EUCAST EUROPEAN COMMITTEE ON ANTIMICROBIAL SUSCEPTIBILITY TESTING

European Society of Clinical Microbiology and Infectious Diseases

European Committee on Antimicrobial Susceptibility Testing

Routine and extended internal quality control for MIC determination and agar dilution for yeasts, moulds and dermatophytes as recommended by EUCAST

Version 5.0, valid from 2020-09-24

This document should be cited as: "The European Committee on Antimicrobial Susceptibility Testing. Routine and extended internal quality control for MIC determination and agar dilution for yeasts, moulds and dermatophytes as recommended by EUCAST. Version 5.0, 2020. http://www.eucast.org."

General	**Page**
Notes	1
Changes	2

Routine quality control	**Page**
Recommended strains for routine quality control	3
One-page Summary of MIC targets and ranges for yeast and mould testing	4
Candida krusei ATCC 6258	5
Candida parapsilosis ATCC 22019	6
Candida albicans CNM-CL F8555	7
Candida krusei CNM-CL-3403	8
Aspergillus fumigatus ATCC 204305	9
Aspergillus flavus ATCC 204304	10
Aspergillus flavus CNM-CM-1813	11
Aspergillus fumigatus SSI-4524	12
Aspergillus fumigatus SSI-5586	13
Trichophyton interdigitale SSI-9363	14
Trichophyton rubrum SSI-7583	15

Notes

Version 5.0, valid from 2020-09-24

1. In EUCAST quality control (QC) tables, both ranges and targets are listed. Repeat testing of EUCAST quality control strains should yield individual MIC values randomly distributed within the recommended ranges. If the number of tests is ≥10, the mode MIC should be the target value.

2. Ranges and targets are established by EUCAST.

3. EUCAST quality control strains for routine QC are used to monitor the entire test performance (material, inoculum, incubation, reading etc). At least 2 quality control strains with different target MICs should be tested at regular intervals, or if panels are used irregularly with every panel set up for clinical use or research purposes. Mould QC strains should always be included for antifungal susceptibility testing of mould, specially when using the azole resistance agar-screening method (E.Def 10.1).

4. QC ranges are presented both as a one-page summary and in separate tables for each strain. Both tables contain the same data.

5. For information about the reference methods for susceptibility testing of yeast and moulds see "Methods in antifungal susceptibility testing of yeasts E.Def 7.3.2", "Methods in antifungal susceptibility testing of moulds E.Def 9.3.2 and 10.1", and "Methods in antifungal susceptibility testing of dermatophytes E.Def 11.0, respectively.

6. ATCC: American Type Culture Collection.

7. CNM-CL: Yeast collection of the Spanish National Centre of Microbiology. The QC strain is deposited in the Culture Collection University of Gothenburg https://www.ccug.se/ from where will be available.

8. *A. fumigatus* SSI-4524: a QC strain harbouring TR34/L98H substitution for quality control of azole-containing agar plates. The QC strain is deposited in the Culture Collection University of Gothenburg https://www.ccug.se/ from where will be available.

9. *A. fumigatus* SSI-5586: a QC harbouring G54W substitution for quality control of azole-containing agar plates. The QC strain is deposited in the Culture Collection University of Gothenburg https://www.ccug.se/ from where will be available

10. *T. interdigitale* SSI-9363: The QC strain is deposited in the Culture Collection University of Gothenburg https://www.ccug.se/ from where will be available.

11. *T. rubrum* SSI-7583: The QC strain is deposited in the Culture Collection University of Gothenburg https://www.ccug.se/ from where will be available.

Changes from previous version

Version 5.0, valid from 2020-09-24	**Changes** Cells containing a change or an addition from EUCAST QC Tables v. 4.0 are marked yellow (Format changes are not marked yellow).
1. Notes	The microdilution method versions have been updated from 7.3.1 to 7.3.2 and from 9.3.1 to 9.3.2, respectively, and the agar screening metod E.Def 10.1 and the dermatophyte method E.Def 11.0 have been added.
4. Summary Antifungals QCs	Dermatophytes have been included in the text describing recommendations for citation. Terbinafine target and range MICs have been included for *A. flavus* ATCC 204304 and *A. flavus* CLM-CM1813
Sheets, 5-11	The microdilution method versions have been updated from 7.3.1 to 7.3.2 and from 9.3.1 to 9.3.2, respectively.
10. ATCC 204304	Terbinafine target and range MICs have been included for *A. flavus* ATCC 204304.
11. CNM-CM1813	Terbinafine target and range MICs have been included for *A. flavus* CLM-CM1813.
14. SSI-9396	*Trichophyton interdigitale* SSI-9363 has been added with tentative targets and ranges.
15 SSI-7583	*Trichophyton rubrum* SSI-7583 has been added with tentative targets and ranges.

EUCAST EUROPEAN COMMITTEE ON ANTIMICROBIAL SUSCEPTIBILITY TESTING
European Society of Clinical Microbiology and Infectious Diseases

Version 5.0, valid from 2020-09-24

Routine quality control

Candida krusei ATCC 6258
Candida parapsilosis ATCC 22019
Candida albicans CNM-CL F8555
Candida krusei CNM-CL-3403
Aspergillus fumigatus ATCC 204305
Aspergillus flavus ATCC 204304
Aspergillus flavus CNM-CM-1813
Aspergillus fumigatus SSI-4524
Aspergillus fumigatus SSI-5586
Trichophyton interdigitale SSI-9396
Trichophyton rubrum SSI-7583

European Subcommittee on Antifungal Susceptibility Testing (EUCAST AFST)

Routine and extended internal quality control for antifungal susceptibility as recommended by EUCAST

Version 5.0, valid from 2020-09-24

This document should be cited as: "The European Committee on Antimicrobial Susceptibility Testing. Routine and extended internal quality control for MIC determination and agar dilution for yeasts, moulds and dermatophytes as recommended by EUCAST. Version 5.0, 2020. http://www.eucast.org."

QC strains	Drug MICs (mg/L)																			
	Amphotericin B		Anidulafungin		Fluconazole		5-FC		Isavuconazole		Itraconazole		Micafungin		Voriconazole		Posaconazole		Terbinafine	
	Target	Range	Target	Range	Target	Range	Target	Range	Target	Range	Target	Range	Target	Range	Target	Range	Target	Range	Target	Range
Candida krusei ATCC 6258	0.25-0.5	0.125-1	0.03	0.016-0.06	32	16-64	2	1-4	0.03	0.016-0.06	0.06	0.03-0.125	0.06	0.03-0.125	0.06-0.125	0.03-0.25	0.03	0.016-0.06	-	-
Candida parapsilosis ATCC 22019	0.25-0.5	0.125-1	0.5	0.25-1	1	0.5-2	0.25	0.125-0.5	0.016	0.008-0.03	0.06	0.03-0.125	1	0.5-2	0.03	0.016-0.06	0.03	0.016-0.06	-	-
Candida albicans CNM-CL F8555	0.125-0.25	0.06-0.5	-	-	64	32-128	0.125	0.06-0.25	-	-	0.5	0.25-1	-	-	1	0.5-2	0.25	0.125-0.5	-	-
Candida krusei CNM-CL-3403	0.5	0.25-1	-	-	32	16-64	4	2-8	-	-	0.25	0.125-0.5	-	-	0.25	0.125-0.5	0.125	0.06-0.25	-	-
Aspergillus fumigatus ATCC 204305	0.5	0.25-1	-	-	-	-	-	-	-	-	0.25	0.125-0.5	-	-	0.5	0.25-1	0.06-0.125	0.03-0.25	-	-
Aspergillus flavus ATCC 204304	1	0.5-2	-	-	-	-	-	-	-	-	0.25	0.125-0.5	-	-	1	0.5-2	0.25	0.125-0.5	0.5	0.25-1
Aspergillus flavus CNM-CM-1813	2	1-4	-	-	-	-	-	-	-	-	0.25	0.125-0.5	-	-	1	0.5-2	0.25	0.125-0.5	0.5	0.25-1
Trichophyton interdigitale SSI-9363*											[0.06]	[0.03-0.25]			[0.25]	[0.125-1]			[0.016]	[0.016-0.06]
Trichophyton rubrum SSI-7583*											[0.016]	[0.008-0.03]			[0.03]	[0.008-0.03]			[0.016]	[0.008-0.03]

* Targets and ranges for *Trichophyton* isolates are tentative hence in brackets.

E.Def 10.1 Growth scoring and interpretation on azole screening agar plates for EUCAST recommended QC strains (two days of incubation)

Design of 4-well plate:

Itraconazole (4 mg/L)	Voriconazole (2 mg/L)
Posaconazole (0.5 mg/L)	Growth control (-)

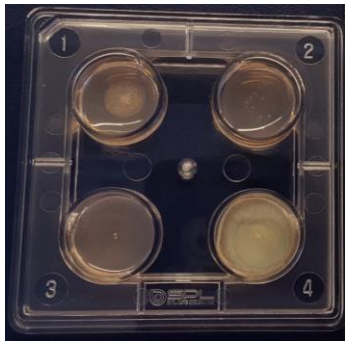
Score definition:

0: no visible growth;
0.5: 1-5 tiny colonies;
1: weak/minimal growth (either as >5 tiny colonies or confluent weak growth where the azole agar has been inoculated (covering ≤ half the well);
2: clearly visible growth with hyphal extension but not covering the entire well (and less than the control well);
3: un-inhibited prominent growth covering the majority of the well and similar to that in the control well.

Scores for QC strains:

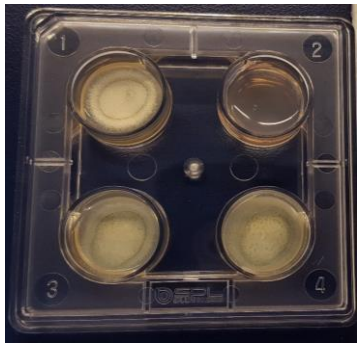
***Aspergillus fumigatus* SSI-4524**

2-3	0.5-2
0-1	3



***Aspergillus fumigatus* SSI-5586**

2-3	0
2-3	3



Candida krusei ATCC 6258[a]

Version 5.0, valid from 2020-09-24

See EUCAST E.Def 7.3.2 for MIC methodology

Antimicrobial agent	MIC[b] (mg/L)	
	Target	Range
Amphotericin B	0.25-0.5	0.125-1
Anidulafungin	0.03	0.016-0.06
Caspofungin	NA[c]	NA[c]
Fluconazole	32	16-64
Flucytosine	2	1-4
Isavuconazole	0.03	0.016-0.06
Itraconazole	0.06	0.03-0.125
Micafungin	0.06	0.03-0.125
Voriconazole	0.06-0.125	0.03-0.25
Posaconazole	0.03	0.016-0.06

[a] ATCC: American Type Culture Collection.

[b] *Candida* QC strains requires MIC reading in a spectrophotometer after one day of incubation.

[c] Not available.

Candida parapsilosis ATCC 22019[a]

Version 5.0, valid from 2020-09-24

See EUCAST E.Def 7.3.2 for MIC methodology

Antimicrobial agent	MIC[b] (mg/L)	
	Target	Range
Amphotericin B	0.25-0.5	0.125-1.0
Anidulafungin	0.5	0.25-1.0
Caspofungin	NA[c]	NA[c]
Fluconazole	1	0.5-2
Flucytosine	0.25	0.125-0.5
Isavuconazole	0.016	0.008-0.03
Itraconazole	0.06	0.03-0.125
Micafungin	1	0.5-2
Voriconazole	0.03	0.016-0.06
Posaconazole	0.03	0.016-0.06

[a] ATCC: American Type Culture Collection.

[b] *Candida* QC strains requires MIC reading in a spectrophotometer after one day of incubation.

[c] Not available.

Candida albicans CNM-CL F8555[a]

Version 5.0, valid from 2020-09-24

See EUCAST E.Def 7.3.2 for MIC methodology

Antimicrobial agent	MIC[b] (mg/L)	
	Target	**Range**
Amphotericin B	0.125-0.25	0.06-0.5
Anidulafungin	NA[c]	NA[c]
Caspofungin	NA[c]	NA[c]
Fluconazole	64	32-128
Flucytosine	0.125	0.06-0.25
Isavuconazole	NA[c]	NA[c]
Itraconazole	0.5	0.25-1
Micafungin	NA[c]	NA[c]
Voriconazole	1	0.5-2
Posaconazole	0.25	0.125-0.5

[a] CNM-CL: Yeast collection of the Spanish National Centre of Microbiology. The QC strain is deposited in the Culture Collection University of Gothenburg https://www.ccug.se/ from where will be available.

[b] *Candida* QC strains requires MIC reading in a spectrophotometer after one day of incubation.

[c] Not available.

Candida krusei CNM-CL 3403[a]

Version 5.0, valid from 2020-09-24

See EUCAST E.Def 7.3.2 for MIC methodology

Antimicrobial agent	MIC[b] (mg/L)	
	Target	Range
Amphotericin B	0.5	0.25-1
Anidulafungin	NA[c]	NA[c]
Caspofungin	NA[c]	NA[c]
Fluconazole	32	16-64
Flucytosine	4	2-8
Isavuconazole	NA[c]	NA[c]
Itraconazole	0.25	0.125-0.5
Micafungin	NA[c]	NA[c]
Voriconazole	0.25	0.125-0.5
Posaconazole	0.125	0.06-0.25

[a] CNM-CL: Yeast collection of the Spanish National Centre of Microbiology. The QC strain is deposited in the Culture Collection University of Gothenburg https://www.ccug.se/ from where will be available.

[b] *Candida* QC strains requires MIC reading in a spectrophotometer after one day of incubation.

[c] Not available.

Aspergillus fumigatus ATCC 204305[a]

Version 5.0, valid from 2020-09-24

See EUCAST E.Def 9.3.2 for MIC methodology

Antimicrobial agent	MIC[b] (mg/L)	
	Target	Range
Amphotericin B	0.5	0.25-1
Anidulafungin	NA[c]	NA[c]
Caspofungin	NA[c]	NA[c]
Fluconazole	NA[c]	NA[c]
Flucytosine	NA[c]	NA[c]
Isavuconazole	NA[c]	NA[c]
Itraconazole	0.25	0.125-0.5
Micafungin	NA[c]	NA[c]
Voriconazole	0.5	0.25-1
Posaconazole	0.06-0.125	0.03-0.25

[a] ATCC: American Type Culture Collection.

[b] *Aspergillus* QC strains should be read visually at a no growth inhibition endpoint after 2 days of incubation.

[c] Not available.

Aspergillus flavus ATCC 204304[a]

Version 5.0, valid from 2020-09-24

See EUCAST E.Def 9.3.2 for MIC methodology

Antimicrobial agent	MIC[b] (mg/L)	
	Target	Range
Amphotericin B	1	0.5-2
Anidulafungin	NA[c]	NA[c]
Caspofungin	NA[c]	NA[c]
Fluconazole	NA[c]	NA[c]
Flucytosine	NA[c]	NA[c]
Isavuconazole	NA[c]	NA[c]
Itraconazole	0.25	0.125-0.5
Micafungin	NA[c]	NA[c]
Terbinafine	0.5	0.25-1
Voriconazole	1	0.5-2
Posaconazole	0.25	0.125-0.5

[a] ATCC: American Type Culture Collection.

[b] *Aspergillus* QC strains should be read visually at a no growth inhibition endpoint after 2 days of incubation.

[c] Not available.

Aspergillus flavus CNM-CM 1813[a]

Version 5.0, valid from 2020-09-24

See EUCAST E.Def 9.3.2 for MIC methodology

Antimicrobial agent	MIC[b] (mg/L)	
	Target	Range
Amphotericin B	2	1-4
Anidulafungin	NA[c]	NA[c]
Caspofungin	NA[c]	NA[c]
Fluconazole	NA[c]	NA[c]
Flucytosine	NA[c]	NA[c]
Isavuconazole	NA[c]	NA[c]
Itraconazole	0.25	0.125-0.5
Micafungin	NA[c]	NA[c]
Terbinafine	0.5	0.25-1
Voriconazole	1	0.5-2
Posaconazole	0.25	0.125-0.5

[a] CNM-CM: Spanish National Centre for Microbiology, Filamentous Fungi Culture Collection. The QC strain is deposited in the Culture Collection Universisy of Gothenburg https://www.ccug.se/ from where will be available.

[b] *Aspergillus* QC strains should be read visually at a no growth inhibition endpoint after 2 days of incubation.

[c] Not available.

A. fumigatus SSI-5586 [a]

Version 5.0, valid from 2020-09-24

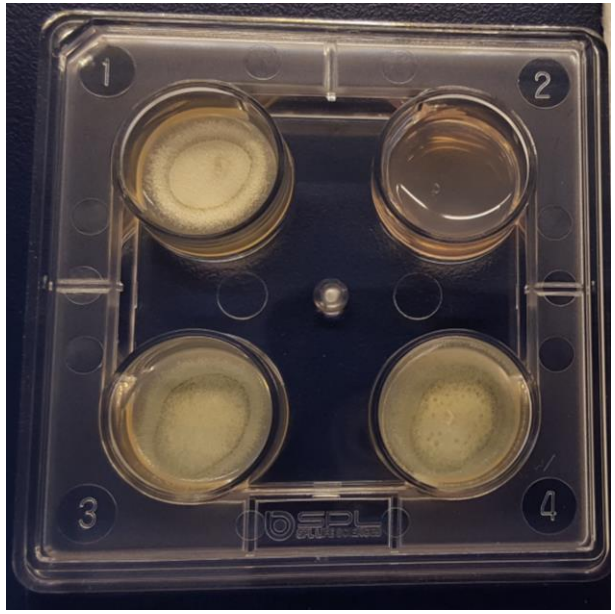
See EUCAST E.Def 10.1 for azole screening test

QC strain harbouring G54W substitution for quality control of azole-containing agar plates.

Well 1 (itraconazole 4 mg/L), well 2 (voriconazole 2 mg/L), well 3 (posaconazole 0.5 mg/L), and well 4 (drug free control well).

Score definition
0: no visible growth;
0.5: 1-5 tiny colonies;
1: weak/minimal growth (either as >5 tiny colonies or confluent weak growth where the agar has been inoculated (covering ≤ half the well));
2: clearly visible growth with hyphal extension but not covering the entire well (and less than the control well);
3: un-inhibited prominent growth covering the majority of the well and similar to that in the control well.

2-3	0
2-3	3



[a] SSI: Statens Serum Institut, Copenhagen, Denmark
The QC strain is deposited in the Culture Collection Universisy of Gothenburg https://www.ccug.se/ from where will be available during 2019

A. fumigatus SSI-4524 [a]

Version 5.0, valid from 2020-09-24

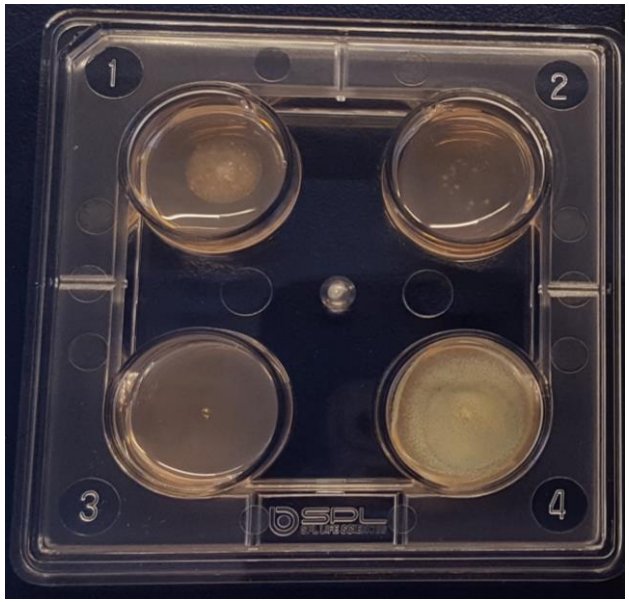
See EUCAST E.Def 10.1 for azole screening test

QC strain harbouring TR34/L98H substitution for quality control of azole-containing agar plates.

Well 1 (itraconazole 4 mg/L), well 2 (voriconazole 2 mg/L), well 3 (posaconazole 0.5 mg/L), and well 4 (drug free control well).

Score definition
0: no visible growth;
0.5: 1-5 tiny colonies;
1: weak/minimal growth (either as >5 tiny colonies or confluent weak growth where the agar has been inoculated (covering ≤ half the well));
2: clearly visible growth with hyphal extension but not covering the entire well (and less than the control well);
3: un-inhibited prominent growth covering the majority of the well and similar to that in the control well.

2-3	0.5-2
0-1	3



[a] SSI: Statens Serum Institut, Copenhagen, Denmark
The QC strain is deposited in the Culture Collection Universisy of Gothenburg https://www.ccug.se/ from where will be available.

Trichophyton interdigitale SSI-9363[a]

Version 5.0, valid from 2020-09-24

See EUCAST E.Def 11.0 for MIC methodology

Antimicrobial agent	MIC (mg/L)	
	Target	Range
Amorolfine	[0.125-0.25]	[0.03-0.25]
Amphotericin B	NA[b]	NA[b]
Anidulafungin	NA[b]	NA[b]
Caspofungin	NA[b]	NA[b]
Fluconazole	NA[b]	NA[b]
Flucytosine	NA[b]	NA[b]
Isavuconazole	NA[b]	NA[b]
Itraconazole	[0.06]	[0.03-0.25]
Micafungin	NA[b]	NA[b]
Terbinafine	[0.016]	[0.016-0.06]
Voriconazole	[0.25]	[0.125-1]
Posaconazole	NA[b]	NA[b]

[a] SSI: Statens Serum Institut, Copenhagen, Denmark. The QC strain is deposited in the Culture Collection University of Gothenburg https://www.ccug.se/ from where will be available.

[c] Not available.

Values indicated in brackets [] are tentative

Trichophyton rubrum SSI-7583[a]

Version 5.0, valid from 2020-09-24

See EUCAST E.Def 11.0 for MIC methodology

Antimicrobial agent	MIC (mg/L)	
	Target	Range
Amorolfine	[0.125]	[0.03-0.125]
Amphotericin B	NA[b]	NA[b]
Anidulafungin	NA[b]	NA[b]
Caspofungin	NA[b]	NA[b]
Fluconazole	NA[b]	NA[b]
Flucytosine	NA[b]	NA[b]
Isavuconazole	NA[b]	NA[b]
Itraconazole	[0.016]	[0.008-0.03]
Micafungin	NA[b]	NA[b]
Terbinafine	[0.016]	[0.008-0.03]
Voriconazole	[0.03]	[0.008-0.03]
Posaconazole	NA[b]	NA[b]

[a] SSI: Statens Serum Institut, Copenhagen, Denmark. The QC strain is deposited in the Culture Collection University of Gothenburg https://www.ccug.se/ from where will be available.

[c] Not available.
Values indicated in brackets [] are tentative