

Antimicrobial Resistance Strains

Microbiologics offers a wide range of strains with characterized antimicrobial resistance mechanisms including:

- Extended-Spectrum β -lactamases (ESBLs)
- Carbapenemases
- Vancomycin-Resistant Enterococci (VRE)
- Methicillin-Resistant *Staphylococcus aureus* (MRSA)

Microbiologics also offers several strains of *Clostridium difficile*. Older adults, who take antibiotics and get medical care, are at risk for *C. difficile* infections.

These strains come in convenient, ready-to-use formats, which are used for the quality control of laboratory developed tests, antimicrobial resistance tests, and tests for toxinotypes. For more information visit our website at www.microbiologics.com.

Penicillinase without Extended-Spectrum β -Lactamase Activity:

Name	Catalog #	Characteristics
<i>Escherichia coli</i> derived from ATCC® 35218™*	0495	TEM-1 β -lactamase producer ¹

Extended-Spectrum β -lactamases (ESBL)

Name	Catalog #	Characteristics
TEM β-lactamase		
<i>Escherichia coli</i> NCTC 13351	01085	TEM-3 ESBL ²
SHV β-lactamase		
<i>Klebsiella pneumoniae</i> subsp. <i>pneumoniae</i> derived from ATCC® 700603™*	0784	Produces SHV-18 ESBL ³
CTX-M β-lactamase		
<i>Enterobacter cloacae</i> NCTC 13464	01105	<i>bla</i> _{CTX-M} group 9 ²

Name	Catalog #	Characteristics
KPC Carbapenemases		
<i>Klebsiella pneumoniae</i> NCTC 13438	01117	Produces carbapenemase KPC-3 ²
<i>Klebsiella pneumoniae</i> derived from ATCC® BAA-1705™*	01005	<i>bla</i> _{KPC} positive; <i>bla</i> _{NDM} negative Produces carbapenemase KPC; Carbapenem-resistant (imipenem and ertapenem) ³
<i>Escherichia coli</i> derived from ATCC® BAA-2340™*	01201	<i>bla</i> _{KPC} positive; <i>bla</i> _{NDM} negative; Produces carbapenemase KPC; Carbapenem-resistant (imipenem and ertapenem) ³

Name	Catalog #	Characteristics
Metallo-β-lactamases		
<i>Escherichia coli</i> derived from ATCC® BAA-2469™*	01113	New Delhi metallo-β-lactamase (NDM-1) positive; <i>bla</i> _{KPC} negative; <i>bla</i> _{NDM} positive; Carbapenem-resistant (imipenem and ertapenem) ³
<i>Escherichia coli</i> NCTC 13476	01136	IMP-type ²
<i>Klebsiella pneumoniae</i> derived from ATCC® BAA-2146™*	01060	New Delhi metallo-beta-lactamase (NDM-1) positive; <i>bla</i> _{KPC} negative; <i>bla</i> _{NDM} positive ³
<i>Klebsiella pneumoniae</i> NCTC 13440	01112	VIM-1 ²
<i>Klebsiella pneumoniae</i> NCTC 13443	01145	NDM-1 positive New Delhi metallo-β-lactamase ²
OXA Carbapenemases		
<i>Klebsiella pneumoniae</i> NCTC 13442	01148	OXA-48 ²

AmpC β-lactamases

Name	Catalog #	Characteristics
<i>Enterobacter cloacae</i> derived from ATCC® BAA-1143™*	01018	Control strain for the AmpC disk test; High level producer of chromosomal AmpC β-lactamase ³
<i>Pseudomonas aeruginosa</i> derived from ATCC® 27853™*	0353	Contains inducible AmpC β-lactamase ⁴

Plasmid-mediated Fluoroquinolone Resistance

Name	Catalog #	Characteristics
<i>Klebsiella pneumoniae</i> NCTC 13440	01112	VIM-1 ²

Name	Catalog #	Characteristics
<i>Enterococcus faecalis</i> derived from ATCC® 51299™*	0959	<i>vanB</i> positive; ant(6)-I aac(6') aph(2'''); Low-level vancomycin resistant; Sensitive to teicoplanin ³ Resistant to high level aminoglycosides (gentamicin and streptomycin) ¹
<i>Enterococcus faecalis</i> derived from ATCC® 51575™*	01089	<i>vanB</i> positive; Resistant to gentamicin, streptomycin and vancomycin; Sensitive to teichoplanin ³

Name	Catalog #	Characteristics
<i>Enterococcus faecium</i> derived from ATCC® 700221™*	01000	<i>vanA</i> positive; <i>IS16</i> and <i>esp</i> positive; Resistant to vancomycin and teicoplanin ³
<i>Enterococcus faecium</i> NCTC 12204	01143	<i>vanA</i> type glycopeptide resistance Vancomycin resistant ²
<i>Enterococcus gallinarum</i> derived from ATCC® 700425™*	0745	<i>vanC-1</i> positive Intermediate resistance to vancomycin Sensitive to teichoplanin ³

Methicillin-Resistant *Staphylococcus aureus*

Name	Catalog #	Characteristics
<i>Staphylococcus aureus</i> subsp. <i>aureus</i> derived from ATCC® 33592™*	0889	<i>mecA</i> positive; SCC <i>mec</i> type III positive; Methicillin and gentamicin resistant ³ .
<i>Staphylococcus aureus</i> subsp. <i>aureus</i> derived from ATCC® 43300™*	0852	<i>mecA</i> positive; SCC <i>mec</i> type II positive; Methicillin and oxacillin resistant ³ .
<i>Staphylococcus aureus</i> subsp. <i>aureus</i> derived from ATCC® 700698™*	01022	<i>mecA</i> positive; SCC <i>mec</i> type II positive; Methicillin resistant; Heterogeneous susceptibility to vancomycin ³ .
<i>Staphylococcus aureus</i> subsp. <i>aureus</i> derived from ATCC® 700699™*	0158	<i>mecA</i> positive SCC <i>mec</i> type II positive; Methicillin resistant; Reduced vancomycin susceptibility; Mu50; Absence of <i>pvl</i> gene. Propagate on BHI with 4 µg/l vancomycin in order to retain reduced susceptibility; ³ For Cepheid® GeneXpert, use catalog #0158MRSA; For Roche LightCycler®, use catalog #0158ROCHE
<i>Staphylococcus aureus</i> derived from ATCC® BAA-1708™*	01007	<i>mecA</i> positive SCC <i>mec</i> type II positive; Methicillin resistant; <i>mupA</i> positive ³ high-level mupirocin resistance ⁴
<i>Staphylococcus aureus</i> derived from ATCC® BAA-2312™*	01122	<i>mecC</i> positive; SCC <i>mec</i> type XI positive; Methicillin resistant; This strain contains a divergent <i>mecA</i> gene that is not detected by standard PCR kits. ³
<i>Staphylococcus aureus</i> NCTC 12493	01065	<i>mecA</i> positive; Methicillin resistant ¹

Macrolide-Resistant *Staphylococcus aureus*

Name	Catalog #	Characteristics
<i>Staphylococcus aureus</i> subsp. <i>aureus</i> derived from ATCC® BAA-976™*	0146	Positive for <i>msrA</i> -mediated macrolide-only resistance; Negative control for inducible clindamycin resistant; D-zone test negative ⁴

Inducible Clindamycin Resistant *Staphylococcus aureus*

Name	Catalog #	Characteristics
<i>Staphylococcus aureus</i> subsp. <i>aureus</i> derived from ATCC® BAA-977™*	0147	Positive for <i>ermA</i> -mediated resistance; Positive control for inducible clindamycin resistant; D-zone test positive ⁴

Neisseria gonorrhoeae Resistant Strains

Name	Catalog #	Characteristics
<i>Neisseria gonorrhoeae</i> CDC F-28	01217	According to the CDC document "Neisseria gonorrhoeae Reference Strains for Susceptibility Testing" this strain is resistant to spectinomycin (SpcR). ⁵
<i>Neisseria gonorrhoeae</i> CDC SPL-4	01218	According to the CDC document "Neisseria gonorrhoeae Reference Strains for Susceptibility Testing" this strain exhibits decreased sensitivity to cefixime (CfxDS). ⁵
<i>Neisseria gonorrhoeae</i> CDC SPJ-15	01219	According to the CDC document "Neisseria gonorrhoeae Reference Strains for Susceptibility Testing" this is an isolate with a critical MIC greater than or equal to 1.0 ug/ml of azithromycin (AznC). ⁵

Name	Catalog #	Characteristics
<i>Clostridium difficile</i> derived from ATCC® 43255™*	01206	Genotype: • <i>tcdA</i> positive, <i>tcdB</i> positive Toxinotype 0, Ribotype 087 ³
<i>Clostridium difficile</i> derived from ATCC® 43593™*	0833	Genotype: • <i>tcdA</i> negative, <i>tcdB</i> negative • <i>cdtB</i> negative Ribotype 060; Serogroup B ³
<i>Clostridium difficile</i> derived from ATCC® 9689™*	0329	Genotype: • <i>tcdA</i> positive, <i>tcdB</i> positive • <i>cdtB</i> negative Toxinotype 0; Ribotype 001; Produces cytotoxin ³

Name	Catalog #	Characteristics
<i>Clostridium difficile</i> derived from ATCC® 700057™*	0527	Genotype: <ul style="list-style-type: none"> • <i>tcdA</i> negative, <i>tcdB</i> negative • <i>cdtB</i> negative Ribotype 038; nontoxigenic ³
<i>Clostridium difficile</i> derived from ATCC® BAA-1870™*	01048	Genotype: <ul style="list-style-type: none"> • <i>tcdA</i> positive, <i>tcdB</i> positive • <i>cdtB</i> positive Toxinotype III; Ribotype 027; PFGE Type NAP1; REA type I 8 Binary Toxin positive ³
<i>Clostridium difficile</i> CDC 20110736	01161	Genotype: <ul style="list-style-type: none"> • <i>tcdA</i> negative, <i>tcdB</i> negative • <i>tcdC_deletion</i> negative • <i>cdtA</i> negative, <i>cdtB</i> negative⁶
<i>Clostridium difficile</i> CDC 20110995	01162	Genotype: <ul style="list-style-type: none"> • <i>tcdA</i> positive, <i>tcdB</i> positive • <i>tcdC_deletion</i> 0 bp • <i>cdtA</i> negative, <i>cdtB</i> negative PFGE Type NAP11 ⁶
<i>Clostridium difficile</i> CDC 20120296	01163	Genotype: <ul style="list-style-type: none"> • <i>tcdA</i> positive, <i>tcdB</i> positive • <i>tcdC_deletion</i> 39 bp • <i>cdtA</i> positive, <i>cdtB</i> positive PFGE Type NAP8 ⁶
<i>Clostridium difficile</i> CDC 20120905	01164	Genotype: <ul style="list-style-type: none"> • <i>tcdA</i> positive, <i>tcdB</i> positive • <i>tcdC_deletion</i> 0 bp • <i>cdtA</i> negative, <i>cdtB</i> negative PFGE Type NAP4 ⁶
<i>Clostridium difficile</i> CDC 20121308	01165	Genotype: <ul style="list-style-type: none"> • <i>tcdA</i> positive, <i>tcdB</i> positive • <i>tcdC_deletion</i> 18 bp • <i>cdtA</i> positive, <i>cdtB</i> positive PFGE Type NAP1 ⁶
<i>Clostridium difficile</i> CDC 20131122	01166	Genotype: <ul style="list-style-type: none"> • <i>tcdA</i> positive, <i>tcdB</i> positive • <i>tcdC_deletion</i> 39 bp • <i>cdtA</i> positive, <i>cdtB</i> positive PFGE Type NAP7 ⁶

Drug Resistant QC Set 5224

Name	Set #	Characteristics
<i>Staphylococcus aureus</i> subsp. <i>aureus</i> derived from ATCC® 43300™*	5224	<i>mecA</i> positive; SCC <i>mec</i> type II positive; Methicillin and oxacillin resistant ³ .
<i>Enterococcus faecalis</i> derived from ATCC® 51299™*		<i>vanB</i> positive; ant(6)-I aac(6') aph(2'''); Low-level vancomycin resistant; Sensitive to teicoplanin ³ Resistant to high level aminoglycosides (gentamicin and streptomycin) ¹
<i>Klebsiella pneumoniae</i> subsp. <i>pneumoniae</i> derived from ATCC® 700603™*		Produces SHV-18 ESBL ³
<i>Enterobacter cloacae</i> derived from ATCC® BAA-1143™*		Control strain for the AmpC disk test; High level producer of chromosomal AmpC β- lactamase ³
<i>Klebsiella pneumoniae</i> derived from ATCC® BAA-1705™*		<i>bla</i> _{KPC} positive; <i>bla</i> _{NDM} negative Produces carbapenemase KPC; Carbapenem- resistant (imipenem and ertapenem) Modified Hodge Test positive ³
<i>Klebsiella pneumoniae</i> derived from ATCC® BAA-1705™*		<i>bla</i> _{KPC} positive; <i>bla</i> _{NDM} negative Produces carbapenemase KPC; Carbapenem- resistant (imipenem and ertapenem) Modified Hodge Test positive ³

References

- ¹European Committee on Antimicrobial Susceptibility Testing (EUCAST). *Extended quality control as recommended by EUCAST*; Version 6.0, valid from 2016-01-01. www.eucast.org. European Society of Clinical Microbiology and Infectious Diseases (ESCMID). Basel, Switzerland.
- ²The National Collection of Type Cultures (NCTC): *Antimicrobial Resistance Reference Strains Available from NCTC*, Website; www.phe-culturecollections.org.uk. Public Health England. Salisbury, U.K.
- ³American Type Culture Collection (ATCC®) *ATCC Multidrug-Resistant Testing Reference Strains*, Website; www.atcc.org. Manassas, VA, United States.
- ⁴Clinical Laboratory Standards Institute (CLSI®) *M100S Performance Standards for Antimicrobial Susceptibility Testing*. 26th Edition. January, 2016. Wayne, PA, United States
- ⁵Center for Disease Control (CDC): *Neisseria gonorrhoeae Reference Strains for Antimicrobial Susceptibility Testing*. 2005. Atlanta, GA, United States
- ⁶Center for Disease Control (CDC). Atlanta, GA, United States.



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