

# European Committee on Antimicrobial Susceptibility Testing

## Routine and extended internal quality control for MIC determination and disk diffusion as recommended by EUCAST

Version 12.0, valid from 2022-01-01

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## Notes

1. In EUCAST quality control (QC) tables, both ranges and targets are listed. Repeat testing of EUCAST quality control strains should yield individual MIC and zone diameter values randomly distributed within the recommended ranges. If the number of tests is  $\geq 10$ , the mode MIC should be the target value and the mean zone diameter should be close to the target value (optimally  $\pm 1$  mm from the target).
2. Ranges in bold/italics are established by EUCAST. All targets are established by EUCAST.
3. For access to ISO standard documents, see [http://www.eucast.org/documents/external\\_documents/](http://www.eucast.org/documents/external_documents/).
4. EUCAST quality control strains for routine QC are used to monitor test performance. Control tests should be set up and checked daily, or at least four times per week, for antibiotics which are part of routine panels. For analysis of the QC test results, see [EUCAST Disk Diffusion Manual](#).
5. Specific  $\beta$ -lactamase-producing strains are recommended to check the inhibitor component of  $\beta$ -lactam-inhibitor combinations. This should be part of the routine QC. The active component is checked with a susceptible QC strain.
6. EUCAST quality control strains for extended QC are complementary to the EUCAST routine QC strains. These strains are recommended for detection of specific resistance mechanisms (ESBL, MRSA, VRE, HLGR and PBP mutations) and are used to confirm that the method will detect resistance mediated by known resistance mechanisms. Extended QC should be performed with any change in the susceptibility testing system (with each new batch of disks or medium) and/or monthly.

## Changes from previous version

Version 12.0 2022-01-01	Changes Cells containing a change or an addition from EUCAST QC Tables v. 11.0 are marked yellow.
Recommended strains for routine QC	<ul style="list-style-type: none"> <li>• <i>Vibrio</i> spp. added</li> </ul>
ATCC 25922	<p><b>New QC ranges</b></p> <ul style="list-style-type: none"> <li>• Azithromycin (zone diameter)</li> <li>• Meropenem-vaborbactam (zone diameter)</li> </ul> <p><b>Revised QC ranges</b></p> <ul style="list-style-type: none"> <li>• Imipenem (MIC)</li> <li>• Imipenem-relebactam (MIC)</li> </ul> <p><b>New comments</b></p> <ul style="list-style-type: none"> <li>• Comment 7</li> </ul> <p><b>Revised comments</b></p> <ul style="list-style-type: none"> <li>• Comment 4 (one general comment on control of inhibitor components)</li> </ul>
ATCC 27853	<p><b>New QC ranges</b></p> <ul style="list-style-type: none"> <li>• Meropenem-vaborbactam (zone diameter)</li> </ul> <p><b>Revised comments</b></p> <ul style="list-style-type: none"> <li>• Comment 5 (one general comment on control of inhibitor components)</li> </ul>
ATCC 49619	<p><b>New QC ranges</b></p> <ul style="list-style-type: none"> <li>• Florfenicol (MIC)</li> </ul> <p><b>Removed QC ranges</b></p> <ul style="list-style-type: none"> <li>• Amoxicillin-clavulanic acid (MIC), see comment 4</li> <li>• Imipenem-relebactam (MIC), see comment 4</li> </ul> <p><b>Revised comments</b></p> <ul style="list-style-type: none"> <li>• Comment 4</li> </ul>
ATCC 49766	<p><b>Revised comments</b></p> <ul style="list-style-type: none"> <li>• Comment 5 (one general comment on control of inhibitor components)</li> </ul>
ATCC 33396	<p><b>New table</b></p> <ul style="list-style-type: none"> <li>• MIC QC ranges for florfenicol</li> </ul>
Control of the inhibitor component of $\beta$ -lactam-inhibitor-combinations	<p><b>New QC ranges</b></p> <ul style="list-style-type: none"> <li>• Meropenem-vaborbactam for <i>K. pneumoniae</i> ATCC BAA-2814 (zone diameter)</li> </ul>



## **Routine quality control**

## Recommended strains for routine quality control

Table 1 lists the recommended QC strains for each organism or groups of organisms in the EUCAST Breakpoint Tables. The recommendations are based on using a strain of the same (or a similar) species as the organism to be tested (*i.e.* principal QC), but sometimes other QC strains have to be added to cover all agents. Table 2 lists the EUCAST recommended QC strains for control of  $\beta$ -lactam inhibitor combinations.

**Table 1**

Recommendations for principal QC <sup>1</sup>		Recommendations for agents not covered by principal QC <sup>1</sup>	
Organism	QC strain	Agent	QC strain
<i>Enterobacterales</i> <sup>2</sup>	<i>E. coli</i> ATCC 25922	Colistin (MIC)	Add <i>E. coli</i> NCTC 13846
<i>Pseudomonas</i> spp.	<i>P. aeruginosa</i> ATCC 27853	Piperacillin (zone diameter)	<i>E. coli</i> ATCC 25922
		Ticarcillin (zone diameter)	<i>E. coli</i> ATCC 25922
		Colistin (MIC)	Add <i>E. coli</i> NCTC 13846
<i>Stenotrophomonas maltophilia</i>	<i>E. coli</i> ATCC 25922		
<i>Acinetobacter</i> spp.	<i>P. aeruginosa</i> ATCC 27853	Trimethoprim-sulfamethoxazole (MIC and zone diameter)	<i>E. coli</i> ATCC 25922
		Colistin (MIC)	Add <i>E. coli</i> NCTC 13846
<i>Staphylococcus</i> spp.	<i>S. aureus</i> ATCC 29213	Roxithromycin (MIC)	<i>H. influenzae</i> ATCC 49766
<i>Enterococcus</i> spp.	<i>E. faecalis</i> ATCC 29212	Ampicillin-sulbactam (MIC)	See table 2
		Amoxicillin (MIC)	<i>E. coli</i> ATCC 25922
		Amoxicillin-clavulanic acid (MIC)	See table 2
Streptococcus groups A, B, C and G	<i>S. pneumoniae</i> ATCC 49619	Teicoplanin (MIC)	<i>S. aureus</i> ATCC 29213
		Minocycline (MIC)	<i>S. aureus</i> ATCC 29213
		Trimethoprim (MIC)	<i>S. aureus</i> ATCC 29213
		Roxithromycin (MIC)	<i>H. influenzae</i> ATCC 49766
<i>Streptococcus pneumoniae</i>	<i>S. pneumoniae</i> ATCC 49619	Teicoplanin (MIC)	<i>S. aureus</i> ATCC 29213
		Minocycline (MIC)	<i>S. aureus</i> ATCC 29213
		Roxithromycin (MIC)	<i>H. influenzae</i> ATCC 49766
Viridans group streptococci	<i>S. pneumoniae</i> ATCC 49619	Teicoplanin (MIC)	<i>S. aureus</i> ATCC 29213
<i>Haemophilus influenzae</i>	<i>H. influenzae</i> ATCC 49766	Piperacillin-tazobactam (MIC)	See table 2
		Ceftolozane-tazobactam (MIC)	See table 2
<i>Moraxella catarrhalis</i>	<i>H. influenzae</i> ATCC 49766		
<i>Listeria monocytogenes</i>	<i>S. pneumoniae</i> ATCC 49619		
<i>Pasteurella multocida</i>	<i>H. influenzae</i> ATCC 49766	Benzylpenicillin (MIC)	<i>S. pneumoniae</i> ATCC 49619
<i>Campylobacter jejuni</i> and <i>coli</i>	<i>C. jejuni</i> ATCC 33560	Ciprofloxacin (MIC)	<i>S. aureus</i> ATCC 29213
		Erythromycin (MIC)	<i>S. aureus</i> ATCC 29213
		Tetracycline (MIC)	<i>S. aureus</i> ATCC 29213
<i>Corynebacterium</i> spp.	<i>S. pneumoniae</i> ATCC 49619	Ciprofloxacin (MIC)	<i>S. aureus</i> ATCC 29213
<i>Aerococcus sanguinicola</i> and <i>urinae</i>	<i>S. pneumoniae</i> ATCC 49619	Ciprofloxacin (MIC)	<i>S. aureus</i> ATCC 29213
<i>Kingella kingae</i>	<i>H. influenzae</i> ATCC 49766	Benzylpenicillin (MIC)	<i>S. pneumoniae</i> ATCC 49619
<i>Aeromonas</i> spp.	<i>P. aeruginosa</i> ATCC 27853	Trimethoprim-sulfamethoxazole (MIC and zone diameter)	<i>E. coli</i> ATCC 25922

### Recommended strains for routine quality control

Recommendations for principal QC <sup>1</sup>		Recommendations for agents not covered by principal QC <sup>1</sup>	
Organism	QC strain	Agent	QC strain
<i>Vibrio</i> spp.	<i>E. coli</i> ATCC 25922	Azithromycin (MIC)	<i>S. aureus</i> ATCC 29213
		Doxycycline (MIC)	<i>S. aureus</i> ATCC 29213
		Tetracycline (zone diameter)	<i>S. aureus</i> ATCC 29213
<i>Achromobacter xylosoxidans</i>	<i>P. aeruginosa</i> ATCC 27853	Trimethoprim-sulfamethoxazole (MIC and zone diameter)	<i>E. coli</i> ATCC 25922
<i>Bacillus</i> spp.	<i>S. aureus</i> ATCC 29213	Imipenem (MIC and zone diameter)	<i>E. coli</i> ATCC 25922
		Meropenem (MIC and zone diameter)	<i>E. coli</i> ATCC 25922
		Vancomycin (zone diameter)	<i>E. faecalis</i> ATCC 29212
<i>Burkholderia pseudomallei</i>	<i>E. coli</i> ATCC 25922	Doxycycline (MIC)	<i>S. aureus</i> ATCC 29213
		Tetracycline (zone diameter)	<i>S. aureus</i> ATCC 29213

<sup>1</sup> β-lactam-inhibitor combinations must be tested with both a susceptible QC strain and a β-lactamase-producing QC strain (see Table 2).

<sup>2</sup> Recent taxonomic studies have narrowed the definition of the family Enterobacteriaceae. Some previous members of this family are now included in other families within the Order *Enterobacterales*.

**Table 2**

Control of β-lactam inhibitor combinations <sup>1</sup>		
Organism	QC strain for active component	QC strain for inhibitor component
<i>Enterobacterales</i> <sup>2</sup>	<i>E. coli</i> ATCC 25922	See page 17
<i>Pseudomonas</i> spp.	<i>P. aeruginosa</i> ATCC 27853	See page 17
<i>Enterococcus</i> spp.	<i>E. coli</i> ATCC 25922	See page 17
<i>Streptococcus pneumoniae</i>	<i>S. pneumoniae</i> ATCC 49619	See page 17
Viridans group streptococci	<i>S. pneumoniae</i> ATCC 49619	See page 17
<i>Haemophilus influenzae</i>	<i>H. influenzae</i> ATCC 49766 or <i>E. coli</i> ATCC 25922	See page 17
<i>Moraxella catarrhalis</i>	<i>H. influenzae</i> ATCC 49766	See page 17
<i>Pasteurella multocida</i>	<i>H. influenzae</i> ATCC 49766	See page 17
<i>Vibrio</i> spp.	<i>E. coli</i> ATCC 25922	See page 17
<i>Achromobacter xylosoxidans</i>	<i>P. aeruginosa</i> ATCC 27853	See page 17
<i>Burkholderia pseudomallei</i>	<i>E. coli</i> ATCC 25922	See page 17

<sup>1</sup> β-lactam-inhibitor combinations must be tested with both a susceptible QC strain and a β-lactamase-producing QC strain.

<sup>2</sup> Recent taxonomic studies have narrowed the definition of the family Enterobacteriaceae. Some previous members of this family are now included in other families within the Order *Enterobacterales*.

**Escherichia coli ATCC 25922**

(NCTC 12241, CIP 76.24, DSM 1103, CCUG 17620, CECT 434)

See EUCAST Breakpoint Tables for short descriptions of MIC and disk diffusion methodology.

Antimicrobial agent	MIC (mg/L)		Disk content (µg)	Inhibition zone diameter (mm)	
	Target <sup>1</sup>	Range <sup>2</sup>		Target <sup>1</sup>	Range <sup>2</sup>
Amikacin	1-2	0.5-4	30	22-23	19-26
Amoxicillin	4	<b>2-8</b>	-	-	-
Amoxicillin-clavulanic acid <sup>3,4</sup>	4	2-8	20-10	21	18-24 <sup>5</sup>
Ampicillin	4	2-8	10	18-19	15-22 <sup>5</sup>
Ampicillin-sulbactam <sup>4,6</sup>	<b>2</b>	<b>1-4</b>	10-10	21-22	19-24 <sup>5</sup>
Azithromycin	-	-	15	<b>17</b>	<b>14-20<sup>7</sup></b>
Aztreonam	0.125	0.06-0.25	30	32	28-36
Cefadroxil	-	-	30	<b>17</b>	<b>14-20</b>
Cefalexin	<b>8</b>	<b>4-16</b>	30	<b>18</b>	<b>15-21</b>
Cefazolin	2	1-4	30	24	21-27
Cefepime	0.03-0.06	0.016-0.125	30	34	31-37
Cefiderocol <sup>8</sup>	0.125-0.25	0.06-0.5	30	<b>27</b>	<b>24-30</b>
Cefixime	0.5	0.25-1	5	<b>23</b>	<b>20-26</b>
Cefotaxime	0.06	0.03-0.125	5	<b>28</b>	<b>25-31</b>
Cefoxitin	4	2-8	30	26	23-29
Cefpodoxime	0.5	0.25-1	10	25-26	23-28
Ceftaroline	0.06	0.03-0.125	5	<b>27</b>	<b>24-30</b>
Ceftazidime	0.125-0.25	0.06-0.5	10	<b>26</b>	<b>23-29</b>
Ceftazidime-avibactam <sup>4,9</sup>	0.125-0.25	0.06-0.5	10-4	<b>27</b>	<b>24-30</b>
Ceftibuten	0.25	0.125-0.5	30	31	27-35
Ceftobiprole	0.06	0.03-0.125	5	<b>28</b>	<b>25-31</b>
Ceftolozane-tazobactam <sup>4,10</sup>	0.25	0.125-0.5	30-10	28	24-32
Ceftriaxone	0.06	0.03-0.125	30	32	29-35
Cefuroxime	4	2-8	30	23	20-26
Chloramphenicol	4	2-8	30	24	21-27
Ciprofloxacin	0.008	0.004-0.016	5	<b>33</b>	<b>29-37</b>
Colistin <sup>11</sup>	0.5-1	0.25-2	-	-	-
Delafloxacin	0.016	0.008-0.03	IP	IP	IP
Doripenem	0.03	0.016-0.06	10	31	27-35
Eravacycline	0.06	0.03-0.125	20	<b>21</b>	<b>18-24</b>
Ertapenem	0.008	0.004-0.016	10	32-33	29-36
Fosfomycin <sup>12</sup>	1	0.5-2	200 <sup>13</sup>	<b>30</b>	<b>26-34<sup>14</sup></b>
Gentamicin	0.5	0.25-1	10	22-23	19-26
Imipenem	0.125-0.25	0.06-0.5	10	29	26-32
Imipenem-relebactam <sup>4,15</sup>	0.125-0.25	0.06-0.5	10-25	30	27-33
Levofloxacin	0.016-0.03	0.008-0.06	5	33	29-37
Mecillinam <sup>16</sup>	0.06-0.125	0.03-0.25	10	27	24-30
Meropenem	0.016-0.03	0.008-0.06	10	31-32	28-35
Meropenem-vaborbactam <sup>4,17</sup>	0.016-0.03	0.008-0.06	20-10	<b>34</b>	<b>31-37</b>
Moxifloxacin	0.016-0.03	0.008-0.06	5	31-32	28-35
Nalidixic acid	2	1-4	30	25	22-28
Neomycin	Note <sup>18</sup>	Note <sup>18</sup>	10	<b>17</b>	<b>14-20</b>
Netilmicin	-	≤0.5-1	10	<b>21</b>	<b>18-24</b>
Nitrofurantoin	8	4-16	100	<b>20</b>	<b>17-23</b>
Nitroxoline	<b>4</b>	<b>2-8</b>	30	<b>21</b>	<b>18-24</b>
Norfloxacin	0.06	0.03-0.125	10	31-32	28-35
Ofloxacin	0.03-0.06	0.016-0.125	5	31	29-33
Pefloxacin	-	-	5	<b>29</b>	<b>26-32</b>
Piperacillin	2	1-4	30	<b>24</b>	<b>21-27</b>
Piperacillin-tazobactam <sup>4,10</sup>	2	1-4	30-6	<b>24</b>	<b>21-27</b>
Temocillin	<b>16</b>	<b>8-32</b>	30	<b>19</b>	<b>16-22<sup>14</sup></b>
Ticaracillin	8	4-16	75	27	24-30
Ticaracillin-clavulanic acid <sup>3,4</sup>	8	4-16	75-10	27	24-30
Tigecycline <sup>19</sup>	0.06-0.125	0.03-0.25	15	23-24	20-27
Tobramycin	0.5	0.25-1	10	22	18-26
Trimethoprim	1	0.5-2	5	24-25	21-28
Trimethoprim-sulfamethoxazole <sup>20</sup>	≤0.5	-	1.25-23.75	26	23-29

***Escherichia coli* ATCC 25922**  
(NCTC 12241, CIP 76.24, DSM 1103, CCUG 17620, CECT 434)

<sup>1</sup> Calculated by EUCAST.

<sup>2</sup> From Clinical and Laboratory Standards Institute, M100-S32, 2022, except ranges in bold/italics established by EUCAST. All ranges have been validated by EUCAST.

<sup>3</sup> For MIC testing, the concentration of clavulanic acid is fixed at 2 mg/L.

<sup>4</sup> For control of the inhibitor component, see Routine quality control for  $\beta$ -lactam-inhibitor combinations.

<sup>5</sup> Ignore growth that may appear as a thin inner zone on some batches of Mueller-Hinton agar.

<sup>6</sup> For MIC testing, the concentration of sulbactam is fixed at 4 mg/L.

<sup>7</sup> Take growth appearing as a thin inner zone on some batches of Mueller-Hinton agar into account.

<sup>8</sup> Broth microdilution MIC determination must be performed in iron-depleted Mueller-Hinton broth and specific reading instructions must be followed. For testing conditions and reading instructions, see <https://www.eucast.org/eucastguidancedocuments/>.

<sup>9</sup> For MIC testing, the concentration of avibactam is fixed at 4 mg/L.

<sup>10</sup> For MIC testing, the concentration of tazobactam is fixed at 4 mg/L.

<sup>11</sup> Quality control of colistin must be performed with both a susceptible QC strain (*E. coli* ATCC 25922 or *P. aeruginosa* ATCC 27853) and the colistin resistant *E. coli* NCTC 13846 (*mcr-1* positive). For *E. coli* NCTC 13846 (CCUG 70662, DSM 105182), the colistin MIC target value is 4 mg/L and should only on occasion be 2 or 8 mg/L.

<sup>12</sup> Agar dilution is the reference method for fosfomycin. Fosfomycin MICs must be determined in the presence of glucose-6-phosphate (25 mg/L in the medium). Follow the manufacturer's instructions for commercial systems.

<sup>13</sup> Fosfomycin 200  $\mu$ g disks must contain 50  $\mu$ g glucose-6-phosphate.

<sup>14</sup> Ignore isolated colonies within the inhibition zone and read the outer zone edge (for reading examples see the EUCAST Reading Guide).

<sup>15</sup> For MIC testing, the concentration of relebactam is fixed at 4 mg/L.

<sup>16</sup> Agar dilution is the reference method for mecillinam MIC determination.

<sup>17</sup> For MIC testing, the concentration of vaborbactam is fixed at 8 mg/L.

<sup>18</sup> There is currently no MIC range for *E. coli* ATCC 25922 and neomycin.

<sup>19</sup> For tigecycline broth microdilution MIC determination, the medium must be prepared fresh on the day of use.

<sup>20</sup> Trimethoprim:sulfamethoxazole in the ratio 1:19. MIC values are expressed as the trimethoprim concentration.

IP = In Preparation



***Pseudomonas aeruginosa* ATCC 27853**

(NCTC 12903, CIP 76.110, DSM 1117, CCUG 17619, CECT 108)

**See EUCAST Breakpoint Tables for short descriptions of MIC and disk diffusion methodology.**

Antimicrobial agent	MIC (mg/L)		Disk content (µg)	Inhibition zone diameter (mm)	
	Target <sup>1</sup>	Range <sup>2</sup>		Target <sup>1</sup>	Range <sup>2</sup>
Amikacin	2	1-4	30	23	20-26
Aztreonam	4	2-8	30	26	23-29
Cefepime	1-2	0.5-4	30	28	25-31
Cefiderocol <sup>3</sup>	0.125-0.25	0.06-0.5	30	<b>26</b>	<b>23-29</b>
Ceftazidime	2	1-4	10	<b>24</b>	<b>21-27</b>
Ceftazidime-avibactam <sup>4,5</sup>	1-2	0.5-4	10-4	<b>24</b>	<b>21-27</b>
Ceftolozane-tazobactam <sup>5,6</sup>	0.5	0.25-1	30-10	28	25-31
Ciprofloxacin	0.25-0.5	0.125-1	5	29	25-33
Colistin <sup>7</sup>	1-2	0.5-4	-	-	-
Doripenem	0.25	0.125-0.5	10	31-32	28-35
Fosfomycin <sup>8</sup>	4	2-8	-	-	-
Gentamicin	1	0.5-2	10	20	17-23
Imipenem	2	1-4	10	24	20-28
Imipenem-relebactam <sup>5,9</sup>	0.5	0.25-1	10-25	28-29	26-31
Levofloxacin	1-2	0.5-4	5	22-23	19-26
Meropenem	0.25-0.5	0.125-1	10	30	27-33
Meropenem-vaborbactam <sup>5,10</sup>	0.25-0.5	0.125-1	20-10	<b>32</b>	<b>29-35</b>
Netilmicin	2	0.5-8	10	<b>18</b>	<b>15-21</b>
Piperacillin	2-4	1-8	-	-	-
Piperacillin-tazobactam <sup>5,6</sup>	2-4	1-8	30-6	<b>26</b>	<b>23-29</b>
Ticarcillin	16	8-32	-	-	-
Ticarcillin-clavulanic acid <sup>5,11</sup>	16	8-32	75-10	24	20-28
Tobramycin	0.5	0.25-1	10	23	20-26

<sup>1</sup> Calculated by EUCAST.<sup>2</sup> From Clinical and Laboratory Standards Institute, M100-S32, 2022, except ranges in bold/italics established by EUCAST. All ranges have been validated by EUCAST.<sup>3</sup> Broth microdilution MIC determination must be performed in iron-depleted Mueller-Hinton broth and specific reading instructions must be followed. For testing conditions and reading instructions, see <https://www.eucast.org/eucastguidancedocuments/>.<sup>4</sup> For MIC testing, the concentration of avibactam is fixed at 4 mg/L.<sup>5</sup> For control of the inhibitor component, see Routine quality control for β-lactam-inhibitor combinations.<sup>6</sup> For MIC testing, the concentration of tazobactam is fixed at 4 mg/L.<sup>7</sup> Quality control of colistin must be performed with both a susceptible QC strain (*E. coli* ATCC 25922 or *P. aeruginosa* ATCC 27853) and the colistin resistant *E. coli* NCTC 13846 (*mcr-1* positive). For *E. coli* NCTC 13846 (CCUG 70662, DSM 105182), the colistin MIC target value is 4 mg/L and should only on occasion be 2 or 8 mg/L.<sup>8</sup> Agar dilution is the reference method for fosfomycin. Fosfomycin MICs must be determined in the presence of glucose-6-phosphate (25 mg/L in the medium). Follow the manufacturer's instructions for commercial systems.<sup>9</sup> For MIC testing, the concentration of relebactam is fixed at 4 mg/L.<sup>10</sup> For MIC testing, the concentration of vaborbactam is fixed at 8 mg/L.<sup>11</sup> For MIC testing, the concentration of clavulanic acid is fixed at 2 mg/L.

IP = In Preparation

***Staphylococcus aureus* ATCC 29213**

(NCTC 12973, CIP 103429, DSM 2569, CCUG 15915, CECT 794)

 $\beta$ -lactamase-producing strain (weak)**See EUCAST Breakpoint Tables for short descriptions of MIC and disk diffusion methodology.**

Antimicrobial agent	MIC (mg/L)		Disk content ( $\mu$ g)	Inhibition zone diameter (mm)	
	Target <sup>1</sup>	Range <sup>2</sup>		Target <sup>1</sup>	Range <sup>3</sup>
Amikacin	2	1-4	30	21	18-24
Ampicillin	-	-	2	18	15-21
Azithromycin	1	0.5-2	-	-	-
Benzylpenicillin	0.5-1	0.25-2	1 unit	15	12-18
Cefoxitin	2	1-4	30	27	24-30
Ceftaroline	0.25	0.125-0.5	5	27	24-30
Ceftobiprole	0.25-0.5	0.125-1	5	25	22-28
Chloramphenicol	4-8	2-16	30	24	20-28
Ciprofloxacin	0.25	0.125-0.5	5	24	21-27
Clarithromycin	0.25	0.125-0.5	-	-	-
Clindamycin	0.125	0.06-0.25	2	26	23-29
Dalbavancin <sup>4</sup>	0.06	0.03-0.125	-	-	-
Daptomycin <sup>5</sup>	0.25-0.5	0.125-1	-	-	-
Delafloxacin	0.002-0.004	0.001-0.008	IP	IP	IP
Doxycycline	0.25	0.125-0.5	-	-	-
Eravacycline	0.03-0.06	0.016-0.125	20	23	20-26
Erythromycin	0.5	0.25-1	15	26	23-29
Fosfomycin <sup>6</sup>	1-2	0.5-4	-	-	-
Fusidic acid	0.125	0.06-0.25	10	29	26-32
Gentamicin	0.25-0.5	0.125-1	10	22	19-25
Lefamulin	0.125	0.06-0.25	5	26	23-29
Levofloxacin	0.125-0.25	0.06-0.5	5	26	23-29
Linezolid	2	1-4	10	24	21-27
Minocycline	0.125-0.25	0.06-0.5	30	26	23-29
Moxifloxacin	0.03-0.06	0.016-0.125	5	28	25-31
Mupirocin	<b>0.125</b>	<b>0.06-0.25</b>	200	34	31-37
Neomycin	Note <sup>7</sup>	Note <sup>7</sup>	10	19	16-22
Netilmicin	$\leq 0.25$	-	10	23	20-26
Nitrofurantoin	16	8-32	100	20	17-23
Norfloxacin	1	0.5-2	10	21	18-24
Ofloxacin	0.25-0.5	0.125-1	5	24	21-27
Oritavancin <sup>4</sup>	0.03-0.06	0.016-0.125	-	-	-
Oxacillin	Note <sup>8</sup>	Note <sup>8</sup>	1	22	19-25
Quinupristin-dalfopristin	0.5	0.25-1	15	24	21-27
Rifampicin	0.008	0.004-0.016	5	33	30-36
Tedizolid	0.25-0.5	0.125-1	2	22	19-25
Teicoplanin	0.5	0.25-1	-	-	-
Telavancin <sup>4</sup>	0.06	0.03-0.125	-	-	-
Telithromycin	0.125	0.06-0.25	15	IP	IP
Tetracycline	0.25-0.5	0.125-1	30	27	23-31
Tigecycline <sup>9</sup>	0.06-0.125	0.03-0.25	15	22	19-25
Tobramycin	0.25-0.5	0.125-1	10	23	20-26
Trimethoprim	2	1-4	5	25	22-28
Trimethoprim-sulfamethoxazole <sup>10</sup>	$\leq 0.5$	-	1.25-23.75	29	26-32
Vancomycin	1	0.5-2	-	-	-

***Staphylococcus aureus* ATCC 29213****(NCTC 12973, CIP 103429, DSM 2569, CCUG 15915, CECT 794)** $\beta$ -lactamase-producing strain (weak)

<sup>1</sup> Calculated by EUCAST.

<sup>2</sup> From Clinical and Laboratory Standards Institute, M100-S32, 2022, except ranges in bold/italics established by EUCAST. All ranges have been validated by EUCAST.

<sup>3</sup> Established and validated by EUCAST.

<sup>4</sup> MICs must be determined in the presence of polysorbate-80 (0.002% in the medium for broth dilution methods; agar dilution methods have not been validated). Follow the manufacturer's instructions for commercial systems.

<sup>5</sup> Daptomycin MICs must be determined in the presence of Ca<sup>2+</sup> (50 mg/L in the medium for broth dilution methods; agar dilution methods have not been validated). Follow the manufacturer's instructions for commercial systems.

<sup>6</sup> Agar dilution is the reference method for fosfomycin. Fosfomycin MICs must be determined in the presence of glucose-6-phosphate (25 mg/L in the medium). Follow the manufacturer's instructions for commercial systems.

<sup>7</sup> There is currently no MIC range for *S. aureus* ATCC 29213 and neomycin.

<sup>8</sup> There is currently no EUCAST MIC range for *S. aureus* ATCC 29213 and oxacillin. The range in CLSI M100-S32 is 0.125-0.5 mg/L.

<sup>9</sup> For tigecycline broth microdilution MIC determination, the medium must be prepared fresh on the day of use.

<sup>10</sup> Trimethoprim:sulfamethoxazole in the ratio 1:19. MIC values are expressed as the trimethoprim concentration.

IP = In Preparation

***Enterococcus faecalis* ATCC 29212**

(NCTC 12697, CIP 103214, DSM 2570, CCUG 9997, CECT 795)

**See EUCAST Breakpoint Tables for short descriptions of MIC and disk diffusion methodology.**

Antimicrobial agent	MIC (mg/L)		Disk content (µg)	Inhibition zone diameter (mm)	
	Target <sup>1</sup>	Range <sup>2</sup>		Target <sup>1</sup>	Range <sup>3</sup>
Ampicillin	1	0.5-2	2	<b>18</b>	<b>15-21</b>
Ciprofloxacin	0.5-1	0.25-2	5	<b>22</b>	<b>19-25</b>
Eravacycline	0.03	0.016-0.06	20	<b>23</b>	<b>20-26</b>
Gentamicin	8	4-16	30 <sup>4</sup>	<b>15</b>	<b>12-18</b>
Imipenem	1	0.5-2	10	<b>27</b>	<b>24-30</b>
Levofloxacin	0.5-1	0.25-2	5	<b>22</b>	<b>19-25</b>
Linezolid	2	1-4	10	<b>22</b>	<b>19-25</b>
Nitrofurantoin	8	4-16	100	<b>21</b>	<b>18-24</b>
Norfloxacin	4	2-8	10	<b>19</b>	<b>16-22</b>
Quinupristin-dalfopristin	4	2-8	15	<b>14</b>	<b>11-17</b>
Streptomycin	Note <sup>5</sup>	Note <sup>5</sup>	300 <sup>6</sup>	17	14-20 <sup>7</sup>
Teicoplanin	0.5	0.25-1	30	<b>18</b>	<b>15-21</b>
Tigecycline <sup>8</sup>	0.06	0.03-0.125	15	<b>23</b>	<b>20-26</b>
Trimethoprim	0.25	0.125-0.5	5	<b>28</b>	<b>24-32</b>
Trimethoprim-sulfamethoxazole <sup>9</sup>	≤0.5 <sup>2</sup>	-	1.25-23.75	<b>30</b>	<b>26-34</b>
Vancomycin	2	1-4	5	<b>13</b>	<b>10-16</b>

<sup>1</sup> Calculated by EUCAST.<sup>2</sup> From Clinical and Laboratory Standards Institute, M100-S32, 2022, except ranges in bold/italics established by EUCAST. All ranges have been validated by EUCAST.<sup>3</sup> Established and validated by EUCAST.<sup>4</sup> Screening disk for high-level aminoglycoside-resistance in enterococci.<sup>5</sup> There is currently no MIC range for *E. faecalis* ATCC 29212 and streptomycin.<sup>6</sup> Screening disk for high-level streptomycin-resistance in enterococci.<sup>7</sup> From Clinical and Laboratory Standards Institute, M100-S32, 2022.<sup>8</sup> For tigecycline broth microdilution MIC determination, the medium must be prepared fresh on the day of use.<sup>9</sup> Trimethoprim:sulfamethoxazole in the ratio 1:19. MIC values are expressed as the trimethoprim concentration.

IP = In Preparation

***Streptococcus pneumoniae* ATCC 49619\***

(NCTC 12977, CIP 104340, DSM 11967, CCUG 33638)

Strain with reduced susceptibility to benzylpenicillin

\* Zone edges for *S. pneumoniae* on MH-F are often accompanied by  $\alpha$ -haemolysis. Read inhibition of growth and not inhibition of haemolysis. Tilt the plate to easier differentiate between haemolysis and growth. There is usually growth in the whole area of  $\alpha$ -haemolysis but on some MH-F media, there is additional  $\alpha$ -haemolysis without growth.

**See EUCAST Breakpoint Tables for short descriptions of MIC and disk diffusion methodology.**

Antimicrobial agent	MIC (mg/L)		Disk content ( $\mu$ g)	Inhibition zone diameter (mm)	
	Target <sup>1</sup>	Range <sup>2</sup>		Target <sup>1</sup>	Range <sup>3</sup>
Amoxicillin	0.06	0.03-0.125	-	-	-
Amoxicillin-clavulanic acid	Note <sup>4</sup>	Note <sup>4</sup>	-	-	-
Ampicillin	0.125	0.06-0.25	2	<b>28</b>	<b>25-31</b>
Azithromycin	0.125	0.06-0.25	-	-	-
Benzylpenicillin	0.5	0.25-1	1 unit	<b>19</b>	<b>16-22</b>
Cefaclor	2	1-4	30	<b>28</b>	<b>25-31</b>
Cefepime	0.06-0.125	0.03-0.25	30	<b>34</b>	<b>31-37</b>
Cefotaxime	0.06	0.03-0.125	5	<b>31</b>	<b>28-34</b>
Cefpodoxime	0.06	0.03-0.125	10	<b>32</b>	<b>29-35</b>
Ceftaroline	0.016	0.008-0.03	-	-	-
Ceftobiprole	0.008-0.016	0.004-0.03	-	-	-
Ceftriaxone	0.06	0.03-0.125	30	<b>35</b>	<b>32-38</b>
Cefuroxime	0.5	0.25-1	30	<b>31</b>	<b>28-34</b>
Chloramphenicol	4	2-8	30	<b>27</b>	<b>24-30</b>
Ciprofloxacin	-	-	5	<b>25</b>	<b>22-28</b>
Clarithromycin	0.06	0.03-0.125	-	-	-
Clindamycin	0.06	0.03-0.125	2	<b>25</b>	<b>22-28</b>
Dalbavancin <sup>5</sup>	0.016	0.008-0.03	-	-	-
Daptomycin <sup>6</sup>	0.125-0.25	0.06-0.5	-	-	-
Delafloxacin	0.008	0.004-0.016	IP	IP	IP
Doripenem	0.06	0.03-0.125	10	<b>34</b>	<b>31-37</b>
Doxycycline	0.03-0.06	0.016-0.125	-	-	-
Eravacycline	0.008-0.016	0.004-0.03	20	<b>27</b>	<b>24-30</b>
Ertapenem	0.06-0.125	0.03-0.25	10	<b>31</b>	<b>28-34</b>
Erythromycin	0.06	0.03-0.125	15	<b>29</b>	<b>26-32</b>
Florfenicol	<b>2</b>	<b>1-4</b>	-	-	-
Imipenem	0.06	0.03-0.125	10	<b>38</b>	<b>34-42</b>
Imipenem-relebactam	Note <sup>4</sup>	Note <sup>4</sup>	-	-	-
Lefamulin	0.125-0.25	0.06-0.5	5	<b>18</b>	<b>15-21</b>
Levofloxacin	1	0.5-2	5	<b>24</b>	<b>21-27</b>
Linezolid	0.5-1	0.25-2	10	<b>26</b>	<b>23-29</b>
Meropenem	0.06-0.125	0.03-0.25	10	<b>34</b>	<b>30-38</b>
Minocycline	-	-	30	<b>28</b>	<b>25-31</b>
Moxifloxacin	0.125	0.06-0.25	5	<b>27</b>	<b>24-30</b>
Nitrofurantoin	8	4-16	100	<b>28</b>	<b>25-31</b>
Norfloxacin	4	2-8	10	<b>21</b>	<b>18-24</b>
Ofloxacin	2	1-4	5	<b>21</b>	<b>18-24</b>
Oritavancin <sup>5</sup>	0.002	0.001-0.004	-	-	-
Oxacillin <sup>7</sup>	-	-	1	<b>11</b>	<b>8-14<sup>7</sup></b>
Rifampicin	0.03	0.016-0.06	5	<b>29</b>	<b>26-32</b>
Tedizolid	0.25	0.125-0.5	2	<b>22</b>	<b>19-25</b>
Teicoplanin	-	-	30	<b>21</b>	<b>18-24</b>
Telithromycin	0.008-0.016	0.004-0.03	15	<b>30</b>	<b>27-33</b>
Tetracycline	0.125-0.25	0.06-0.5	30	<b>31</b>	<b>28-34</b>
Tigecycline <sup>8</sup>	0.03-0.06	0.016-0.125	15	<b>27</b>	<b>24-30</b>
Trimethoprim-sulfamethoxazole <sup>9</sup>	0.25-0.5	0.125-1	1.25-23.75	<b>22</b>	<b>18-26</b>
Vancomycin	0.25	0.125-0.5	5	<b>20</b>	<b>17-23</b>

***Streptococcus pneumoniae* ATCC 49619\*****(NCTC 12977, CIP 104340, DSM 11967, CCUG 33638)**

Strain with reduced susceptibility to benzylpenicillin

<sup>1</sup> Calculated by EUCAST.<sup>2</sup> From Clinical and Laboratory Standards Institute, M100-S32, 2022, except ranges in bold/italics established by EUCAST. All ranges have been validated by EUCAST.<sup>3</sup> Established and validated by EUCAST.<sup>4</sup> The addition of a beta-lactamase inhibitor does not add clinical benefit when testing *S. pneumoniae*.<sup>5</sup> MICs must be determined in the presence of polysorbate-80 (0.002% in the medium for broth dilution methods; agar dilution methods have not been validated). Follow the manufacturer's instructions for commercial systems.<sup>6</sup> Daptomycin MICs must be determined in the presence of Ca<sup>2+</sup> (50 mg/L in the medium for broth dilution methods; agar dilution methods have not been validated). Follow the manufacturer's instructions for commercial systems.<sup>7</sup> *S. aureus* ATCC 29213 can be used for quality control of oxacillin 1 µg with target 22 mm and range 19-25 mm (according to disk diffusion methodology for *S. aureus*).<sup>8</sup> For tigecycline broth microdilution MIC determination, the medium must be prepared fresh on the day of use.<sup>9</sup> Trimethoprim:sulfamethoxazole in the ratio 1:19. MIC values are expressed as the trimethoprim concentration.

IP = In Preparation

***Haemophilus influenzae* ATCC 49766**  
(NCTC 12975, CIP 103570, DSM 11970, CCUG 29539)

See EUCAST Breakpoint Tables for short descriptions of MIC and disk diffusion methodology.

Antimicrobial agent	MIC (mg/L)		Disk content (µg)	Inhibition zone diameter (mm)	
	Target <sup>1</sup>	Range <sup>2</sup>		Target <sup>1</sup>	Range <sup>3</sup>
Amoxicillin	<b>0.25</b>	<b>0.125-0.5</b>	-	-	-
Amoxicillin-clavulanic acid <sup>4,5</sup>	<b>0.25</b>	<b>0.125-0.5</b>	2-1 <sup>6</sup>	<b>20</b>	<b>17-23</b>
Ampicillin	<b>0.125</b>	<b>0.06-0.25</b>	2	<b>22</b>	<b>19-25</b>
Ampicillin-sulbactam <sup>5,6</sup>	<b>0.125</b>	<b>0.06-0.25</b>	-	-	-
Azithromycin	<b>1</b>	<b>0.5-2</b>	-	-	-
Benzylpenicillin	-	-	1 unit	<b>18</b>	<b>15-21</b>
Cefepime	<b>0.06</b>	<b>0.03-0.125</b>	30	<b>33</b>	<b>30-36</b>
Cefixime	<b>0.03</b>	<b>0.016-0.06</b>	5	<b>32</b>	<b>29-35</b>
Cefotaxime	<b>0.008</b>	<b>0.004-0.016</b>	5	<b>33</b>	<b>29-37</b>
Cefpodoxime	<b>0.06</b>	<b>0.03-0.125</b>	10	<b>33</b>	<b>30-36</b>
Ceftaroline	<b>0.008</b>	<b>0.004-0.016</b>	-	-	-
Ceftibuten	<b>0.03</b>	<b>0.016-0.06</b>	30	<b>34</b>	<b>31-37</b>
Ceftolozane-tazobactam <sup>5,7</sup>	Note <sup>8</sup>	Note <sup>8</sup>	30-10	<b>27</b>	<b>24-30</b>
Ceftriaxone	<b>0.004</b>	<b>0.002-0.008</b>	30	<b>38</b>	<b>34-42</b>
Cefuroxime	0.5	0.25-1	30	<b>30</b>	<b>26-34</b>
Chloramphenicol	<b>0.5</b>	<b>0.25-1</b>	30	<b>34</b>	<b>31-37</b>
Ciprofloxacin	<b>0.008</b>	<b>0.004-0.016</b>	5	<b>36</b>	<b>32-40</b>
Clarithromycin	<b>8</b>	<b>4-16</b>	-	-	-
Doripenem	0.125	0.06-0.25	10	<b>29</b>	<b>26-32</b>
Doxycycline	<b>0.5</b>	<b>0.25-1</b>	-	-	-
Ertapenem	0.03	0.016-0.06	10	<b>30</b>	<b>27-33</b>
Erythromycin	<b>4</b>	<b>2-8</b>	15	<b>13</b>	<b>10-16</b>
Imipenem	0.5	0.25-1	10	<b>27</b>	<b>24-30</b>
Levofloxacin	<b>0.016</b>	<b>0.008-0.03</b>	5	<b>35</b>	<b>31-39</b>
Meropenem	0.06	0.03-0.125	10	<b>31</b>	<b>27-35</b>
Minocycline	<b>0.25</b>	<b>0.125-0.5</b>	30	<b>29</b>	<b>26-32</b>
Moxifloxacin	<b>0.016</b>	<b>0.008-0.03</b>	5	<b>33</b>	<b>30-36</b>
Nalidixic acid	-	-	30	<b>29</b>	<b>26-32</b>
Ofloxacin	<b>0.03</b>	<b>0.016-0.06</b>	5	<b>34</b>	<b>31-37</b>
Piperacillin-tazobactam <sup>5,7</sup>	Note <sup>9</sup>	Note <sup>9</sup>	30-6	<b>36</b>	<b>32-40</b>
Rifampicin	<b>0.5</b>	<b>0.25-1</b>	5	<b>24</b>	<b>21-27</b>
Roxithromycin	<b>8</b>	<b>4-16</b>	-	-	-
Telithromycin	<b>2</b>	<b>1-4</b>	15	<b>17</b>	<b>14-20</b>
Tetracycline	<b>0.5</b>	<b>0.25-1</b>	30	<b>31</b>	<b>28-34</b>
Trimethoprim-sulfamethoxazole <sup>10</sup>	<b>0.03</b>	<b>0.016-0.06</b>	1.25-23.75	<b>31</b>	<b>27-35</b>

<sup>1</sup> Calculated by EUCAST.

<sup>2</sup> From Clinical and Laboratory Standards Institute, M100-S32, 2022, except ranges in bold/italics established by EUCAST. All ranges have been validated by EUCAST.

<sup>3</sup> Established and validated by EUCAST.

<sup>4</sup> For MIC testing, the concentration of clavulanic acid is fixed at 2 mg/L.

<sup>5</sup> For control of the inhibitor component, see Routine quality control for β-lactam-inhibitor combinations. Test according to methodology for non-fastidious organisms.

<sup>6</sup> For MIC testing, the concentration of sulbactam is fixed at 4 mg/L.

<sup>7</sup> For MIC testing, the concentration of tazobactam is fixed at 4 mg/L.

<sup>8</sup> Use *E. coli* ATCC 25922 to control the ceftolozane component (according to methodology for *E. coli*).

<sup>9</sup> Use *E. coli* ATCC 25922 to control the piperacillin component (according to methodology for *E. coli*).

<sup>10</sup> Trimethoprim:sulfamethoxazole in the ratio 1:19. MIC values are expressed as the trimethoprim concentration.

IP = In Preparation

***Campylobacter jejuni* ATCC 33560**  
(NCTC 11351, CIP 70.2T, DSM 4688, CCUG 11284)

See EUCAST Breakpoint Tables for short descriptions of MIC and disk diffusion methodology.

Antimicrobial agent	MIC (mg/L)		Disk content (µg)	Inhibition zone diameter (mm)	
	Target	Range		Target <sup>1</sup>	Range <sup>2</sup>
Ciprofloxacin	IP	IP	5	<b>38</b>	<b>34-42</b>
Erythromycin	IP	IP	15	<b>31</b>	<b>27-35</b>
Tetracycline	IP	IP	30	<b>34</b>	<b>30-38</b>

<sup>1</sup> Calculated by EUCAST.

<sup>2</sup> Established and validated by EUCAST.

IP = In Preparation



***Mannheimia haemolytica* ATCC 33396**

(NCTC 9380, DSM 10531, CCUG 12392T)

**Test according to EUCAST methodology for fastidious organisms (MH-F broth for broth microdilution).**

Antimicrobial agent	MIC (mg/L)		Disk content (µg)	Inhibition zone diameter (mm)	
	Target <sup>1</sup>	Range <sup>2</sup>		Target	Range
Florfenicol	1	0.5-2	-	-	-

<sup>1</sup> Calculated by EUCAST.

<sup>2</sup> Established and validated by EUCAST.

IP = In Preparation

## Control of the inhibitor component of $\beta$ -lactam-inhibitor combinations

See EUCAST Breakpoint Tables for short descriptions of MIC and disk diffusion methodology.

### *Escherichia coli* ATCC 35218

(NCTC 11954, CIP 102181, DSM 5923, CCUG 30600, CECT 943)

TEM-1  $\beta$ -lactamase-producing strain (non-ESBL)

Antimicrobial agent	MIC (mg/L)		Disk content ( $\mu$ g)	Inhibition zone diameter (mm)	
	Target <sup>1</sup>	Range <sup>2</sup>		Target <sup>1</sup>	Range <sup>2</sup>
Amoxicillin-clavulanic acid <sup>3</sup>	<b>8-16</b>	<b>4-32</b>	20-10	19-20	17-22 <sup>4</sup>
Ampicillin-sulbactam <sup>5</sup>	<b>32-64</b>	<b>16-128</b>	10-10	16	13-19 <sup>4</sup>
Ceftolozane-tazobactam <sup>6,7</sup>	0.125	0.06-0.25	30-10	28	25-31
Piperacillin-tazobactam <sup>6,7</sup>	1	0.5-2	30-6	<b>24</b>	<b>21-27</b>
Ticarcillin-clavulanic acid <sup>3</sup>	16	8-32	75-10	23	21-25

### *Klebsiella pneumoniae* ATCC 700603\*

(NCTC 13368, CCUG 45421, CECT 7787)

SHV-18 ESBL producer

\* Two colony types are normally observed for this strain and should be included when subculturing and testing the strain.

Antimicrobial agent	MIC (mg/L)		Disk content ( $\mu$ g)	Inhibition zone diameter (mm)	
	Target <sup>1</sup>	Range <sup>2</sup>		Target <sup>1</sup>	Range <sup>2</sup>
Ceftazidime-avibactam <sup>8</sup>	0.5-1	0.25-2	10-4	<b>21</b>	<b>18-24</b>
Ceftolozane-tazobactam <sup>6,7</sup>	1	0.5-2	30-10	21	17-25
Piperacillin-tazobactam <sup>6,7</sup>	16	8-32	30-6	<b>17</b>	<b>14-20</b>

### *Klebsiella pneumoniae* ATCC BAA-2814

KPC-3, SHV-11 and TEM-1

Antimicrobial agent	MIC (mg/L)		Disk content ( $\mu$ g)	Inhibition zone diameter (mm)	
	Target <sup>1</sup>	Range <sup>2</sup>		Target <sup>1</sup>	Range <sup>2</sup>
Imipenem-relebactam <sup>9</sup>	0.125-0.25	0.06-0.5	10-25	25	22-28
Meropenem-vaborbactam <sup>10</sup>	0.25	0.125-0.5	20-10	<b>18</b>	<b>15-21</b>

### *Staphylococcus aureus* ATCC 29213

(NCTC 12973, CIP 103429, DSM 2569, CCUG 15915, CECT 794)

$\beta$ -lactamase-producing strain (weak)

Antimicrobial agent	MIC (mg/L)		Disk content ( $\mu$ g)	Inhibition zone diameter (mm)	
	Target <sup>1</sup>	Range <sup>2</sup>		Target <sup>1</sup>	Range <sup>2</sup>
Amoxicillin-clavulanic acid <sup>3</sup>	Note <sup>11</sup>	Note <sup>11</sup>	2-1	<b>22</b>	<b>19-25</b>

## Control of the inhibitor component of $\beta$ -lactam-inhibitor combinations

<sup>1</sup> Calculated by EUCAST.

<sup>2</sup> From Clinical and Laboratory Standards Institute, M100-S32, 2022, except ranges in bold/italics established by EUCAST. All ranges have been validated by EUCAST.

<sup>3</sup> For MIC testing, the concentration of clavulanic acid is fixed at 2 mg/L.

<sup>4</sup> Ignore growth that may appear as a thin inner zone on some batches of Mueller-Hinton agar.

<sup>5</sup> For MIC testing, the concentration of sulbactam is fixed at 4 mg/L.

<sup>6</sup> For MIC testing, the concentration of tazobactam is fixed at 4 mg/L.

<sup>7</sup> Either *E. coli* ATCC 35218 or *K. pneumoniae* ATCC 700603 can be used to check the inhibitor component.

<sup>8</sup> For MIC testing, the concentration of avibactam is fixed at 4 mg/L.

<sup>9</sup> For MIC testing, the concentration of relebactam is fixed at 4 mg/L.

<sup>10</sup> For MIC testing, the concentration of vaborbactam is fixed at 8 mg/L.

<sup>11</sup> For MIC testing, *E. coli* ATCC 35218 is used to check the inhibitor component.

IP = In Preparation



## **Extended quality control for detection of resistance mechanisms with disk diffusion**

## Quality control strains for detection of resistance mechanisms with disk diffusion on Mueller-Hinton agar

See EUCAST Breakpoint Tables for short descriptions of MIC and disk diffusion methodology.

### ESBL production in *Enterobacterales*

#### *Klebsiella pneumoniae* ATCC 700603\*

(NCTC 13368, CCUG 45421, CECT 7787)

SHV-18 ESBL-producer

\* Two colony types are normally observed for this strain and should be included when subculturing and testing the strain.

Antimicrobial agent	Disk content (µg)	Target susceptibility <sup>1</sup>	Range <sup>2</sup> (mm)	Comments
Aztreonam	30	R	9-17	
Cefotaxime	5	I or R	<b>12-18</b>	
Cefpodoxime	10	R	9-16	
Ceftazidime	10	I or R	<b>6-12</b>	
Ceftriaxone	30	I or R	<b>16-22</b>	

### Methicillin resistance in *Staphylococcus aureus*

#### *Staphylococcus aureus* NCTC 12493

(CCUG 67181)

Methicillin resistant (MRSA), *mecA* positive

Antimicrobial agent	Disk content (µg)	Target susceptibility <sup>1</sup>	Range <sup>2</sup> (mm)	Comments
Cefoxitin	30	R	<b>14-20</b>	

### *vanB*-mediated glycopeptide resistance in enterococci

#### *Enterococcus faecalis* ATCC 51299

(NCTC 13379 ,CIP 104676, DSM 12956, CCUG 34289)

*vanB*-positive strain

Antimicrobial agent	Disk content (µg)	Target susceptibility <sup>1</sup>	Range <sup>2</sup> (mm)	Comments
Teicoplanin	30	S	<b>16-20</b>	
Vancomycin	5	R	<b>6-12</b>	Examine the zone edge closely from the front of the plate with the plate held up to light (transmitted light). Inhibition zones with fuzzy zone edges are interpreted as resistant, even if the zone diameter is above the susceptible breakpoint (for reading examples see the EUCAST Reading Guide or Breakpoint Tables).

### High-level aminoglycoside resistance in enterococci

#### *Enterococcus faecalis* ATCC 51299

(NCTC 13379 ,CIP 104676, DSM 12956, CCUG 34289)

High-level gentamicin and streptomycin resistant

Antimicrobial agent	Disk content (µg)	Target susceptibility <sup>1</sup>	Range <sup>2</sup> (mm)	Comments
Gentamicin	30	R	<b>6</b>	
Streptomycin	300	R	<b>6</b>	

## **Quality control strains for detection of resistance mechanisms with disk diffusion on Mueller-Hinton agar**

<sup>1</sup> Targets comply with EUCAST clinical breakpoints and are set to ensure that resistance mechanisms are correctly detected. Interpretation according to EUCAST clinical breakpoints: S="Susceptible, standard dosing regimen", I="Susceptible, increased exposure", R=Resistant.

<sup>2</sup> From Clinical and Laboratory Standards Institute, M100-S32, 2022, except ranges in bold/italics established by EUCAST. All ranges have been validated by EUCAST.

## Quality control strains for detection of resistance mechanisms with disk diffusion on Mueller-Hinton fastidious (MH-F) agar

See EUCAST Breakpoint Tables for short descriptions of MIC and disk diffusion methodology.

### Reduced susceptibility to $\beta$ -lactam agents due to PBP mutations in *Haemophilus influenzae*

*Haemophilus influenzae* ATCC 49247

(NCTC 12699, CIP 104604, DSM 9999, CCUG 26214)

Antimicrobial agent	Disk content ( $\mu$ g)	Target susceptibility <sup>1</sup>	Range <sup>2</sup> (mm)	Comments
				Inhibition zones with growth of small colonies up to the disk are interpreted as no zone. Read the outer edge of zones where an otherwise clear inhibition zone contains an area of growth around the disk (for reading examples see the EUCAST Reading Guide or Breakpoint Tables).
Ampicillin	2	R	<b>6-12</b>	
Benzylpenicillin	1 unit	R	<b>6-9</b>	

<sup>1</sup> Targets comply with EUCAST clinical breakpoints and are set to ensure that resistance mechanisms are correctly detected. Interpretation according to EUCAST clinical breakpoints: S="Susceptible, standard dosing regimen", I="Susceptible, increased exposure", R=Resistant.

<sup>2</sup> Established and validated by repeated testing by EUCAST.