

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

**A. 510(k) Number: k041572**

**B. Purpose for Submission:**

To add piperacillin at 0.5 – 128 ug/mL to the Gram-Negative AST panels

**C. Analyte:**

Piperacillin at 0.5-128 ug/mL

**D. Type of Test:**

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

**E. Applicant:**

Becton, Dickinson & Company

**F. Proprietary and Established Names:**

BD Phoenix™ Automated Microbiology System – Piperacillin Gram Negative

**G. Regulatory Information:**

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

**H. 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™ GN 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-negative aerobic and facultative anaerobic bacteria belonging to the family *Enterobacteriaceae* and non – *Enterobacteriaceae*.

2. Indication(s) for use:

This submission is for the addition of the antibiotic piperacillin at concentrations of 0.5 – 128 µg/mL to the gram negative susceptibility panel.

3. Special condition for use statement(s):

Prescription Use Only

Results for *Proteus spp.*, *Providencia spp.*, and *Stenotrophomonas maltophilia* have been excluded in the BD Phoenix™ therefore no results will be reported. An alternate method should be performed with these combinations.

4. Special instrument Requirements:

Not Applicable

## I. 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. A growth control well is included. 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 agent 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.

**J. Substantial Equivalence Information:**

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

Similarities		
Item	Device	Predicate
Intended use	Intended for the <i>in vitro</i> rapid identification (ID) and quantitative determination of antimicrobial susceptibility by minimal inhibitory concentration (MIC) of gram-negative aerobic and facultative anaerobic bacteria.	same
Isolates	Isolated colonies from culture used	Isolated colonies from culture used
Results	Report results as minimum inhibitory concentration (MIC) and categorical interpretation (SIR)	Report results as minimum inhibitory concentration (MIC) and categorical interpretation (SIR)
Incubation conditions	<16 hours	<16 hours
Differences		
Item	Device	Predicate
Inoculum preparation	Inoculum density equated to 0.5 McFarland standard	Inoculum density equated to 1.0 McFarland standard
Reading algorithm	Results are determined from serial twofold dilutions of antimicrobial agents	Results are determined from extrapolation of doubling dilutions
Technology	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.

**K. 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.”

**L. 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.

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

1. Analytical performance:

*a. Precision/Reproducibility:*

Thirteen 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, Stability, Expected values (controls, calibrators, or method):*

NCCLS recommended Quality Control strains were tested (see table below). The Phoenix results demonstrate that the system can produce QC results in the recommended range.

Organism	Concentration	Reference results	Phoenix™ results
<i>E. coli</i> ATCC 25922 (range 1-4 ug/ml )	1	1	
	2	119	54
	4	88	505
	8		4
	16		11
	32		1
<i>P aeruginosa</i> ATCC 27853 range 1-8 ug/mL	≤ 0.5		1
	1		6
	2	46	13
	4	147	434
	8	15	105
	16		11
	32		2
	16		

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 recommendation and used to compare with the Phoenix™ results. 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. A

comparison was provided to the reference method with the following agreement.

	total	EA	% EA	Eval Total	Eval EA	Eval EA %	CA total	CA %	#R	min	maj	vmj
<b>Clinical</b>	<b>1515</b>	<b>1422</b>	<b>93.9</b>	<b>905</b>	<b>819</b>	<b>90.5</b>	<b>1406</b>	<b>92.8</b>	<b>598</b>	<b>82</b>	<b>23</b>	<b>4</b>
<b>Challenge</b>	<b>266</b>	<b>257</b>	<b>96.6</b>	<b>208</b>	<b>199</b>	<b>95.7</b>	<b>264</b>	<b>99.2</b>	<b>58</b>	<b>2</b>	<b>0</b>	<b>0</b>
<b>Combined</b>	<b>1781</b>	<b>1679</b>	<b>94.3</b>	<b>1113</b>	<b>1018</b>	<b>91.5</b>	<b>1670</b>	<b>93.8</b>	<b>656</b>	<b>84</b>	<b>23</b>	<b>4</b>

**EA**-Essential Agreement

**CA**-Category Agreement

**Eval**- evaluable

**R**-resistant isolates

**maj**-major discrepancies

**vmj**-very major discrepancies

**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.

The test device had a growth rate of >95%.

***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:**

*Enterobacteriaceae* and Non-*Enterobacteriaceae* excluding *Pseudomonas aeruginosa*; ≤16 (S), 32-64(I), ≥128 (R)

*Pseudomonas aeruginosa* ≤ 64 (S), ≥ 128 (R)

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

**N. Conclusion:**

The submitted information in this premarket notification is complete and supports a substantial equivalence decision.