative criteria and QC are the same as recommended by NCCLS. All values will be included in the package insert.

**M. Conclusion:**

This device demonstrates acceptable performance as described in the FDA guidance document, “Class II Special Controls Guidance Document: Antimicrobial Susceptibility Test (AST) Systems; Guidance for Industry and FDA” and therefore the testing of linezolid on the BD Phoenix™ Automated Microbiology System is substantially equivalent to other commercial devices such as bioMerieux Vitek® AST panels.