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 and moulds as recommended by EUCAST

Version 3.0, valid from 2019-04-04

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 and moulds as recommended by EUCAST. Version 3.0, 2019. 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

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 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 7.3.1" and "Methods in antifungal susceptibility testing of moulds E.Def 9.3.1 and 10.1", respectively.

6. ATCC: American Type Culture Collection.

7. CNM-CL: Yeast collection of the Spanish National Centre of Microbiology.
Available from the EUCAST Development Laboratory (EDL) for fungi:
http://www.eucast.org/organization/developmentlaboratories/

8. *A. fumigatus* SSI-4524: a QC strain harbouring TR34/L98H substitution for quality control of azole-containing agar plates.

9. *A. fumigatus* SSI-5586: a QC harbouring G54W substitution for quality control of azole-containing agar plates.

Changes from previous version

Version 3.0 **2019-03-27**	**Changes** Cells containing a change or an addition from EUCAST QC Tables v. 2.0 are marked yellow (Format changes are not marked yellow)
General	The format of the document has been aligned to the format of the corresponding QC document for antibacterials
	An overview sheet has been added presenting all targets and ranges in a one page format

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

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

European Subcommittee on Antifungal Susceptibility Testing (EUCAST AFST)

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

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 and moulds as recommended by EUCAST. Version 3.0, 27th of March 2019. http://www.eucast.org."

E.Def 7.3 and 9.3 MIC target and ranges for EUCAST recommended QC strains (MICs should be read after 24 ± 2 h of incubation for *Candida* QC strains and after 48 h of incubation for *Aspergillus* QC strains)

QC strains	Drug MICs (mg/L)																	
	Amphotericin B		Anidulafungin		Fluconazole		5-FC		Isavuconazole		Itraconazole		Micafungin		Voriconazole		Posaconazole	
	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	0.015-0.06	32	16-64	2	1-4	0.03	0.015-0.06	0.06	0.03-0.125	0.06	0.03-0.125	0.06-0.125	0.03-0.25	0.03	0.015-0.06
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	0.015	0.008-0.03	0.06	0.03-0.125	1	0.5-2	0.03	0.015-0.06	0.03	0.015-0.06
Candida albicans CNM-CL F8555	0.125-0.25	0.06-0.05	-	-	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
Aspergillus flavus CNM-CM-1813	2	1-4	-	-	-	-	-	-	-	-	0.25	0.125-0.5	-	-	1	0.5-2	0.25	0.125-0.5

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 (-)

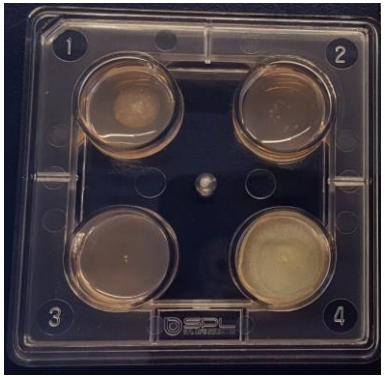
Score definition:

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:

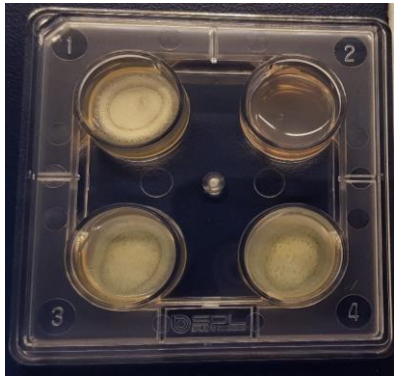
***Aspergillus fumigatus* SSI-4524**

1-3	0.5-2
0.5-1	3



***Aspergillus fumigatus* SSI-5586**

2-3	0
3	3



Candida krusei ATCC 6258[a]

See EUCAST E.Def 7.3.1 for MIC methodology

Antimicrobial agent	MIC[b] (mg/L)	
	Target	Range
Amphotericin B	0.25-0.5	0.125-1
Anidulafungin	0.03	0.015-0.06
Caspofungin	NA[c]	NA[c]
Fluconazole	32	16-64
Flucytosine	2	1-4
Isavuconazole	0.03	0.015-0.06
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	0.015-0.06

[a] ATCC: American Type Culture Collection.

[b] *Candida* QC strains requires MIC reading in a spectrophotometer (50% of growth inhibition compared to the drug-free control well) after one day of incubation.

[c] Not available.

Candida parapsilosis ATCC 22019[a]

See EUCAST E.Def 7.3.1 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	0.5-2.0
Flucytosine	0.25	0.125-0.5
Isavuconazole	0.015	0.008-0.03
Itraconazole	0.06	0.03-0.125
Micafungin	1	0.5-2.0
Voriconazole	0.03	0.015-0.06
Posaconazole	0.03	0.015-0.06

[a] ATCC: American Type Culture Collection.

[b] *Candida* QC strains requires MIC reading in a spectrophotometer (50% of growth inhibition compared to the drug-free control well) after one day of incubation.

[c] Not available.

Candida albicans CNM-CL F8555[a]

See EUCAST E.Def 7.3.1 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. Available from the EUCAST Development Laboratory (EDL) for fungi: http://www.eucast.org/organization/developmentlaboratories/

[b] *Candida* QC strains requires MIC reading in a spectrophotometer (50% of growth inhibition compared to the drug-free control well) after one day of incubation.

[c] Not available.

Candida krusei CNM-CL 3403[a]

See EUCAST E.Def 7.3.1 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. Available from the EUCAST Development Laboratory (EDL) for fungi: http://www.eucast.org/organization/developmentlaboratories/

[b] *Candida* QC strains requires MIC reading in a spectrophotometer (50% of growth inhibition compared to the drug-free control well) after one day of incubation.

[c] Not available.

Aspergillus fumigatus ATCC 204305[a]

See EUCAST E.Def 9.3.1 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

[c] Not available.

Aspergillus flavus ATCC 204304[a]

See EUCAST E.Def 9.3.1 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]
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]

See EUCAST E.Def 9.3.1 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]
Voriconazole	1	0.5-2
Posaconazole	0.25	0.125-0.5

[a] CNM-CM: Spanish National Centre for Microbiology, Filamentous Fungi Culture Collection. Available from the EUCAST Development Laboratory (EDL) for fungi: http://www.eucast.org/organization/developmentlaboratories/.

[b] *Aspergillus* QC strains should be read visually at a no growth

[c] Not available.

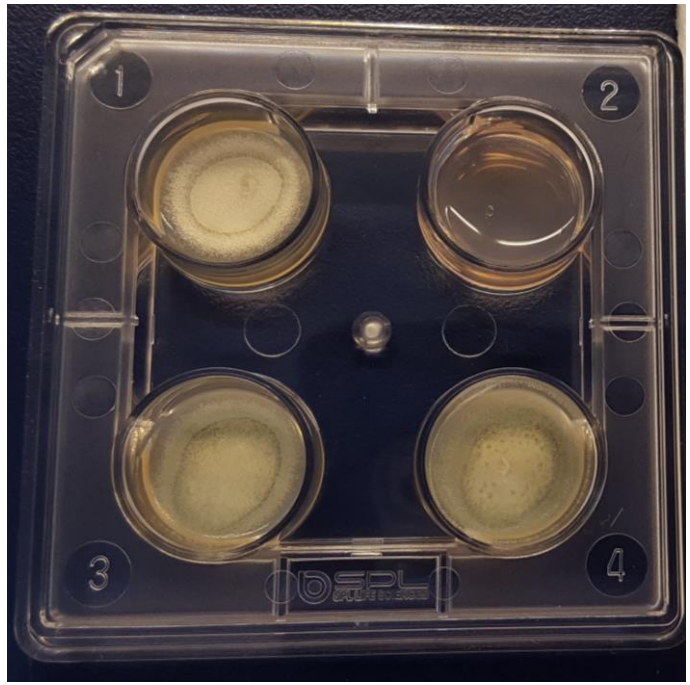
A. fumigatus SSI-5586 [a]

See EUCAST E.Def 10.1 for azole screening test

QC strain harbouring G54W substitution for quality control of azole-containing agar plates.
Each well of the plate contains the following azoles: 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).
Expected growth pattern after 48 h:

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
3	3



a SSI: Statens Serum Institut, Copenhagen, Denmark
Available from the EUCAST Development Laboratory (EDL) for fungi: http://www.eucast.org/organization/developmentlaboratories/

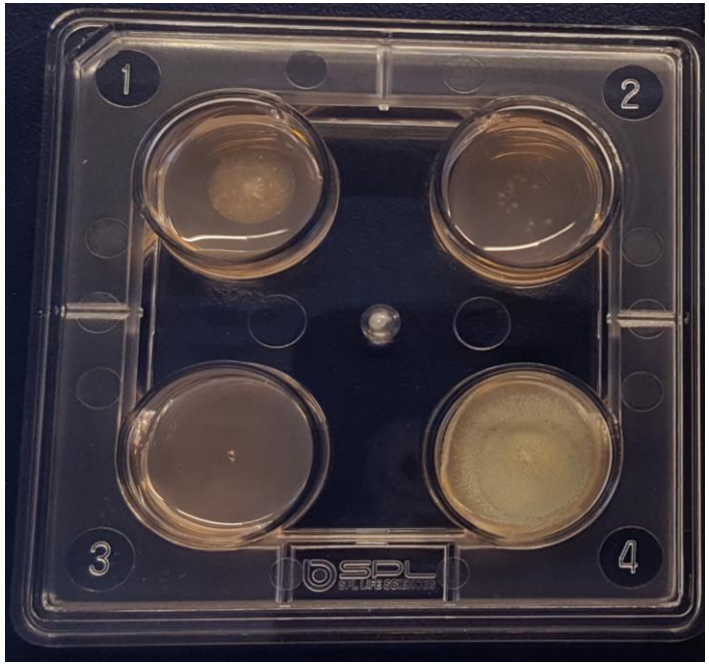
A. fumigatus SSI-4524 [a]

See EUCAST E.Def 10.1 for azole screening test

QC strain harbouring TR34/L98H substitution for quality control of azole-containing agar plates.
Each well of the plate contains the following azoles: 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).
Expected growth pattern after 48 h:

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
3	3



a SSI: Statens Serum Institut, Copenhagen, Denmark
Available from the EUCAST Development Laboratory (EDL) for fungi: http://www.eucast.org/organization/developmentlaboratories/