

Introduction

The Growth Promotion Test is an important function in the United States (USP), European (Ph. Eur.) and Japanese (JP) Pharmacopeias. Its purpose is to determine the suitability of media used in pharmaceutical tests. This Technical Information Bulletin (TIB) discusses the basic requirements of the Growth Promotion Test and explains how to perform the test using the EZ-CFU™ and EZ-CFU™ One Step Products.

The Growth Promotion Test should be performed on each batch of purchased ready-prepared medium and each batch of dehydrated medium or medium prepared from components in the laboratory (henceforth, any new, untested batch of medium will be called the “new batch of medium”).

The basic requirements for the growth promotion test are as follows: one, the new batch of medium must be inoculated with a small number of microorganisms, two, the laboratory should test the medium with the microorganisms required by the pharmacopeias and three, the microorganisms must not be more than five passages removed from Reference Culture (also called the original master seed lot). In order for the new batch of medium to be approved for use, growth on the new batch of medium must be comparable to growth obtained on a batch of medium previously approved by the laboratory.

The EZ-CFU™ and EZ-CFU™ One Step microorganisms are standardized, lyophilized preparations designed to deliver an inoculum of less than 100 CFU when used as directed. The microorganisms are only four passages from internationally recognized Reference Culture Collections. Documentation records a chain-of-evidence to ensure that each product can be traced to a Reference Culture. See Table 4 for a list of EZ-CFU™ and EZ-CFU™ One Step microorganisms.

The difference between the EZ-CFU™ and EZ-CFU™ One Step products is that the EZ-CFU™ product has a greater microorganism concentration and therefore requires a 1:10 dilution in order to deliver less than 100 CFU per 0.1 mL. The EZ-CFU™ One Step product does not require the dilution step.

MicroBioLogics indicates the average number of CFU per mL on the Certificate of Assay included with every EZ-CFU™ or EZ-CFU™ One Step product. The value on the Certificate of Assay is obtained using a statistically valid method but the laboratory using the product may obtain a different CFU value because different methods can yield different results. MicroBioLogics guarantees that an EZ-CFU™ or EZ-CFU™ One Step inoculum will deliver less than 100 CFU per 0.1 mL when used as directed. The customer should establish the CFU count in the inoculum by plating it on nonselective agar.

The USP, Ph. Eur. and JP have harmonized the Microbial Enumeration Tests and the Tests for Specified Microorganisms. The Sterility Test is scheduled to be fully harmonized by the pharmacopeias sometime in 2009. The Growth Promotion Test varies slightly between the Microbial Enumeration Tests, the Tests for Specified Microorganisms and the Sterility Test. For this reason, the Growth Promotion Test to be used for each type of test is described in this TIB, in addition to other important considerations for all three tests.

This TIB is meant to be a guide. Refer to the pharmacopeias for official text.

Microbiologic Examination of Nonsterile Products: Microbial Enumeration Tests

Purpose

The purpose of the Growth Promotion Test for Microbial Enumeration Tests is to assure the nutritive properties of a new batch of medium by challenging it with a small number of microorganisms.

Requirements

The Growth Promotion Test for the Microbial Enumeration Test has the following requirements:

1. Inoculate agar plates or broth with only a small number of microorganisms (not more than 100 CFU).
2. Use the microorganisms recommended by the pharmacopeias. The microorganisms should be traceable to a Reference Culture Collection, and should be no more than five passages from Reference Culture (original master seed lot).
3. Follow USP, Ph. Eur., or JP instructions. The USP, Ph. Eur., and JP are harmonized for this test.

Procedure

The new batch of medium and the previously approved batch of medium should be tested in parallel. All media should be tested in duplicate. Each agar plate or media tube should be tested with only one microorganism at a time. Below is a brief outline of the procedure for performing the Growth Promotion Test on media used in Microbial Enumeration Tests.

1. Determine which EZ-CFU™ or EZ-CFU™ One Step microorganisms are needed to test the medium. See Table 1.
2. For each microorganism to be tested, label two plates or tubes from the new batch of medium and two plates or tubes from the previously approved batch of medium.
3. Prepare an inoculum of each of the test microorganisms by following the directions in the EZ-CFU™ or EZ-CFU™ One Step product insert.
4. Dispense 0.1 mL of the inoculum per plate of agar or tube of broth. 0.1 mL will deliver less than 100 CFU. Use the same microorganism preparation to inoculate two plates or tubes from the new batch of medium and two plates or tubes from the previously approved batch of medium.
5. If using solid media, use the Surface-Spread Method. Use a spreader to disperse the inoculum and distribute it over the entire agar plate.
6. If the new medium is broth, also test each microorganism individually on two nonselective control agar plates. Inoculate the nonselective agar plates with 0.1 mL of the same inoculum suspension that was used to inoculate the new and previously approved batches of medium. The purpose of testing the microorganism on nonselective agar is to verify that 0.1 mL of inoculum contains less than 100 CFU. It is possible to determine the CFU concentration in the inoculum by counting the colonies on the agar plates whereas this is not possible after incubating broth.
7. Test a negative control to ensure the new medium and the diluent (if one is used) are sterile. If using an EZ-CFU™ product, the negative control is the diluent used to dilute the microorganism suspension 1:10. Inoculate a tube or agar plate with 0.1 mL of the diluent.
If using the EZ-CFU™ One Step product, the negative control is a non-inoculated plate or tube from the new batch of medium. The medium is not inoculated because the microorganism suspension is not diluted.
If the new medium is broth and the broth is clear after incubation, it may be subbed to nonselective agar in order to ensure that the broth is sterile.
The negative control must have no growth after incubation, in order for the new batch of medium to be approved.
8. Follow pharmacopeia directions for incubation temperature and length of incubation for each microorganism tested. See Table 1. The negative control should be subjected to the same conditions as the inoculated media.

Acceptance Criteria

1. SOLID MEDIA

EZ-CFU™ and EZ-CFU™ One Step and the Growth Promotion Test

- Average the number of colonies on the two plates from the new batch of medium and average the number of colonies on the two plates from the previously approved batch of medium. In order for the new batch of medium to be approved, the following acceptance criteria must be met for each microorganism tested:
 1. There must be growth on the agar plates.
 2. There must be no more than 100 colonies on the agar plates.
 3. The average number of colonies on the plates from the new batch of medium must be within a factor of 2 of the average number of colonies from the previously approved batch of medium. For example, if the average number of colonies on the previously approved media is 50, then the average number of colonies on the plates from the new batch of medium must be between 25 and 100. If, on the other hand, the average number of colonies on the previously approved media is 20, then the average number of colonies on the plates from the new batch of medium must be between 10 and 40.

2. BROTH

- Visually compare growth in the two tubes from the new batch of liquid medium to growth in the two tubes from the previously approved batch of medium. In order for the new batch of medium to be approved, the following acceptance criteria must be met for each microorganism tested:
 1. There should be growth in the tubes from both the new and previously approved batches of medium and on the control agar plates.
 2. The control plates should have no more than 100 colonies.
 3. The amount of turbidity in the tubes from the new batch of liquid medium should be comparable to amount of turbidity in the tubes from the previously approved batch of liquid medium. No quantitative definition of “comparable” has been established by the USP, Ph. Eur. or JP. Visual comparability is sufficient.

Table 1: Growth Promotion Test Requirements for Microbial Enumeration Tests

Microorganism ^{1,2}	Type of Medium	Temperature	Incubation Period
<i>Staphylococcus aureus</i> EZ-CFU™ One Step 0485Z or 0579Z or EZ-CFU™ 0485C	Soybean-Casein Digest Agar and Soybean-Casein Digest Broth	30-35° C	≤3 days (results can be seen in 18-24 hrs.)
<i>Pseudomonas aeruginosa</i> EZ-CFU™ One Step 0484Z or 0576Z	Soybean-Casein Digest Agar and Soybean-Casein Digest Broth	30-35° C	≤3 days (results can be seen in 18-24 hrs.)
<i>Bacillus subtilis subsp. spizizenii</i> ² EZ-CFU™ One Step 0486Z or EZ-CFU™ 0486C	Soybean-Casein Digest Agar and Soybean-Casein Digest Broth	30-35° C	≤3 days (results can be seen in 18-24 hrs.)
<i>Candida albicans</i> EZ-CFU™ One Step 0443Z or EZ-CFU™ 0443C	Soybean-Casein Digest Agar and Sabouraud Dextrose Agar	Soybean-Casein Digest Agar 30-35°C Sabouraud Dextrose Agar 20-25°C	≤5 days (results can be seen at 48 hrs. at 30-35 °C and at 72 hrs. at 20-25°C)
<i>Aspergillus brasiliensis</i> ³ EZ-CFU™ One Step 0392Z or EZ-CFU™ 0392C	Soybean-Casein Digest Agar and Sabouraud Dextrose Agar	Soybean-Casein Digest Agar 30-35°C Sabouraud Dextrose Agar 20-25°C	≤5 days (results can be seen at 48 hrs. at 30-35 °C and at 72 hrs. at 20-25°C)

¹ See Table 4 for Cross Reference of MicroBioLogics Products with recommended Reference Cultures

² *Bacillus subtilis subsp. spizizenii* is referred to *Bacillus subtilis* in the pharmacopeias. More information about the name can be found in Table 4.

³ *Aspergillus brasiliensis* has replaced the name *Aspergillus niger* in legacy pharmacopeias. More information can be found in Table 4 footnotes.

Microbiological Examination of Nonsterile Products: Tests for Specified Microorganisms

Purpose

The purpose of this growth promotion test is to ensure that the new batch of medium is performing correctly with respect to growth promotion, inhibitory and indicative properties by challenging the medium with a small number of microorganisms.

Requirements

The Growth Promotion Test for the Tests for Specified Microorganisms has the following requirements:

1. Inoculate the agar or broth with the number of microorganisms required by the type of test. The types of tests are as follows:
 - Test for Growth-Promoting Properties, Solid Media – Inoculate medium with no more than 100 CFU of the appropriate microorganism.
 - Test for Growth-Promoting Properties, Liquid Media – Inoculate medium with no more than 100 CFU of the appropriate microorganism.
 - Test for Inhibitory Properties, Liquid or Solid Media – Inoculate medium with at least 100 CFU of the appropriate microorganism.
 - Test for Indicative Properties – Inoculate medium with no more than 100 CFU of the appropriate microorganism.
2. Use the microorganisms recommended in the pharmacopeias. The microorganisms should be traceable to a Reference Culture Collection, and should be no more than five passages from Reference Culture (original master seed lot).
3. Follow USP, Ph. Eur., or JP instructions. The USP, Ph. Eur. and JP are harmonized for this test.
4. The new batch of medium may require more than one type of test. All the tests must meet the criteria described in the procedures in order for the new batch to be approved.

Procedure

Test for Growth-Promoting Properties, Solid Media

Test for Growth-Promoting Properties, Liquid Media

Test for Indicative Properties

The new batch of medium and the previously approved batch of medium should be tested in parallel and in duplicate. The medium should be tested with only one microorganism at a time. Below is a brief outline of the procedure for performing the Growth Promotion Test on media used for Growth-Promoting and Indicative Properties.

1. Determine which EZ-CFU™ or EZ-CFU™ One Step microorganisms are needed to test the medium. See Table 2.
2. For each microorganism to be tested, label two plates or tubes from the new batch of medium and two plates or tubes from the previously approved batch of medium.
3. Prepare an inoculum of each of the required microorganisms by following the directions in the EZ-CFU™ or EZ-CFU™ One Step product insert.
4. Dispense 0.1 mL of the inoculum per plate of agar or tube of broth. 0.1 mL will deliver less than 100 CFU. Use the same microorganism preparation to inoculate two plates or tubes from the new batch and two plates or tubes from the previously approved batch of medium.
5. If using solid media, use the Surface-Spread Method. Use a spreader to disperse the inoculum and distribute it over the entire agar plate.

EZ-CFU™ and EZ-CFU™ One Step and the Growth Promotion Test

6. If the new medium is selective or liquid, also test each microorganism individually on two nonselective control agar plates. Inoculate the plates or tubes with 0.1 ml of the same inoculum suspension that was used to inoculate the new and previously approved batches of medium. This is done because:
 - If testing a solid, selective medium, it is necessary to determine how many microorganisms are in the inoculum since growth-promoting medium can be inhibitory even to microorganisms that should grow on it.
 - If testing a liquid medium, it is necessary to verify that it was inoculated with less than 100 CFU since, unlike solid medium, there are no colonies to count after the liquid medium has been incubated. Inoculate the plates with the same inoculum used on the new and the previously approved batches of medium.
7. Test a negative control to ensure the new medium and the diluent (if one is used) are sterile. If using an EZ-CFU™ product, the negative control is the diluent used to dilute the microorganism suspension 1:10. Inoculate a tube or agar plate with 0.1 mL of the diluent. If using the EZ-CFU™ One Step product, the negative control is a non-inoculated plate or tube from the new batch of medium. The medium is not inoculated because the microorganism suspension is not diluted.

The negative control must have no growth after incubation, in order for the new batch of medium to be approved.
8. Follow pharmacopeia directions for incubation temperature and length of incubation for each microorganism tested. See Table 2. The negative control should be subjected to the same conditions as the inoculated media.

Acceptance Criteria

1. SOLID MEDIA

- Average the number of colonies on the two plates from the new batch of medium and average the number of colonies on the two plates from the previously accepted batch of medium. In order for the results to be acceptable, the following acceptance criteria must be met for each microorganism tested:
 1. There must be growth on the control agar plates and the growth-promoting agar plates.
 2. There must be no more than 100 colonies on the control agar plates or the growth-promoting agar plates.
 3. The average number of colonies on the new batch of medium must be “comparable” to the average number of colonies on the batch of previously approved medium. No quantitative definition of “comparable”, such as 50% or 70%, has been established in the USP, Ph. Eur. or JP.

2. LIQUID MEDIA

- Visually compare growth in the two tubes from the new batch of liquid medium to growth in the two tubes from the previously approved batch of medium. In order for the results to be acceptable, the following acceptance criteria must be met for each microorganism tested:
 1. There should be growth in the tubes from both the new and previously approved batches of liquid medium and on the control agar plates.
 2. There must be no more than 100 colonies on the control agar plates.
 3. The amount of turbidity in the new batch of liquid medium should be “comparable” to that in the previously approved batch of medium. No quantitative definition of “comparable” has been established by the USP, Ph. Eur. or JP.

3. INDICATIVE REACTIONS

- Visually compare the colonies on the agar plates to the colonies on the previously approved batch of medium. The colonies should be similar in appearance. Expected indicative reactions are described in Table 2.

Procedure

Test for Inhibitory Properties, Liquid or Solid Media

This test should be performed at the same time as the Tests for Growth-Promotion and Indicative properties. The new batch of medium and the previously approved batch of medium should be tested in parallel and in duplicate. Each plate or tube of medium should be tested with only one microorganism.

1. Determine which EZ-CFU™ microorganism is needed to test the medium. See Table 2.
2. Label two plates or tubes from the new batch of medium and two plates or tubes from the previously approved batch of medium.
3. Prepare an inoculum of each of the required microorganism. The inoculum must contain at least 100 CFU per 0.1 mL. To prepare the inoculum do the following:
 - Use an EZ-CFU™ product.
 - Rehydrate 2 pellets in 2 mL hydration fluid as described in the EZ-CFU™ product insert.
 - Do not dilute further. The pellet-hydration fluid suspension contains 100 to 999 CFU per 0.1 mL
4. Dispense 0.1 mL of the inoculum per plate or agar of tube of broth. Use the same microorganism preparation to inoculate two plates or tubes from the new batch of medium and two plates or tubes from the previously approved batch of medium.
5. If using solid media, use the Surface-Spread Method. Use a spreader to disperse the inoculum and distribute it over the entire agar plate.
6. Also, test two nonselective control agar plates with the test microorganism. This is done in order to verify the agar or broth being tested for inhibitory properties was inoculated with at least 100 CFU since there will be no growth or very little growth on the media that has inhibitory properties. Inoculate the control plates with 0.1 mL of the same inoculum used on the two plates or tubes from the new media and the previously approved media.
7. Test a negative control to ensure the new medium is sterile. (This may have already been done during the Tests for Growth Promoting and/or Indicative Properties). The negative control is a non-inoculated plate or tube from the new batch of medium.
If the new medium is broth and the broth is clear after incubation, it may be subbed to nonselective agar in order to ensure that the broth is sterile.
The negative control must have not growth after incubation in order for the new batch of medium to be approved.
8. Follow pharmacopeia directions for incubation temperature and length of incubation for each microorganism tested. See Table 2. The negative and positive control should be subjected to the same conditions.

Acceptance Criteria

- The test microorganism should be inhibited on the plates or tubes from both the new and previously approved batches of inhibitory medium.
- There should be at least 100 colonies on the nonselective control agar plate.

EZ-CFU™ and EZ-CFU™ One Step and the Growth Promotion Test

Table 2: Growth Promotion Test Requirements for Tests for Specified Microorganisms

Type of Medium	Microorganisms ¹	Properties	Temp	Incubation Period
Enterobacteria Enrichment Broth Mossel	<i>E. coli</i> EZ-CFU™ One Step 0483Z or 0581Z or EZ-CFU™ 0483C	Growth promoting	30-35°C	24 hrs.
	<i>P. aeruginosa</i> EZ-CFU™ One Step 0484Z or 0576Z	Growth promoting	30-35°C	24 hrs.
	<i>S. aureus</i> EZ-CFU™ 0485C	Inhibitory	30-35°C	48 hrs.
Violet Red Bile Glucose Agar	<i>E. coli</i> EZ-CFU™ One Step 0483Z or 0581Z or EZ-CFU™ 0483C	Growth promoting & Indicative (purplish-red colonies)	30-35°C	Growth: 18 hrs. Indicative: 18-24 hrs.
	<i>P. aeruginosa</i> EZ-CFU™ One Step 0484Z or 0576Z	Growth promoting & Indicative (colorless colonies)	30-35°C	Growth: 18 hrs. Indicative: 18-24 hrs.
MacConkey Broth	<i>E. coli</i> EZ-CFU™ One Step 0483Z or 0581Z or EZ-CFU™ 0483C	Growth promoting	42-44°C	24 hrs.
	<i>S. aureus</i> EZ-CFU™ 0485C	Inhibitory	42-44°C	48 hrs.
MacConkey Agar	<i>E. coli</i> EZ-CFU™ One Step 0483Z or 0581Z or EZ-CFU™ 0483C	Growth promoting & Indicative (pink colonies)	30-35°C	Growth: 18 hrs. Indicative: 18-72 hrs.
Rappaport Vassiliadis Salmonella Enrichment Broth	<i>S. enterica</i> subsp. <i>enterica</i> serovar Typhimurium EZ-CFU™ One Step 0363Z or EZ-CFU™ 0363C OR	Growth promoting	30-35°C	18 hrs.
	<i>S. enterica</i> subsp. <i>enterica</i> serovar Abony, EZ-CFU™ One Step 0890Z or EZ-CFU™ 0890C			
	<i>S. aureus</i> EZ-CFU™ 0485C	Inhibitory	30-35°C	24 hrs.
Xylose Lysine Deoxycholate Agar	<i>S. enterica</i> subsp. <i>enterica</i> serovar Typhimurium EZ-CFU™ One Step 0363Z or EZ-CFU™ 0363C OR <i>S. enterica</i> subsp. <i>enterica</i> serovar Abony EZ-CFU™ One Step 0890Z or EZ-CFU™ 0890C	Growth promoting & Indicative (red colonies with or without black centers)	30-35°C	Growth -18 hrs. Indicative 18-48 hrs.
Cetrimide Agar	<i>P. aeruginosa</i> EZ-CFU™ One Step 0484Z or 0576Z	Growth Promoting	30-35°C	18 hrs.
	<i>E. coli</i> EZ-CFU™ 0483C	Inhibitory	30-35°C	72 hrs.
Mannitol Salt Agar	<i>S. aureus</i> EZ-CFU™ One Step 0485Z or 0579Z or EZ-CFU™ 0485C	Growth promoting & Indicative (yellow or white colonies with yellow zone)	30-35°C	Growth: 18 hrs. Indicative: 18-72 hrs.
	<i>E. coli</i> EZ-CFU™ 0483C	Inhibitory	30-35°C	72 hrs.
Reinforced Medium for Clostridia	<i>C. sporogenes</i> EZ-CFU™ One Step 0487Z or 0580Z or EZ-CFU™ 0487C OR <i>C. sporogenes</i> EZ-CFU™ One Step 0317Z or EZ-CFU™ 0317C	Growth Promoting	30-35°C	48 hrs. anaerobic conditions
Columbia agar	<i>C. sporogenes</i> EZ-CFU™ One Step 0487Z or 0580Z or EZ-CFU™ 0487C OR <i>C. sporogenes</i> EZ-CFU™ One Step 0317 or EZ-CFU™ 0317C	Growth Promoting	30-35°C	48 hrs. anaerobic conditions
Sabouraud Dextrose Agar	<i>C. albicans</i> EZ-CFU™ One Step 0443Z or EZ-CFU™ 0443C	Growth Promoting & Indicative (white colonies)	30-35°C	Growth: 24 hrs. Indicative: 48 hrs.
Sabouraud Dextrose Broth	<i>C. albicans</i> EZ-CFU™ One Step 0443Z or EZ-CFU™ 0443C	Growth Promoting	30-35°C	3 days.

¹ See Table 4 for Cross Reference of MicroBioLogics Products with recommended Reference Cultures

Sterility Tests

Purpose

The purpose of the growth promotion test for the Sterility Test is to check the nutritive properties of the new batch of medium by challenging the medium with a small number of microorganisms. The medium being tested is always liquid.

Requirements

The Sterility Tests have the following requirements:

1. Inoculate the broth with only a small number of microorganisms (not more than 100 cfu).
2. Use the microorganisms recommended by the USP, Ph. Eur. or JP. The required microorganisms vary in the pharmacopeias since this test is not fully harmonized yet. The microorganisms should be traceable to a Reference Culture Collection and should be no more than five passages from Reference Culture (original master seed lot).
3. Follow USP, Ph. Eur. or JP instructions.

Procedure

The new batch of medium and the previously approved batch of medium should be tested in parallel and in duplicate. The medium should be tested with only one microorganism at a time. Below is a brief outline of the procedure for performing the Growth Promotion Test on media used for Sterility Tests.

1. Determine which EZ-CFU™ or EZ-CFU™ One Step microorganisms are needed to test the medium. See Table 3.
2. For each microorganism to be tested, label two tubes from the new batch of medium and two tubes from the previously approved batch of medium.
3. Prepare an inoculum of each of the required microorganisms by following the directions in the EZ-CFU™ or EZ-CFU™ One Step product insert.
4. Dispense 0.1 mL of the inoculum in two tubes of the batch of new media and two tubes of the batch of previously approved media. 0.1 mL will deliver less than 100 CFU. Use the same microorganism preparation to inoculate the new batch and the previously approved batch of medium.
5. Also, test each microorganism individually on two nonselective control agar plates. Inoculate the plates with 0.1 mL of the same inoculum that was used to inoculate the new and previously approved batches of medium. This is done in order to verify 0.1 mL contains less than 100 CFU. It is possible to determine the CFU concentration in the inoculum by counting the colonies on the agar plates whereas this is not possible after incubating broth.
6. Test a negative control to ensure the new medium and diluent (if one is used) are sterile. If using an EZ-CFU™ product, the negative control is the diluent used to dilute the microorganism suspension 1:10. Inoculate a tube from the batch of new medium with 0.1 mL of the diluent. If using the EZ-CFU™ One Step product, the negative control is a non-inoculated tube from the new batch of medium. The medium is not inoculated because the microorganism suspension is not diluted.
Incubate the negative control tube for 14 days. If the broth is clear after incubation, it may be subbed to nonselective agar plates in order to ensure that the broth is sterile. The negative control must have no growth after incubation, in order for the new batch of medium to be approved.
7. Follow pharmacopeia directions for incubation temperature and length of incubation for each microorganism tested. See Table 3. The negative control should be incubated at the same temperature as the inoculated media.

EZ-CFU™ and EZ-CFU™ One Step and the Growth Promotion Test

Acceptance Criteria

After incubation, visually compare the turbidity in the two tubes from the new batch of medium to the turbidity in the two tubes from the previously approved batch of medium. In order for the new batch of medium to be approved the following acceptance criteria must be met for each microorganism tested:

- There should be growth in the tubes from both the new and previously approved batches of liquid medium and on the control agar plates.
- The control plate should have no more than 100 colonies
- The amount of turbidity in the tubes from the new batch of liquid medium should be “comparable” to that in the tubes from the previously approved batch of medium. No quantitative definition of “comparable” has been established by the USP, Ph. Eur. or JP.

Table 3: Growth Promotion Test Requirements for the Sterility Test

Microorganism ¹	Type of Medium	Temperature	Incubation Period
<i>Clostridium sporogenes</i> EZ-CFU™ One Step 0317Z or EZ-CFU™ 0317C OR <i>C. sporogenes</i> EZ-CFU™ One Step 0487Z or EZ-CFU™ 0487C	Fluid Thioglycollate Medium	30-35° C	≤3 days
<i>Pseudomonas aeruginosa</i> ² EZ-CFU™ One Step 0484Z or 0576Z	Fluid Thioglycollate Medium	30-35° C	≤3 days
<i>Staphylococcus aureus</i> EZ-CFU™ One Step 0485Z or 0579Z EZ-CFU™ 0485C	Fluid Thioglycollate Medium	30-35° C	≤3 days
<i>Clostridium sporogenes</i> EZ-CFU™ One Step 0317Z or EZ-CFU™ 0317C OR <i>C. sporogenes</i> EZ-CFU™ One Step 0487Z or EZ-CFU™ 0487C	Alternative Fluid Thioglycollate Medium	30-35° C	≤3 days
<i>Aspergillus brasiliensis</i> ³ EZ-CFU™ One Step 0392Z or EZ-CFU™ 0392C	Soybean-Casein Digest Medium ⁴	20-25° C	≤5 days
<i>Bacillus subtilis</i> ⁵ EZ-CFU™ One Step 0486Z or EZ-CFU™ 0486C	Soybean-Casein Digest Medium ⁴	20-25° C	≤ 3 days
<i>Candida albicans</i> EZ-CFU™ One Step 0443Z or EZ-CFU™ 0443C	Soybean-Casein Digest Medium ⁴	20-25° C	≤5 days

¹See Table 4 for Cross Reference of MicroBioLogics Products with Reference Cultures.

²*Kocuria rhizophila*, MicroBioLogics EZ-CFU™ One Step, 0688Z, or EZ-CFU™, 0688C may be substituted for *Pseudomonas aeruginosa* (USP).

³*Aspergillus brasiliensis* has replaced the name *Aspergillus niger* in the legacy pharmacopeias. More information can be found in Table 4 footnotes.

⁴Fluid Thioglycollate medium may be used when testing a product containing a preservative that cannot be tested by the membrane filtration method provided the method has been validated.

⁵*Bacillus subtilis subsp. spizizenii* is referred to *Bacillus subtilis* in the pharmacopeias. More information about the name can be found in Table 4.

Important Considerations for all Growth Promotion Tests

In order to get consistent results, do the following:

- Use the microorganism cultures recommended by the pharmacopeia. The cultures should be traceable to a Reference Culture Collection, and should be no more than five passages from Reference Culture (original master seed lot).
- If testing selective media, run a control on nonselective media such as Tryptic Soy Agar at the same time because recovery on selective media is not as high as on nonselective media.
- If performing a Growth Promotion Test on liquid medium, run a control on nonselective agar at the same time in order to verify that the correct number of microorganisms was added for the test.
- Don't exchange the rubber stoppers on the hydrating fluid for the rubber stoppers on the pellet vials. The moisture on the hydrating fluid stopper may harm the pellets.
- Let the media and the vial of pellets equilibrate to room temperature. The hydration fluid and any dilution fluids should warm for 30 minutes at 35° before use.
- Use a pipettor and calibrate it routinely.
- Vortex suspensions until they are homogenous.
- Use a spreader to disperse the inoculum over the entire plate.
- Follow pharmacopeia directions for temperature, incubation time, and atmosphere.
- After testing EZ-CFU™ One Step suspension, refrigerate it if planning to use it again. With the exception of 0320Z and 0318Z, the refrigerated suspension can be used for up to eight hours.
- Calibrate thermometers and validate incubators yearly.
- Some microorganisms such as Bacillus and Aspergillus produce colonies that spread. These colonies can be hard to count if they become too mature.
- If using the pour plate method, add 0.1 mL of inoculum containing less than 100 CFU to an empty agar plate. Pour molten agar over the inoculum and mix well by swirling the contents in the plate. Since recovery may not be as high as when using the spread plate method, run a spread plate as a control. The molten media must be cooled to 45° Celsius. Invert and incubate the agar plate after it has solidified.
- For optimum results, many experts recommend using parallel testing instead of historical data when comparing new media to previously approved media. When parallel (side by side) testing is used, the new media and the previously approved media are inoculated with the same inoculum by the same technician and are subjected to identical incubation conditions. The only variable is the media.
- A Verification Study is sufficient when using the EZ-CFU or EZ-CFU One Step product for the first time. MicroBioLogics has already validated the procedures and, per the USP, all the customer needs to do is verify that the product works for them using their procedures, equipment etc. MicroBioLogics recommends five repetitive tests, using the same inoculum suspension, should be performed for the verification study. Results should meet the specifications outlined in this TIB.
- In order to ensure the safety of the consumer, a pharmaceutical product may need to be tested for microorganisms other than those mentioned in the Tests for Specified Microorganisms. If microorganism controls other than those mentioned in this TIB are needed, go to www.microbiologics.com to find a complete list of EZ-CFU™ and EZ-CFU™ One Step microorganisms that can be used in Growth Promotion Testing.

Table 4: Cross Reference of MicroBioLogics Products with Reference Cultures

<i>Microorganism Name</i>	<i>Reference Culture #</i>	<i>EZ-CFU™ One Step and/or EZ-CFU™ Product #¹</i>
<i>Aspergillus brasiliensis</i> ²	ATCC® 16404™*	0392Z, 0392C
<i>Bacillus subtilis subsp. spizizenii</i> ³	ATCC® 6633™*	0486Z, 0486C
<i>Candida albicans</i>	ATCC® 10231™*	0443Z, 0443C
<i>Clostridium sporogenes</i>	ATCC® 19404™*	0317Z, 0317C
<i>Clostridium sporogenes</i>	ATCC® 11437™*	0487Z, 0487C
<i>Clostridium sporogenes</i>	NCIMB 12343	0580Z
<i>Escherichia coli</i>	ATCC® 8739™*	0483Z, 0483C
<i>Escherichia coli</i>	NCIMB 8545	0581Z
<i>Kocuria rhizophila</i>	ATCC® 9341™*	0688Z, 0688C
<i>Pseudomonas aeruginosa</i>	ATCC® 9027™*	0484Z
<i>Pseudomonas aeruginosa</i>	NCIMB 8626	0576Z
<i>Salmonella enterica subsp. enterica</i>	NCTC 6017	0890C, 0890Z
<i>Salmonella enterica subsp. enterica serovar Typhimurium</i>	ATCC® 14028™*	0363C, 0363Z
<i>Staphylococcus aureus subsp. aureus</i>	ATCC® 6538™*	0485C, 0485Z
<i>Staphylococcus aureus subsp. aureus</i>	NCIMB 9518	0579Z

¹ The code Z indicates an EZ-CFU™ One Step product. The code C indicates an EZ-CFU™ product.

² *Aspergillus brasiliensis* is sometimes referred to as *Aspergillus niger* in the pharmacopeias. ATCC® changed the name of ATCC® 16404™ in 2008 because ATCC® determined that this strain belonged to the species *Aspergillus brasiliensis* after performing a polyphasic study in which molecular data was combined with physiological characteristics. More information can be found at the following link. <http://www.microbiologics.com/docs/LIT.256.pdf>

³ *Bacillus subtilis subsp. spizizenii* is referred to *Bacillus subtilis* in the pharmacopeias. A taxonomic update in 1999 reclassified ATCC® 6633™ as *Bacillus subtilis* subspecies *spizizenii*. The species did not change. Rather, a new subspecies was added. More information can be found in the following reference. Nakamura LK, et al. Relationship of *Bacillus subtilis* clades associated with strains 168 and W23: A proposal for *Bacillus subtilis* subsp. *subtilis* subsp. nov. and *Bacillus subtilis* subsp. *spizizenii* subsp. nov. International Journal of Systematic and Evolutionary Bacteriology 49: 1211-1215, 1999.

Abbreviations and acronyms



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