

# USP Column Codes

## INTRODUCTION

HPLC columns are assigned a USP L listing based on the specification of the packing material used within the column. The L number listings provide a general grouping of phases which have similar characteristics and specifications. The end user must determine if the performance and selectivity of the column is suitable for their separation, as not all phases will perform the same. The USP does provide scope for chromatographers to modify monograph conditions, within certain limits, to ensure optimal analytical results using a specific column.

This Knowledge Note provides the USP listing for all Avantor® ACE® phases, and the general description for all the USP Codes.\*

ACE® Traditional Chemistries		
	USP Code	Particle Size (µm)
ACE C18	L1	1.7, 2, 3, 5, 10
ACE C18-HL	L1	3, 5, 10, 15
ACE C8	L7	2, 3, 5, 10
ACE C4	L26	2, 3, 5, 10
ACE Phenyl	L11	2, 3, 5, 10
ACE CN	L10	2, 3, 5, 10
ACE AQ	L1	2, 3, 5, 10
ACE SIL	L3	2, 3, 5, 10
ACE NH <sub>2</sub>	L8	1.7, 3, 5

\*correct as of Feb 2021

### ACE® Novel Chemistries

	USP Code	Particle Size (µm)
ACE SuperC18	L1	1.7, 2, 3, 5, 10
ACE C18-AR	L1	1.7, 2, 3, 5, 10
ACE C18-PFP	L1	1.7, 2, 3, 5, 10
ACE C18-Amide	L1/L60	1.7, 2, 3, 5, 10
ACE CN-ES	L10	1.7, 2, 3, 5, 10

### Large Molecule Wide Pore ACE® Phases

	USP Code	Particle Size (µm)
ACE C18-300	L1	3, 5, 10
ACE C8-300	L7	3, 5, 10
ACE C4-300	L26	3, 5, 10
ACE CN-300	L10	3, 5, 10
ACE Phenyl-300	L11	3, 5, 10

### ACE® HILIC Phases

	USP Code	Particle Size (µm)
ACE HILIC-A	L3	1.7, 3, 5
ACE HILIC-B	L8	1.7, 3, 5
ACE HILIC-N	Pending	1.7, 3, 5

### Solid Core Technology ACE® Phases

	USP Code	Particle Size (µm)
ACE UltraCore SuperC18	L1	2.5, 5
ACE UltraCore SuperPhenylHexyl	L11	2.5, 5
ACE UltraCore C18	L1	3.5
ACE UltraCore Phenyl Hexyl	L11	3.5
ACE UltraCore Biphenyl	L11	3.5
ACE UltraCore C18-Amide	L60	3.5

### Large Molecule Solid Core Technology ACE® Phases

	USP Code	Particle Size (µm)
ACE UltraCore BIO C18	L1	2.5, 3.5
ACE UltraCore BIO C4	L26	2.5, 3.5
ACE UltraCore BIO Phenyl2	L11	2.5, 3.5

USP Code	Specification
L1	Octadecyl silane chemically bonded to porous or non-porous silica particles or superficially porous particles or ceramic micro-particles, 1.5 to 10 µm in diameter, or a monolithic rod.
L2	Octadecyl silane chemically bonded to silica gel of a controlled surface porosity that has been bonded to a solid spherical core, 30 to 50 µm in diameter.
L3	Porous silica particles or superficially porous particles, 1.5 to 10 µm in diameter, or a monolithic silica rod.
L4	Silica gel of controlled surface porosity bonded to a solid spherical core, 30 to 50 µm in diameter.
L5	Alumina of controlled surface porosity bonded to a solid spherical core, 30 to 50 µm in diameter.
L6	Strong cation-exchange packing – sulfonated fluorocarbon polymer coated on a solid spherical core, 30 to 50 µm in diameter.
L7	Octyl silane chemically bonded to totally porous or superficially porous silica particles, 1.5 to 10 µm in diameter, or a monolithic silica rod.
L8	An essentially monomolecular layer of aminopropylsilane chemically bonded to totally porous silica gel support, 1.5 to 10 µm in diameter, or a monolithic silica rod.
L9	Irregular or spherical, totally porous silica gel having a chemically bonded, strongly acidic cation-exchange coating, 3 to 10 µm in diameter.
L10	Nitrile groups chemically bonded to porous silica particles or superficially porous particles, 1.5 to 10 µm in diameter, or a monolithic silica rod.
L11	Phenyl groups chemically bonded to porous or superficially porous silica particles, 1.5 to 10 µm in diameter, or a monolithic silica rod.
L12	A strong anion-exchange packing made by chemically bonding a quaternary amine to a solid silica spherical core, 30 to 50 µm in diameter.
L13	Trimethyl silane chemically bonded to porous silica particles, 3 to 10 µm in diameter.
L14	Silica gel having a chemically bonded strongly basic quaternary ammonium anion-exchange coating, 5 to 10 µm in diameter.
L15	Hexyl silane chemically bonded to totally porous silica particles, 3 to 10 µm in diameter
L16	Dimethyl silane chemically bonded to porous silica particles, 5 to 10 µm in diameter.
L17	Strong cation-exchange resin consisting of sulfonated cross-linked styrene-divinylbenzene copolymer in the hydrogen form, 6 to 12 µm in diameter.
L18	Amino and cyano groups chemically bonded to porous silica particles, 3 to 10 µm in diameter.
L19	Strong cation-exchange resin consisting of sulfonated cross-linked styrene-divinylbenzene copolymer in the calcium form, 5 to 15 µm in diameter.

USP Code	Specification
L20	Dihydroxypropane groups chemically bonded to porous silica or hybrid particles, 1.5 to 10 µm in diameter, or a monolithic silica rod.
L21	A rigid, spherical styrene-divinylbenzene copolymer, 3 to 30 µm in diameter.
L22	A cation-exchange resin made of porous polystyrene gel with sulfonic acid groups, 5 to 15 µm in diameter.
L23	An anion-exchange resin made of porous polymethacrylate or polyacrylate gel with quaternary ammonium groups, 7 to 12 µm in size.
L24	Polyvinylalcohol chemically bonded to porous silica particles, 5 µm in diameter.
L25	Packing having the capacity to separate compounds with a molecular weight range from 100-5000 (as determined by polyethylene oxide), applied to neutral, anionic, and cationic water-soluble polymers. A polymethacrylate resin base, cross-linked with polyhydroxylated ether (surface contained some residual carboxyl functional groups) was found suitable.
L26	Butyl silane chemically bonded to totally porous or superficially porous silica particles, 1.5 to 10 µm in diameter.
L27	Porous silica particles, 30 to 50 µm in diameter.
L28	A multifunctional support, which consists of a high purity, 100 Å, spherical silica substrate that has been bonded with anionic exchanger, amine functionality in addition to a conventional reversed-phase C8 functionality.
L29	Gamma alumina, reversed-phase, low carbon percentage by weight, alumina-based polybutadiene spherical particles, 5 µm in diameter with a pore volume of 80 Å units.
L30	Ethyl silane chemically bonded to totally porous silica particles, 3 to 10 µm in diameter.
L31	A hydroxide-selective, strong anion-exchange resin – quaternary amine bonded on latex particles attached to a core of 8.5 µm macroporous particles having a pore size of 2000 Å units and consisting of ethylvinylbenzene cross-linked with 55% divinylbenzene.
L32	A chiral ligand-exchange resin packing - L-proline copper complex covalently bonded to irregularly shaped silica particles, 5 to 10 µm in diameter.
L33	Packing having the capacity to separate dextrans by molecular size over a range of 4,000 to 500,000 Da. It is spherical, silica-based, and processed to provide pH stability.
L34	Strong cation-exchange resin consisting of sulfonated cross-linked styrene-divinylbenzene copolymer in the lead form, 7 to 9 µm in diameter.
L35	A zirconium-stabilized spherical silica packing with a hydrophilic (diol-type) molecular monolayer bonded phase having a pore size of 150 Å.
L36	A 3,5-dinitrobenzoyl derivative of L-phenylglycine covalently bonded to 5 µm aminopropyl silica.
L37	Packing having the capacity to separate proteins by molecular size over a range of 2,000 to 40,000 Da. It is a polymethacrylate gel.

USP Code	Specification
L38	A methacrylate-based size-exclusion packing for water-soluble samples
L39	A hydrophilic polyhydroxymethacrylate gel of totally porous spherical resin.
L40	Cellulose tris-3,5-dimethylphenylcarbamate coated porous silica particles, 5 to 20 µm in diameter.
L41	Immobilized α <sub>1</sub> -acid glycoprotein on spherical silica particles, 5 µm in diameter.
L42	Octylsilane and octadecylsilane groups chemically bonded to porous silica particles, 5 µm in diameter.
L43	Pentafluorophenyl groups chemically bonded to silica particles by a propyl spacer, 1.5 to 10 µm in diameter.
L44	A multifunctional support, which consists of a high purity, 60 Å, spherical silica substrate that has been bonded with a cationic exchanger, sulfonic acid functionality in addition to a conventional reversed-phase C8 functionality.
L45	Beta cyclodextrin, R,S-hydroxypropyl ether derivative, bonded to porous silica particles, 3 to 10 µm in diameter.
L46	Polystyrene/divinylbenzene substrate agglomerated with quaternary amine functionalized latex beads, about 9 to 11 µm in diameter.
L47	High-capacity anion-exchange microporous substrate, fully functionalized with a trimethylamine group, 8 µm in diameter.
L48	Sulfonated, cross-linked polystyrene with an outer layer of submicron, porous, anion-exchange microbeads, 5 to 15 µm in diameter.
L49	A reversed-phase packing made by coating a thin layer of polybutadiene on to spherical porous zirconia particles, 3 to 10 µm in diameter.
L50	Multifunction resin with reversed-phase retention and strong anion-exchange functionalities. The resin consists of ethylvinylbenzene, 55% cross-linked with divinylbenzene copolymer, 3 to 15 µm in diameter, and a surface area of not less than 350 m <sup>2</sup> /g. Substrate is coated with quaternary ammonium functionalized latex particles consisting of styrene cross-linked with divinylbenzene.
L51	Amylose tris-3,5-dimethylphenylcarbamate-coated, porous, spherical, silica particles, 5 to 10 µm in diameter.
L52	A strong cation exchange resin made of porous silica with sulfopropyl groups, 5 to 10 µm in diameter.
L53	Weak cation-exchange resin consisting of ethylvinylbenzene, 55% cross-linked with divinylbenzene copolymer, 3 to 15 µm diameter. Substrate is surface grafted with carboxylic acid and/or phosphoric acid functionalized monomers. Capacity not less than 500 µEq/column.
L54	A size exclusion medium made of covalent bonding of dextran to highly cross-linked porous agarose beads, 5 to 15 µm in diameter.
L55	A strong cation exchange resin made of porous silica coated with polybutadiene-maleic acid copolymer, about 5 µm in diameter.

USP Code	Specification
L56	Propyl silane chemically bonded to totally porous silica particles, 3 to 10 µm in diameter.
L57	A chiral-recognition protein, ovomucoid, chemically bonded to silica particles, about 5 µm in diameter, with a pore size of 120 Å.
L58	Strong cation-exchange resin consisting of sulfonated cross-linked styrene-divinylbenzene copolymer in the sodium form, about 6 to 30 µm diameter.
L59	Packing for the size-exclusion separations of proteins (separation by molecular weight) over the range of 5 to 7000 kDa. The packing is spherical 1.5 to 10 µm, silica or hybrid packing with a hydrophilic coating.
L60	Spherical, porous or superficially porous silica particles, 10 µm or less in diameter, the surface of which has been covalently modified with alkyl amide groups and endcapped.
L61	A hydroxide-selective, strong anion-exchange resin consisting of a highly cross-linked core of 13 µm microporous particles having a pore size less than 10 Å units and consisting of ethylvinylbenzene cross-linked with 55% divinylbenzene with a latex coating composed of 85 nm diameter microbeads bonded with alkanol quaternary ammonium ions (6%).
L62	C30 silane bonded phase on a fully porous spherical silica, 3 to 15 µm in diameter
L63	Glycopeptide teicoplanin linked through multiple covalent bonds to a 100 Å units spherical silica.
L64	Strongly basic anion exchange resin consisting of 8% cross-linked styrene divinylbenzene copolymer with a quaternary ammonium group in the chloride form, 45 to 180 µm in diameter.
L65	Strongly acidic cation exchange resin consisting of 2% sulfonated cross-linked styrene divinylbenzene copolymer with a sulfonic acid group in the hydrogen form, 63 to 250 µm in diameter.
L66	A crown ether coated on a 5 µm particle size silica gel substrate. The active site is (S)-18-crown-6-ether.
L67	Porous vinyl alcohol copolymer with a C18 alkyl group attached to the hydroxyl group of the polymer, 2 to 10 µm in diameter.
L68	Spherical, porous silica, 10 µm or less in diameter, the surface of which has been covalently modified with alkyl amide groups and not endcapped.
L69	Ethylvinylbenzene/divinylbenzene substrate agglomerated with quaternary amine functionalized 130 nm latex beads, about 6.5 µm in diameter
L70	Cellulose tris(phenyl carbamate) coated on 5 µm silica.
L71	A rigid, spherical polymethacrylate, 4 to 6 µm in diameter
L72	(S)-phenylglycine and 3,5-dinitroaniline urea linkage covalently bonded to silica.
L73	A rigid, spherical polydivinylbenzene particle, 5 to 10 µm in diameter.

USP Code	Specification
L74	A strong anion-exchange resin consisting of a highly cross-linked core of 7 µm microporous particles having a 100 Å average pore size and consisting of ethylvinylbenzene cross-linked with 55% divinylbenzene and an anion-exchange layer grafted to the surface, which is functionalized with alkyl quaternary ammonium ions.
L75	A chiral-recognition protein, bovine serum albumin (BSA), chemically bonded to silica particles, about 7 µm in diameter, with a pore size of 300 Å.
L76	Silica based weak cation-exchange material, 5 µm in diameter. Substrate is surface polymerized polybutadiene-maleic acid to provide carboxylic acid functionalities. Capacity not less than 29 µEq/column.
L77	Weak cation-exchange resin consisting of ethylvinylbenzene, 55% cross-linked with divinylbenzene copolymer, 6 to 9 µm diameter. Substrate is surface grafted with carboxylic acid functionalized groups. Capacity not less than 500 µEq/column (4 mm x 25 cm).
L78	A silane ligand that consists of both reversed-phase (an alkyl chain longer than C8) and anion-exchange (primary, secondary, or tertiary amino groups) functional groups chemically bonded to porous or non-porous or ceramic micro-particles, 1.0 to 50 µm in diameter or a monolithic rod.
L79	A chiral-recognition protein, human serum albumin (HSA), chemically bonded to silica particles, about 5 µm in diameter.
L80	Cellulose tris(4-methylbenzoate)-coated, porous, spherical, silica particles, 5 µm in diameter
L81	A hydroxide-selective, strong anion-exchange resin consisting of a highly cross-linked core of 9 µm porous particles having a pore size of 2000 Å units and consisting of ethylvinylbenzene cross-linked with 55% divinylbenzene with a latex coating composed of 70 nm diameter microbeads (6% cross-linked) bonded with alkanol quaternary ammonium ions.
L82	Polyamine chemically bonded to cross-linked polyvinyl alcohol polymer, 4 - 5 µm in diameter.
L83	A hydroxide-selective, strong anion-exchange resin – quaternary amine bonded on latex particles attached to a core of 10.5 µm microporous particles having a pore size of 10 Å and consisting of ethylvinylbenzene cross-linked with 55% divinylbenzene.
L84	Weak cation-exchange resin consisting of ethylvinylbenzene, 55% cross-linked with divinylbenzene copolymer, 5 µm diameter. Substrate is surface grafted with carboxylic acid functionalized groups. Capacity not less than 8400 µEq/column (5 mm x 25 cm).
L85	A silane ligand that consists of both reversed-phase (an alkyl chain longer than C8) and weak cation-exchange (carboxyl groups) functional groups chemically bonded to porous or non-porous particles, 1.0 to 50 µm in diameter.
L86	A 5 µm fused core particle with a highly polar ligand possessing 5 hydroxyl groups tethered to the silica gel outer layer.
L87	Dodecyl silane chemically bonded to porous silica particles, 1.5 to 10 µm in diameter.
L88	Glycopeptide vancomycin linked through multiple covalent bonds to 100 Å spherical silica
L89	Packing having the capacity to separate compounds with a molecular weight range from 100-3000 (as determined by polyethylene oxide), applied to neutral and anionic water-soluble polymers. A polymethacrylate resin base, cross-linked with polyhydroxylated ether (surface contains some residual cationic functional groups).

USP Code	Specification
L90	Amylose tris[(S)-alpha-methylbenzylcarbamate] coated on porous, spherical silica particles, 3 to 10 µm in diameter.
L91	Strong anion-exchange resin consisting of monodispersed porous polystyrene/divinyl benzene beads coupled with quaternary amine. Bead size is 10 µm.
L92	A strong anion-exchange resin consisting of a highly cross-linked core of 5 to 9 µm macroporous particles having a 100 Å average pore size and consisting of ethylvinylbenzene cross-linked with 55% divinylbenzene and an anion-exchange layer grafted to the surface, which is functionalized with alkanol quaternary ammonium ions.
L93	Cellulose tris(3,5-dimethylphenylcarbamate) reversed-phase chiral stationary phase coated on 3 or 5 µm silica gel particles.
L94	A strong anion-exchange resin consisting of highly cross-linked 15 µm microporous particles functionalized with very low cross-linked latex (0.5%) to provide alkanol quaternary ammonium ion exchange sites.
L95	Highly polar alkyl ligand comprising five hydroxyl groups that are chemically bonded to totally porous or superficially porous silica or a monolithic silica rod.
L96	Alkyl chain, reversed-phase bonded totally or superficially porous silica designed to retain hydrophilic and other polar compounds when using highly aqueous mobile phases, including 100% aqueous, 1.5 µm to 10 µm in diameter.
L97	Weak cation-exchange resin consisting of a highly cross-linked core of 5.5 µm porous particles having a pore size of 2000 Å units and consisting of ethylvinylbenzene cross-linked with 55% divinylbenzene. Substrate is surface grafted with carboxylic acid functionalized groups. Capacity not less than 2400 µEq/column (4 mm x 25 cm).
L98	Weak cation-exchange resin consisting of a highly cross-linked core of 8 µm microporous particles having an average pore size of 10 Å units and consisting of ethylvinylbenzene cross-linked with 55% divinylbenzene. Substrate is surface grafted with carboxylic acid functionalized groups. Capacity not less than 46 µEq/column (4 mm x 5 cm).
L99	Amylose tris-(3,5-dimethylphenylcarbamate), immobilized on porous, spherical, silica particles, 3 to 5 µm in diameter.
L100	A 55% cross-linked, microporous, hydrophobic resin core (9 µm microporous particles having a pore size of 10 Å units) that consists of a bilayer of anion and cation exchange latex. The first layer is fully sulfonated (140 nm) and the second layer is fully aminated (76 nm).
L101	Cholesteryl groups chemically bonded to porous or non-porous silica or ceramic micro-particles, 1.5 to 10 µm in diameter, or a monolithic rod.
L102	(Naproxen, (S,S)Whelk-O 1) 1-(3,5-dinitrobenzamido)-1,2,3,4-tetrahydrophenanthrene covalently bonded to porous spherical silica particles, 5 to 10 µm in diameter
L103	A hydroxide-selective, strong anion-exchange resin consisting of a highly cross-linked core of 7.5 µm porous particles having a pore size of 2000 Å units and consisting of ethylvinylbenzene cross-linked with 55% divinylbenzene electrostatically bonded with hyperbranched alkanol quaternary ammonium ions.
L104	Triazole groups chemically bonded to porous silica particles, 1.5 to 10 µm in diameter.
L105	A strong anion-exchange resin consisting of a highly cross-linked 9 µm supermacroporous (2000 Å) particles functionalized with very low cross-linked latex (0.2%) to provide alkyl quaternary ammonium ion sites.
L106	Weak cation-exchange resin consisting of ethylvinylbenzene, 55% cross-linked with divinylbenzene copolymer, 5-8 µm diameter, macroporous particles having an average pore size of 100 Å units. Substrate is surface grafted with carboxylic acid and phosphonic acid functional groups. Capacity not less than 2800 µEq/column (4 mm x 25 cm).



USP Code	Specification
L107	Cellulose tris(4-methylbenzoate)-coated porous spherical particles, 3 to 5 µm in diameter, for use with reversed-phase mobile phases.
L108	A chiral-recognition protein, cellobiohydrolase (CBH), chemically bonded to silica particles, about 5 µm in diameter.
L109	Spherical particles of porous graphitic carbon, 3 to 30 µm in diameter.
L110	A strong anion-exchange resin consisting of a highly cross-linked 13 µm microporous (less than 10 Å) particles coated with very low cross-linked latex (0.5%) to provide alkanol quaternary ammonium ion exchange sites.
L111	Polyamine chemically bonded to porous spherical silica particles, 5 µm in diameter.
L112	A hydroxide-selective, strong anion-exchange resin consisting of a highly cross-linked core of 8.5 µm porous particles having a pore size of 2000 Å units and consisting of ethylvinylbenzene cross-linked with 55% divinylbenzene with a latex coating composed of 65 nm diameter microbeads (5% cross-linked) bonded with alkanol quaternary ammonium ions.
L113	A hydroxide-selective, strong anion-exchange resin consisting of a highly cross-linked core of 7.5 µm porous particles having a pore size of 2000 Å units and consisting of ethylvinylbenzene cross-linked with 55% divinylbenzene with a latex coating composed of 65 nm diameter microbeads (5%) cross-linked bonded with alkanol quaternary ammonium ions.
L114	Sulfobetaine graft-polymerized to totally or superficially porous silica, 1.5 to 10 µm in diameter, or a monolithic rod. Packing having densely bonded zwitterionic groups with 1:1 charge balance.
L115	Ethylvinylbenzene/divinylbenzene substrate (55% cross-linked) agglomerated with quaternary amine functionalized 275 nm latex microbeads (6% cross-linked), about 8.5 µm in diameter.
L116	Sulfonated ethylvinylbenzene/divinylbenzene substrate approximately 12 to 14 µm in diameter agglomerated with hydrophilic quaternary amine functionalized glycidyl-derivative methacrylate microbeads.
L117	A crown ether coated on a 5 µm particle size silica gel substrate. The active site is (R)-18-crown-6-ether.
L118	Aqueous polymerized C18 groups on silica particles, 1.2 to 5 µm in diameter.
L119	Cellulose tris-(3,5-dichlorophenylcarbamate), immobilized on porous, spherical, silica particles, 3 to 5 µm in diameter.
L120	A hydroxide-selective, strong anion-exchange resin consisting of a highly cross-linked core of 13 µm microporous particles having a pore size of <10 Angstroms units and consisting of ethylvinylbenzene cross-linked with 55% divinylbenzene with a latex coating composed of 65 nm diameter microbeads (8% crosslinked) bonded with alkanol quaternary ammonium ions. Capacity not less than 10 µEq/column (4 mm x 5 cm).
L121	A hydroxide-selective, strong anion-exchange resin consisting of a highly cross-linked core of 11 µm porous particles having a pore size of less than 10 Angstroms units and consisting of ethylvinylbenzene cross-linked with 55% divinylbenzene electrostatically bonded with hyperbranched alkanol quaternary ammonium ions
L122	Sulfobetaine graft-polymerized to totally or superficially porous hydrophilic polymer particles, 1.0 to 10 µm in diameter, or a monolithic rod. Packing having densely bonded zwitterionic groups with 1:1 charge balance.

USP Code	Specification
L123	Cellulose tris(3-chloro-4-methylphenylcarbamate) coated porous silica particles, 3 to 20 $\mu\text{m}$ in diameter
L124	Strong cation-exchange resin consisting of sulfonated cross-linked styrene-divinylbenzene copolymer in the silver form, average 9 $\mu\text{m}$ in diameter.
L125	Polyvinyl alcohol polymer gel weak cation-exchange packing material, 5 $\mu\text{m}$ porous particles. The surface is polymerized with polybutadiene-maleic acid to provide carboxylic acid functionalities. The Capacity is not less than 1 mEq/column.