



McFARLAND STANDARD

-For in vitro use only-

Catalogue No. TM50-TM60

McFarland Standards are used to standardize the approximate number of bacteria in a liquid suspension by comparing the turbidity of the test suspension with that of the McFarland Standard.

A McFarland Standard is a chemical solution of barium chloride and sulfuric acid; the reaction between these two chemicals results in the production of a fine precipitate, barium sulfate. When shaken well, the turbidity of a McFarland Standard is visually comparable to a bacterial suspension of known concentration as indicated below.

| Cat No. | McFarland Standard | 1% BaCl ₂ (mL) | 1% H ₂ SO ₄ (mL) | Approximate Bacterial Suspension / mL |
|---------|--------------------|---------------------------|--|---------------------------------------|
| TM50 | 0.5 | 0.05 | 9.95 | 1.5 x 10 ⁸ |
| TM51 | 1.0 | 0.10 | 9.90 | 3.0 x 10 ⁸ |
| TM52 | 2.0 | 0.20 | 9.80 | 6.0 x 10 ⁸ |
| TM53 | 3.0 | 0.3 | 9.7 | 9.0 x 10 ⁸ |
| TM54 | 4.0 | 0.4 | 9.6 | 1.2 x 10 ⁹ |
| TM55 | 5.0 | 0.5 | 9.5 | 1.5 x 10 ⁹ |
| TM56 | 6.0 | 0.6 | 9.4 | 1.8 x 10 ⁹ |
| TM57 | 7.0 | 0.7 | 9.3 | 2.1 x 10 ⁹ |
| TM58 | 8.0 | 0.8 | 9.2 | 2.4 x 10 ⁹ |
| TM59 | 9.0 | 0.9 | 9.1 | 2.7 x 10 ⁹ |
| TM60 | 10.0 | 1.0 | 9.0 | 3.0 x 10 ⁹ |

Prior to using, the McFarland Standard should be shaken up well and aliquoted into test tubes identical to those used to prepare the inoculum suspension. Once aliquoted the tubes should be tightly sealed to prevent evaporation from occurring. Before each use, shake well to ensure that the barium sulfate is distributed evenly throughout the solution.

The standard most commonly used in the clinical microbiology laboratory is the 0.5 McFarland Standard, which is prescribed for antimicrobial susceptibility testing and culture media performance testing.

Procedures

1. Mix McFarland Standard on a vortex mixture prior to examination. Ensure that the McFarland Standard is aliquoted into a tube that is the same size and diameter as the tube used to prepare the test suspension.
2. Prepare a test suspension by obtaining a fresh, pure culture of the test organism and inoculating a suitable broth.
3. In the presence of good lighting, visually compare the turbidity of test suspension with that of the McFarland standard by comparing the clarity of the lines on the a Wickerham card.
4. If the test suspension is too light, inoculate with additional organisms or incubate tube until turbidity matches that of the standard. If dilution is necessary, use a sterile pipette and add sufficient broth or saline to obtain a turbidity that matches that of the standard.

Precautions

- *McFarland Standards are sensitive to air and light therefore ensure that the tubes are closed tightly at all times and kept in the dark*
- *The level of McFarland standards should be checked occasionally to ensure that evaporation has not occurred. Discard if any volume is lost*
- *The McFarland Standards should be vigorously agitated on a mechanical vortex before each use and inspected for a uniform turbid appearance. If large particles appear or if clumping is apparent discard the standard*
- *Actual numbers of viable bacteria present in an adjusted suspension depends on the size, viability, and clumping of the particular bacterium used*

Quality Control

The accuracy of the density of McFarland Standards can be checked using a spectrophotometer with a 1-cm light path; a 0.5 McFarland Standard has an absorbance reading of 0.08 to 0.1 at 625-nm.

Alternatively, adjusting a bacterial suspension to the same turbidity and preparing serial 10-fold dilutions can verify the accuracy of a McFarland Standard by performing a plate count of the dilution and ensuring that the suspension gives a representative colony count. Example for 0.5 McFarland Standard:

| Dilution | Expected Number of Colonies from 0.1-mL |
|-----------|---|
| 10^{-1} | TNTC |
| 10^{-2} | TNTC |
| 10^{-3} | TNTC |
| 10^{-4} | TNTC |
| 10^{-5} | TNTC |
| 10^{-6} | 150 |
| 10^{-7} | 15 |

Storage and Shelf Life

Our McFarland Standards should be stored in an upright position at 4°C to 25°C and protected from light. Under these conditions they have a shelf life of 12 weeks from the date of manufacture.

References

1. McFarland J. Nephelometer: an instrument for media used for estimating the number of bacteria in suspensions used for calculating the opsonic index and for vaccines. *J Am Med Assoc* 1907; 14:1176-8.
2. Wickerham LJ. Taxonomy of yeasts. Technical bulletin no. 1029. Washington, DC: US Department of Agriculture, 1951.
3. Washington JA, Warren E, Karlson AG. Stability of barium sulfate turbidity standards. *Appl Microbiol* 1972; 24:1013.
4. Baker CN, Thornsberry C, Hawkinson RW. Inoculum standardization in antimicrobial susceptibility tests: evaluation of the overnight agar cultures and the rapid inoculum standardization system. *J Clin Micro* 1983; 17:450-7.
5. Isenberg HD, Ed. *Clinical microbiology procedures handbook, Vol I.* Washington, DC: ASM, 1992.
6. NCCLS. M22-A2 Quality assurance of commercially prepared microbiological culture media. 2nd ed. Wayne, PA: NCCLS, 1996.
7. Murray PR, Baron EJ, Pfaller MA, Tenover FC, Tenover RH, Eds. *Manual of clinical microbiology.* 7th ed. Washington, DC: ASM, 1999.

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