

European Committee on Antimicrobial Susceptibility Testing

Routine and extended internal quality control as recommended by EUCAST

Version 5.0, valid from 2015-01-09

This document should be cited as

"The European Committee on Antimicrobial Susceptibility Testing. Routine and extended internal quality control as recommended by EUCAST. Version 5.0, 2015. <http://www.eucast.org>."

General	Page
Notes	1
Changes	2

Routine quality control	Page
<i>Escherichia coli</i> ATCC 25922	3
<i>Escherichia coli</i> ATCC 35218	5
<i>Pseudomonas aeruginosa</i> ATCC 27853	6
<i>Staphylococcus aureus</i> ATCC 29213	7
<i>Enterococcus faecalis</i> ATCC 29212	8
<i>Streptococcus pneumoniae</i> ATCC 49619	9
<i>Haemophilus influenzae</i> NCTC 8468	10
<i>Haemophilus influenzae</i> ATCC 49766	11
<i>Campylobacter jejuni</i> ATCC 33560	12

Extended quality control for detection of resistance mechanisms with disk diffusion	Page
<i>Klebsiella pneumoniae</i> ATCC 700603	13
<i>Staphylococcus aureus</i> NCTC 12493	13
<i>Enterococcus faecalis</i> ATCC 51299	13
<i>Haemophilus influenzae</i> ATCC 49247	14

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 ≥ 10 , the mode MIC should be the target value and the mean zone diameter should be close to the target value.

2. For access to ISO standard documents, see http://www.eucast.org/documents/external_documents/.

3. EUCAST quality control strains for routine QC are used to monitor test performance. Control tests should be set up and checked daily, at least for antibiotic agents which are part of routine panels. For analysis of the QC test results, see [EUCAST Disk Diffusion Manual](#), section 9.

4. *E. coli* ATCC 35218 (TEM-1 β -lactamase-producing strain) is recommended to check the inhibitor component of penicillin inhibitor-combination disks for antimicrobial susceptibility testing of Enterobacteriaceae and should be part of the routine QC. *E. coli* ATCC 25922 is used to check the active component.

5. EUCAST quality control strains for extended QC are complementary to the EUCAST routine quality control strains. These strains are recommended for detection of specific resistance mechanisms (ESBL, MRSA, VRE, HLRG and PBP mutations) and are used to check that routine susceptibility testing will result in the correct S, I and R categorisation. 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 5.0 2015-01-09	Changes Cells containing a change or an addition from EUCAST Routine QC tables v. 4.0 or Extended QC tables v 1.0 are marked yellow.
General	EUCAST QC strains for routine and extended quality control presented in one table.
ATCC 25922	New recommendations for quality control of penicillin inhibitor-combination disks.
ATCC 35218	Included in routine quality control of penicillin inhibitor-combination disks. QC ranges added: Amoxicillin-clavulanic acid, ampicillin-sulbactam and piperacillin-tazobactam (MIC). Ticarcillin-clavulanic acid (MIC and zone diameter).
ATCC 49619	Alternative test with <i>S. aureus</i> ATCC 29213 added for oxacillin 1 µg.
NCTC 8468	<i>H. influenzae</i> NCTC 8468 exhibits unusual growth characteristics and will be excluded from 2016.
ATCC 49766	QC ranges added: Amoxicillin MIC range. Zone diameter ranges for amoxicillin-clavulanic acid, ampicillin, benzylpenicillin, cefepime, cefixime, cefotaxime, cefpodoxime, cefuroxime, chloramphenicol, doripenem, ertapenem, erythromycin, imipenem, meropenem, minocycline, nalidixic acid, rifampicin, telithromycin, tetracycline and trimethoprim-sulfamethoxazole.

***Escherichia coli* ATCC 25922**

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

Disk diffusion methodology: Mueller-Hinton agar, McFarland 0.5, air, 35±1°C, 18±2h. Read zone edges as the point showing no growth viewed from the back of the plate against a dark background illuminated with reflected light.

Antimicrobial agent	MIC (mg/L)		Disk content (µg)	Inhibition zone diameter (mm)	
	Target ¹	Range ²		Target ¹	Range ³
Amikacin	1-2	0.5-4	30	23	19-26
Amoxicillin	4	2-8	-	-	-
Amoxicillin-clavulanic acid ^{4,5}	4	2-8	20-10	21	18-24 ⁶
Ampicillin	4	2-8	10	19	15-22 ⁶
Ampicillin-sulbactam ^{5,7}	2	1-4	10-10	22	19-24 ⁶
Aztreonam	0.125	0.06-0.25	30	32	28-36
Cefadroxil	-	-	30	17	14-20
Cefalexin	8	4-16	30	18	15-21
Cefepime	0.03-0.06	0.016-0.125	30	34	31-37
Cefixime	0.5	0.25-1	5	25	23-27
Cefotaxime	0.06	0.03-0.125	5	28	25-31
Cefoxitin	4	2-8	30	26	23-29
Cefpodoxime	0.5	0.25-1	10	26	23-28
Ceftaroline	0.06	0.03-0.125 ³	5	27	24-30
Ceftazidime	0.125-0.25	0.06-0.5	10	26	23-29
Ceftibuten	0.25	0.125-0.5	30	31	27-35
Ceftobiprole	0.06	0.03-0.125 ³	IP	IP	IP
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	35	30-40
Colistin	0.5-1	0.25-2	-	-	-
Doripenem	0.03	0.016-0.06	10	31	27-35
Ertapenem	0.008	0.004-0.016	10	33	29-36
Fosfomycin ⁸	1	0.5-2 ³	-	-	-
Gentamicin	0.5	0.25-1	10	23	19-26
Imipenem	0.125	0.06-0.25	10	29	26-32
Levofloxacin	0.016-0.03	0.008-0.06	5	33	29-37
Mecillinam	0.06-0.125	0.03-0.25	10	27	24-30
Meropenem	0.016-0.03	0.008-0.06	10	31	28-34
Moxifloxacin	0.016-0.03	0.008-0.06	5	32	28-35
Nalidixic acid	2	1-4	30	25	22-28
Netilmicin	-	≤0.5-1	10	21	18-24
Nitrofurantoin	8	4-16	100	20	17-23
Norfloxacin	0.06	0.03-0.125	10	32	28-35
Ofloxacin	0.03-0.06	0.016-0.125	5	31	29-33
Pefloxacin	-	-	5	29	26-32
Piperacillin	2	1-4	30	24	21-27
Piperacillin-tazobactam ^{5,9}	2	1-4	30-6	24	21-27
Ticarcillin	8	4-16	75	27	24-30
Ticarcillin-clavulanic acid ^{4,5}	8	4-16	75-10	27	24-30
Tigecycline ¹⁰	0.125	0.03-0.25	15	24	20-27
Tobramycin	0.5	0.25-1	10	22	18-26
Trimethoprim	1	0.5-2	5	25	21-28
Trimethoprim-sulfamethoxazole ¹¹	≤0.5 ²	-	1.25-23.75	26	23-29

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

¹ Calculated by EUCAST.

² From International Standards Organisation, ISO 20776-1: 2006 (with updates as in the latest CLSI M100 document), except ranges in bold/italics established by EUCAST.

³ From Clinical and Laboratory Standards Institute, M100-S25, 2015, except ranges in bold/italics established by EUCAST. All ranges have been validated by EUCAST.

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

⁵ *E. coli* ATCC 35218 (TEM-1 β -lactamase-producing strain) is used to check the inhibitor component.

⁶ Ignore growth that may appear as a thin inner zone on some batches of Mueller-Hinton agar.

⁷ For MIC testing, the concentration of sulbactam is fixed at 4 mg/L.

⁸ For fosfomycin MIC determination, the medium must be supplemented with glucose-6-phosphate to a final concentration of 25 mg/L.

⁹ For MIC testing, the concentration of tazobactam is fixed at 4 mg/L.

¹⁰ For tigecycline broth microdilution MIC determination, the medium must be prepared fresh on the day of use.

¹¹ Trimethoprim:sulfamethoxazole in the ratio 1:19. MIC values are expressed as the trimethoprim concentration.

IP = In Preparation

***Escherichia coli* ATCC 35218**

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

TEM-1 β -lactamase-producing strain (non-ESBL) used to check the inhibitor component of penicillin inhibitor combination disks.**Disk diffusion methodology:** Mueller-Hinton agar, McFarland 0.5, air, 35±1°C, 18±2h. Read zone edges as the point showing no growth viewed from the back of the plate against a dark background illuminated with reflected light.

Antimicrobial agent	MIC (mg/L)		Disk content (μ g)	Inhibition zone diameter (mm)	
	Target ¹	Range ²		Target ¹	Range ²
Amoxicillin-clavulanic acid ³	8-16	4-32	20-10	20	17-22 ⁴
Ampicillin-sulbactam ⁵	32-64	16-128	10-10	16	13-19 ⁴
Piperacillin-tazobactam ⁶	1	0.5-2	30-6	24	21-27
Ticarcillin-clavulanic acid ³	16	8-32	75-10	23	21-25

¹ Calculated by EUCAST.² From Clinical and Laboratory Standards Institute, M100-S25, 2015, except ranges in bold/italics established by EUCAST. All ranges have been validated by EUCAST.³ For MIC testing, the concentration of clavulanic acid is fixed at 2 mg/L.⁴ Ignore growth that may appear as a thin inner zone on some batches of Mueller-Hinton agar.⁵ For MIC testing, the concentration of sulbactam is fixed at 4 mg/L.⁶ For MIC testing, the concentration of tazobactam is fixed at 4 mg/L.

***Pseudomonas aeruginosa* ATCC 27853**

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

Disk diffusion methodology: Mueller-Hinton agar, McFarland 0.5, air, 35±1°C, 18±2h. Read zone edges as the point showing no growth viewed from the back of the plate against a dark background illuminated with reflected light.

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

¹ Calculated by EUCAST.

² From International Standards Organisation, ISO 20776-1: 2006 (with updates as in the latest CLSI M100 document).

³ From Clinical and Laboratory Standards Institute, M100-S25, 2015, except ranges in bold/italics established by EUCAST. All ranges have been validated by EUCAST.

⁴ For fosfomycin MIC determination, the medium must be supplemented with glucose-6-phosphate to a final concentration of 25 mg/L.

⁵ For MIC testing, the concentration of tazobactam is fixed at 4 mg/L.

⁶ For MIC testing, the concentration of clavulanic acid is fixed at 2 mg/L.

***Staphylococcus aureus* ATCC 29213**

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

 β -lactamase-producing strain (weak)

Disk diffusion methodology: Mueller-Hinton agar, McFarland 0.5, air, 35±1°C, 18±2h. Read zone edges as the point showing no growth viewed from the back of the plate against a dark background illuminated with reflected light.

Antimicrobial agent	MIC (mg/L)		Disk content (µg)	Inhibition zone diameter (mm)	
	Target ¹	Range ²		Target ¹	Range ³
Amikacin	2	1-4	30	21	18-24
Ampicillin	-	-	2	18	15-21
Azithromycin	1	0.5-2	-	-	-
Benzyloxyethylpenicillin	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 ⁴	5	27	24-30
Ceftobiprole	0.25-0.5	0.125-1 ⁴	IP	IP	IP
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
Daptomycin ⁵	0.25-0.5	0.125-1	-	-	-
Doxycycline	0.25	0.125-0.5	-	-	-
Erythromycin	0.5	0.25-1	15	26	23-29
Fosfomycin ⁶	1-2	0.5-4 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
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	0.125	0.06-0.25	200	34	31-37
Netilmicin	≤0.25 ²	-	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
Quinupristin-dalfopristin	0.5	0.25-1	15	24	21-27
Rifampicin	0.008	0.004-0.016	5	33	30-36
Teicoplanin	0.5	0.25-1	-	-	-
Telavancin ⁷	0.06	0.03-0.125	-	-	-
Tetracycline	0.25-0.5	0.125-1	30	27	23-31
Tigecycline ⁸	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 ⁹	≤0.5 ²	-	1.25-23.75	29	26-32
Vancomycin	1	0.5-2	-	-	-

¹ Calculated by EUCAST.² From International Standards Organisation, ISO 20776-1: 2006 (with updates as in the latest CLSI M100 document).³ Established and validated by EUCAST.⁴ From Clinical and Laboratory Standards Institute, M100-S25, 2015, and validated by EUCAST.⁵ For daptomycin MIC determination, the medium must be supplemented with Ca²⁺ to a final concentration of 50 mg/L.⁶ For fosfomycin MIC determination, the medium must be supplemented with glucose-6-phosphate to a final concentration of 25 mg/L.⁷ For telavancin MIC determination, the medium must be supplemented with polysorbate-80 to a final concentration of 0.002%.⁸ For tigecycline broth microdilution MIC determination, the medium must be prepared fresh on the day of use.⁹ 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)

Disk diffusion methodology: Mueller-Hinton agar, McFarland 0.5, air, 35±1°C, 18±2h. Read zone edges as the point showing no growth viewed from the back of the plate against a dark background illuminated with reflected light.

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

¹ Calculated by EUCAST.

² From International Standards Organisation, ISO 20776-1: 2006 (with updates as in the latest CLSI M100 document).

³ Established and validated by EUCAST.

⁴ Screening disk for high-level aminoglycoside-resistance in enterococci.

⁵ For tigecycline broth microdilution MIC determination, the medium must be prepared fresh on the day of use.

⁶ From Clinical and Laboratory Standards Institute, M100-S25, 2015.

⁷ Trimethoprim:sulfamethoxazole in the ratio 1:19. MIC values are expressed as the trimethoprim concentration.

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 α -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 α -haemolysis but on some MH-F media, there is additional α -haemolysis without growth.

Disk diffusion methodology: Mueller-Hinton agar + 5% defibrinated horse blood and 20 mg/L β -NAD, McFarland 0.5, 5% CO₂, 35±1°C, 18±2h. Read zone edges as the point showing no growth viewed from the front of the plate with the lid removed and with reflected light.

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

¹ Calculated by EUCAST.² From International Standards Organisation, ISO 20776-1: 2006 (with updates as in the latest CLSI M100 document).³ Established and validated by EUCAST.⁴ Clinical and Laboratory Standards Institute, M100-S25, 2015, and validated by EUCAST.⁵ For daptomycin MIC determination, the medium must be supplemented with Ca²⁺ to a final concentration of 50 mg/L.⁶ *S. aureus* ATCC 29213 can be used for quality control of oxacillin 1 μ g with target 22 mm and range 19-25 mm.⁷ For tigecycline broth microdilution MIC determination, the medium must be prepared fresh on the day of use.⁸ Trimethoprim:sulfamethoxazole in the ratio 1:19. MIC values are expressed as the trimethoprim concentration.

IP = In Preparation

***Haemophilus influenzae* NCTC 8468¹**
(CIP 54.94, CCUG 23946)

Disk diffusion methodology: Mueller-Hinton agar + 5% defibrinated horse blood and 20 mg/L β -NAD, McFarland 0.5, 5% CO₂, 35±1°C, 18±2h. Read zone edges as the point showing no growth viewed from the front of the plate with the lid removed and with reflected light.

Antimicrobial agent	MIC (mg/L)		Disk content (µg)	Inhibition zone diameter (mm)	
	Target ²	Range		Target ²	Range ³
Amoxicillin-clavulanic acid	Note ¹	Note ¹	2-1	20	17-23
Ampicillin	Note ¹	Note ¹	2	22	19-25
Benzylpenicillin	Note ¹	Note ¹	1 unit	16	13-19
Cefaclor	Note ¹	Note ¹	30	27	24-30
Cefepime	Note ¹	Note ¹	30	32	29-35
Cefixime	Note ¹	Note ¹	5	30	27-33
Cefotaxime	Note ¹	Note ¹	5	32	29-35
Cefpodoxime	Note ¹	Note ¹	10	31	28-34
Ceftaroline	Note ¹	Note ¹	5	-	-
Ceftibuten	Note ¹	Note ¹	30	33	30-36
Ceftriaxone	Note ¹	Note ¹	30	37	33-41
Cefuroxime	Note ¹	Note ¹	30	28	25-31
Chloramphenicol	Note ¹	Note ¹	30	34	30-38
Ciprofloxacin	Note ¹	Note ¹	5	35	31-39
Doripenem	Note ¹	Note ¹	10	29	26-32
Ertapenem	Note ¹	Note ¹	10	30	27-33
Erythromycin	Note ¹	Note ¹	15	15	12-18
Imipenem	Note ¹	Note ¹	10	28	25-31
Levofloxacin	Note ¹	Note ¹	5	35	32-38
Meropenem	Note ¹	Note ¹	10	31	28-34
Minocycline	Note ¹	Note ¹	30	30	27-33
Moxifloxacin	Note ¹	Note ¹	5	32	29-35
Nalidixic acid	Note ¹	Note ¹	30	30	27-33
Ofloxacin	Note ¹	Note ¹	5	33	30-36
Rifampicin	Note ¹	Note ¹	5	23	20-26
Telithromycin	Note ¹	Note ¹	15	18	15-21
Tetracycline	Note ¹	Note ¹	30	31	28-34
Trimethoprim-sulfamethoxazole	Note ¹	Note ¹	1.25-23.75	30	26-34

¹ *H. influenzae* NCTC 8468 exhibits unusual growth characteristics and will be excluded from 2016.

² Calculated by EUCAST.

³ Established and validated by EUCAST.

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

Disk diffusion methodology: Mueller-Hinton agar + 5% defibrinated horse blood and 20 mg/L β -NAD, McFarland 0.5, 5% CO₂, 35±1°C, 18±2h. Read zone edges as the point showing no growth viewed from the front of the plate with the lid removed and with reflected light.

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

¹ Calculated by EUCAST.

² Established and validated by EUCAST.

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

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

⁵ From Clinical and Laboratory Standards Institute, M100-S25, 2015, and validated by EUCAST.

⁶ 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 702, DSM 4688, CCUG 11284)

Disk diffusion methodology: Mueller-Hinton agar + 5% defibrinated horse blood and 20 mg/L β -NAD, McFarland 0.5, microaerobic environment, 41±1°C, 24h. Read zone edges as the point showing no growth viewed from the front of the plate with the lid removed and with reflected light. The MH-F plates should be dried prior to inoculation to reduce swarming (at 20-25°C over night or at 35°C, with the lid removed, for 15 min).

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

¹ Calculated by EUCAST.

² Established and validated by EUCAST.

IP = In Preparation

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

Disk diffusion methodology: Mueller-Hinton agar, McFarland 0.5, air, 35±1°C, 18±2h. Read zone edges as the point showing no growth viewed from the back of the plate against a dark background illuminated with reflected light.

Klebsiella pneumoniae ATCC 700603

(NCTC 13368, CCUG 45421, CECT 7787)

SHV-18 ESBL producer

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

Staphylococcus aureus NCTC 12493

Methicillin resistant (MRSA), *mecA* positive

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

Enterococcus faecalis ATCC 51299

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

High-level gentamicin resistant (HLGR)

Antimicrobial agent	Disk content (µg)	Target susceptibility ¹	Range ² (mm)	Comments
Gentamicin	30	R	6	
Teicoplanin	30	S	16-20	
Vancomycin	5	R	6-12	Examine zone edge with transmitted light (plate held up to light). Inhibition zones with fuzzy zone edges are interpreted as resistant, even if the zone diameter is above the susceptible breakpoint.

¹ 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, I=Intermediate, R=Resistant.

² From Clinical and Laboratory Standards Institute, M100-S25, 2015, 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

Disk diffusion methodology: Mueller-Hinton agar + 5% defibrinated horse blood and 20 mg/L β -NAD, McFarland 0.5, 5% CO₂, 35±1°C, 18±2h. Read zone edges as the point showing no growth viewed from the front of the plate with the lid removed and with reflected light.

Haemophilus influenzae ATCC 49247

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

Reduced susceptibility to β -lactam agents due to mutations in genes coding for PBP enzymes.

Antimicrobial agent	Disk content (μ g)	Target susceptibility ¹	Range ² (mm)	Comments
				Inhibition zone diameters are particularly affected by variation in medium, inoculum and incubation conditions. Inhibition zones with growth of small colonies within the zone are interpreted as 6 mm (no zone).
Ampicillin	2	R	6-12	
Benzympenicillin	1 unit	R	6-9	

¹ 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, I=Intermediate, R=Resistant.

² Established and validated by repeated testing by EUCAST.