

Table 4A-2. Disk Diffusion QC Ranges for Nonfastidious Organisms and β -Lactam Combination Agents^a

Antimicrobial Agent	Disk Content	QC Organisms and Characteristics								
		QC Strains Not Recommended for Routine QC of β -Lactam Combination Agents			QC Strains Recommended for Routine QC of β -Lactam Combination Agents					
		<i>Escherichia coli</i> ATCC ^{®b} 25922	<i>Pseudomonas aeruginosa</i> ATCC [®] 27853	<i>Staphylococcus aureus</i> ATCC [®] 25923	<i>Escherichia coli</i> ATCC [®] 35218 ^{c,d}	<i>Klebsiella pneumoniae</i> ATCC [®] 700603 ^{c,d,e}	<i>Escherichia coli</i> NCTC 13353 ^{c,d}	<i>Klebsiella pneumoniae</i> ATCC [®] BAA-1705 ^{TM,c,d}	<i>Klebsiella pneumoniae</i> ATCC [®] BAA-2814 TM	<i>Acinetobacter baumannii</i> NCTC 13304 ^{c,d}
		β -Lactamase Negative	Inducible AmpC	β -Lactamase Negative, <i>mecA</i> Negative	TEM-1	SHV-18 OXA-2 Mutations in <i>OmpK35</i> and <i>OmpK37</i> TEM-1	CTX-M-15 OXA-1	KPC-2 SHV	KPC-3 SHV-11 TEM-1	OXA-27
Zone Diameter QC Ranges, mm										
Amoxicillin-clavulanate (2:1)	20/10 μ g	18-24	–	28-36	17-22	–	–	–	–	–
Ampicillin	10 μ g	15-22	–	27-35	6	–	–	–	–	–
Ampicillin-sulbactam (2:1)	10/10 μ g	19-24	–	29-37	13-19	–	–	–	–	–
Aztreonam	30 μ g	28-36	23-29	–	31-38	10-16	–	–	–	–
Aztreonam-avibactam	30/20 μ g	32-38	24-30	–	31-38	26-32 ^f	–	–	–	–
Aztreonam-nacubactam (1:1)	10/20 μg	–	17-23	–	–	20-26	–	–	18-26	–
Cefepime	30 μ g	31-37	25-31	23-29	31-37	23-29	6-15 ^g	–	–	6-16 ^g
Cefepime-nacubactam (1:1)	10/20 μg	–	21-29	–	–	24-29	–	–	20-27	–
Cefepime-enmetazobactam ^f	30/20 μ g	32-38	26-32	–	32-38	26-32	27-33	–	–	–
Cefepime-taniborbactam	30/20 μ g	31-37	25-31	–	31-37	24-31	24-30	22-27	–	–
Cefepime-tazobactam	30/20 μ g	32-37	27-31	24-30	–	25-30 ^f	27-31	–	–	–
Cefepime-zidebactam	30/30 μ g	33-40	29-35	–	–	28-34	29-35	–	–	19-25
Cefotaxime	30 μ g	29-35	18-22	25-31	–	17-25	–	–	–	–

Table 4A-2. (Continued)

Antimicrobial Agent	Disk Content	QC Organisms and Characteristics								
		QC Strains Not Recommended for Routine QC of β -Lactam Combination Agents			QC Strains Recommended for Routine QC of β -Lactam Combination Agents					
		<i>Escherichia coli</i> ATCC ^{®b} 25922	<i>Pseudomonas aeruginosa</i> ATCC [®] 27853	<i>Staphylococcus aureus</i> ATCC [®] 25923	<i>Escherichia coli</i> ATCC [®] 35218 ^{c,d}	<i>Klebsiella pneumoniae</i> ATCC [®] 700603 ^{c,d,e}	<i>Escherichia coli</i> NCTC 13353 ^{c,d}	<i>Klebsiella pneumoniae</i> ATCC [®] BAA-1705 ^{TM,c,d}	<i>Klebsiella pneumoniae</i> ATCC [®] BAA-2814 TM	<i>Acinetobacter baumannii</i> NCTC 13304 ^{c,d}
		β -Lactamase Negative	Inducible AmpC	β -Lactamase Negative, <i>mecA</i> Negative	TEM-1	SHV-18 OXA-2 Mutations in <i>OmpK35</i> and <i>OmpK37</i> TEM-1	CTX-M-15 OXA-1	KPC-2 SHV	KPC-3 SHV-11 TEM-1	OXA-27
Zone Diameter QC Ranges, mm										
Cefpodoxime	10 μ g	23-28	—	19-25	—	9-16	—	—	—	—
Ceftaroline	30 μ g	26-34	—	26-35	—	—	—	—	—	—
Ceftaroline-avibactam	30/15 μ g	27-34	17-26	25-34	27-35	21-27 ^f	—	—	—	—
Ceftazidime	30 μ g	25-32	22-29	16-20	—	10-18	—	—	—	—
Ceftazidime-avibactam	30/20 μ g	27-35	25-31	16-22	28-35	21-27 ^f	—	—	—	—
Ceftibuten	30 μ g	—	—	—	—	—	15-23	—	—	—
Ceftibuten-avibactam	10/4 μ g	28-36	—	—	—	24-30	28-34	24-30	22-28	—
Ceftibuten-ledaborbactam	5/2.5 μ g	—	—	—	—	—	24-29	—	—	—
Ceftolozane-tazobactam	30/10 μ g	24-32	25-31	10-18	25-31	17-25	—	—	—	—
Ceftriaxone	30 μ g	29-35	17-23	22-28	—	16-24	—	—	—	—
Imipenem	10 μ g	26-32	20-28	—	—	25-33	—	11-22	6-14	—
Imipenem-relebactam ^f	10/25 μ g	27-33	26-31	—	—	26-32	—	23-29	22-28	—
Meropenem ^g	10 μ g	28-35	27-33	29-37	—	—	—	11-18 ^f	6 ^f	—
Meropenem-vaborbactam	20/10 μ g	31-37	29-35	32-38	—	29-35	—	21-27	16-20	—
Piperacillin	100 μ g	24-30	25-33	—	12-18	—	—	—	—	—

Table 4A-2
Nonfastidious Disk Diffusion QC for β -Lactam Combination Agents
CLSI M02

Table 4A-2. (Continued)

Antimicrobial Agent	Disk Content	QC Organisms and Characteristics								
		QC Strains Not Recommended for Routine QC of β -Lactam Combination Agents			QC Strains Recommended for Routine QC of β -Lactam Combination Agents					
		<i>Escherichia coli</i> ATCC [®] 25922	<i>Pseudomonas aeruginosa</i> ATCC [®] 27853	<i>Staphylococcus aureus</i> ATCC [®] 25923	<i>Escherichia coli</i> ATCC [®] 35218 ^{c,d}	<i>Klebsiella pneumoniae</i> ATCC [®] 700603 ^{c,d,e}	<i>Escherichia coli</i> NCTC 13353 ^{c,d}	<i>Klebsiella pneumoniae</i> ATCC [®] BAA-1705 ^{TM,c,d}	<i>Klebsiella pneumoniae</i> ATCC [®] BAA-2814 TM	<i>Acinetobacter baumannii</i> NCTC 13304 ^{c,d}
		β -Lactamase Negative	Inducible AmpC	β -Lactamase Negative, <i>mecA</i> Negative	TEM-1	SHV-18 OXA-2 Mutations in OmpK35 and OmpK37 TEM-1	CTX-M-15 OXA-1	KPC-2 SHV	KPC-3 SHV-11 TEM-1	OXA-27
Zone Diameter QC Ranges, mm										
Piperacillin-tazobactam	100/10 μ g	24-30	25-33	27-36	24-30	—	—	—	—	—
Sulbactam-durlobactam	10/10 μ g	26-32	—	—	—	—	—	—	—	24-30
Ticarcillin	75 μ g	24-30	21-27	—	6	—	—	—	—	—
Ticarcillin-clavulanate	75/10 μ g	24-30	20-28	29-37	21-25	—	—	—	—	—

Abbreviations: ATCC[®], American Type Culture Collection; MIC, minimal inhibitory concentration; NCTC, National Collection of Type Cultures; QC, quality control.

QC strain selection codes:

- QC strain is recommended for routine QC; any strain for which the QC range is highlighted in green may be used for this antimicrobial agent.
- Test 1 of these agents, highlighted in orange, by a disk diffusion or MIC method to confirm the integrity of the respective QC strain.^{c,d}

Footnotes

- Unsupplemented Mueller-Hinton medium. See Table 4A-1 for QC ranges for combination agents from other drug classes.
- ATCC[®] is a registered trademark of the American Type Culture Collection. Per ATCC[®] convention, the trademark symbol is used after “BAA” in each catalog number, in conjunction with the registered ATCC[®] name.
- Careful attention to organism maintenance (eg, minimal subcultures) and storage (eg, -60°C or below) is especially important for these QC strains because spontaneous loss of the plasmid encoding the β -lactamase has been documented. If stored at temperatures above -60°C or if repeatedly subcultured, these strains may lose their resistance characteristics and QC results may be outside the acceptable ranges.

Table 4A-2. (Continued)

- d. To confirm the integrity of the QC strain, test 1 of the single β -lactam agents highlighted in orange by either a disk diffusion or MIC test method when the strain is first subcultured from a frozen or lyophilized stock culture. In some cases, only MIC ranges are available to accomplish this confirmation (see Table 5A-2). In-range results for the single agent indicate the QC strain is reliable for QC of β -lactam combination agents. It is not necessary to check the QC strain again with a single agent until a new frozen or lyophilized stock culture is put into use, providing recommendations for handling QC strains as described in CLSI M02¹ and CLSI M07² are followed.
- e. Strain may demonstrate 2 colony morphologies: 1) opaque and cream colored and 2) translucent. Both colony morphologies can be used.
- f. QC ranges were established using data from only 1 disk manufacturer. Disks from other manufacturers were not available at the time of testing.
- g. If discrete colonies or a haze of growth are present inside the zone of inhibition, measure the colony-free inner zone.

NOTE: Information in boldface type is new or modified since the previous edition.

References for Table 4A-2

- ¹ CLSI. *Performance Standards for Antimicrobial Disk Susceptibility Tests*. 14th ed. CLSI standard M02. Clinical and Laboratory Standards Institute; 2024.
- ² CLSI. *Methods for Dilution Antimicrobial Susceptibility Tests for Bacteria That Grow Aerobically*. 12th ed. CLSI standard M07. Clinical and Laboratory Standards Institute; 2024.