

Synthetic SARS-CoV-2 Control Variant Information

The Twist Synthetic SARS-CoV-2 RNA controls consist of six non-overlapping 5 kb fragments generated from Twist Gene Fragments then transcribed into ssRNA. These provide coverage of greater than 99.9% of the bases of the viral genome. Standard Controls are supplied in 100 µL at a concentration of approximately one million copies per microliter. Twist also offers certain controls in Assay Ready and Encapsulated Formats that are supplied as a desiccated pellet. The Assay Ready Controls are supplied at approximately two million copies per tube. The Encapsulated Controls are supplied at approximately 50,000 copies per tube.

PART NUMBER	CONTROL NUMBER	GENBANK/ GISAID ID	GISAID NAME	PANGO LINEAGE	AMINO ACID SUBSTITUTIONS	WHO LABEL
102019	Control 1	MT007544.1/ EPI_ISL_406844	Australia/VIC01/2020	B	Spike S247R, NS3 G251V	—
102024	Control 2 ^{1,2}	MN908947.3/ EPI_ISL_402119	Wuhan-Hu-1	B	N/A	—
102860	Control 3	LC528232.1/ EPI_ISL_412968	Japan/Hu_DP_Kng_ 19-020/2020	B	NSP6 L37F	—
102862	Control 4	MT106054.1/ EPI_ISL_411956	USA/TX1/2020	A	NS8 L84S, NS8 T11I, NSP14 D379A	—
102917	Control 5	MT188340/ EPI_ISL_414589	USA/MN2-MDH2/2020	B.11	NSP13 R392C	—
102918	Control 6	MT118835/ EPI_ISL_412862	USA/CA9/2020	B	NSP4 A457V	—
103087	Control 7	EPI_ISL_418227	France/HF2393/2020	B.1	Spike D614G, NS3 Q57H, NSP1 R24C, NSP12 P323L	—
103511	Control 8	MT066176/ EPI_ISL_410218	Taiwan/NTU02/2020	B	NSP4 H313Y	—
103512	Control 9	MT152824/ EPI_ISL_412970	USA/WA2/2020	A.1	NS8 L84S, NSP3 T1022I, NSP13 P504L, NSP13 Y541C	—
103513	Control 10	EPI_ISL_414648	USA/CA-PC101P/2020	B.1	Spike D614G, NSP12 P323L	—
103514	Control 11	EPI_ISL_417739	Iceland/5/2020	B.1.5	Spike D614G, NSP5 K90R, NSP12 P323L	—
103515	Control 12	EPI_ISL_420244	England/SHEF-C05B2/ 2020	B.1.1.1	Spike D614G, N D103Y, N G204R, N R203K, NSP5 G15S, NSP12 P323L	—
103533	Control 13	EPI_ISL_421184	Belgium/ULG-10004/ 2020	B.1.12	Spike D614G, Spike V143D, Spike Y145del, NS3 A99V, NS3 Q57H, NSP2 T85I, NSP3 A534V, NSP6 L37F, NSP12 P323L, NSP14 L409F	—
103907	Control 14 ¹	EPI_ISL_710528	England/205041766/ 2020	B.1.1.7	Spike A570D, Spike D614G, Spike D1118H, Spike H69del, Spike N501Y, Spike P681H, Spike S982A, Spike T716I, Spike V70del, Spike Y145del, N D3L, N G204R, N R203K, N S235F, NS8 Q27stop, NS8 R52I, NS8 Y73C, NSP3 A890D, NSP3 I1412T, NSP3 T183I, NSP6 F108del, NSP6 G107del, NSP6 S106del, NSP12 P323L, NSP12 T806I, NSP13 K460R	Alpha
103909	Control 15 ¹	EPI_ISL_601443	England/MILK- 9E05B3/2020	B.1.1.7	Spike A570D, Spike D614G, Spike D1118H, Spike H69del, Spike N501Y, Spike P681H, Spike S982A, Spike T716I, Spike V70del, Spike Y145del, N D3L, N G204R, N R203K, N S235F, NS8 Q27stop, NS8 R52I, NS8 Y73C, NSP3 A890D, NSP3 I1412T, NSP3 T183I, NSP6 F108del, NSP6 G107del, NSP6 S106del, NSP12 P323L	Alpha



PART NUMBER	CONTROL NUMBER	GENBANK/ GISAID ID	GISAID NAME	PANGO LINEAGE	AMINO ACID SUBSTITUTIONS	WHO LABEL
104043	Control 16	EPI_ISL_678597	South Africa/KRISP-EC-K005299/2020	B.1.351	Spike A243del, Spike A701V, Spike D80A, Spike D215G, Spike D614G, Spike E484K, Spike K417N, Spike L242del, Spike L244del, Spike N501Y, E P71L, N T205I, NS3 Q57H, NS3 S171L, NS8 I121L, NSP2 T85I, NSP3 K837N, NSP5 K90R, NSP6 F108del, NSP6 G107del, NSP6 S106del, NSP12 P323L	Beta
104044	Control 17	EPI_ISL_792683	Japan/IC-0564/2021	P.1	Spike D138Y, Spike D614G, Spike E484K, Spike H655Y, Spike K417T, Spike L18F, Spike N501Y, Spike P26S, Spike R190S, Spike T20N, Spike T1027I, Spike V1176F, N G204R, N P80R, N R203K, NS3 S253P, NS8 E92K, NSP3 K977Q, NSP3 S370L, NSP6 F108del, NSP6 G107del, NSP6 S106del, NSP12 P323L, NSP13 E341D	Gamma
104338	Control 18	EPI_ISL_1662307	India/CT-ILSGS00361/2021	B.1.617.1	Spike D614G, Spike E154K, Spike E484Q, Spike G142D, Spike L452R, Spike P681R, Spike Q1071H, Spike T95I, M I82S, N D377Y, N R203M, NS3 S26L, NS7a V82A, NSP3 S126L, NSP3 T749I, NSP6 L271I, NSP6 T77A, NSP12 P323L, NSP12 Q822H, NSP13 D458Y, NSP13 G206C, NSP13 M429I, NSP15 K259R, NSP15 S261A	Kappa
104529	Control 19	EPI_ISL_1300881	USA/NY-MSHSPSP-PV24650/2020	B.1.526	Spike A701V, Spike D253G, Spike D614G, Spike E484K, Spike L5F, Spike T95I, N M234I, N P199L, NS3 P42L, NS3 Q57H, NS8 T11I, NSP2 T85I, NSP4 L438P, NSP6 F108del, NSP6 G107del, NSP6 S106del, NSP12 P323L, NSP13 Q88H	Iota
104530	Control 20	EPI_ISL_730092	USA/CA-ALSR-4704/2020	B.1.427	Spike D614G, Spike L452R, Spike S13I, Spike W152C, N T205I, NS3 Q57H, NSP2 E264V, NSP2 T85I, NSP4 S395T, NSP12 P323L, NSP13 D260Y	—
104531	Control 21	EPI_ISL_672365	USA/CA-CZB-12943/2020	B.1.429	Spike D614G, Spike L452R, Spike P26S, Spike S13I, Spike W152C, N T205I, NS3 Q57H, NSP2 T85I, NSP9 I65V, NSP12 P323L, NSP13 D260Y	Epsilon
104532	Control 22	EPI_ISL_933685	Mexico/CMX-InDRE_208/2021	B.1.1.519	Spike D614G, Spike P681H, Spike T478K, Spike T732A, N G204R, N R203K, NSP3 P141S, NSP4 T492I, NSP6 I49V, NSP9 T35I, NSP12 P323L	—
104533	Control 23	EPI_ISL_1544014	India/MH-NCCS-P1162000182735/2021	B.1.617.2	Spike D614G, Spike E156G, Spike F157del, Spike L452R, Spike P681R, Spike R158del, Spike T19R, Spike T478K, N D377Y, N R203M, N R385K, NS3 S26L, NS7a L116F, NS7a T120I, NS7a V82A, NS8 G8V, NSP2 P129L, NSP3 P822L, NSP4 A446V, NSP6 V149A, NSP12 G671S, NSP12 P323L, NSP13 P77L, NSP15 H234Y	Delta
104534	Control 24	EPI_ISL_1939891	India/MH-SEQ-221_S66_R1_001/2021	B.1.617.3	Spike D614G, Spike D950N, Spike E484Q, Spike E1072K, Spike L452R, Spike P681R, Spike T19R, N D377Y, N P67S, N R203M, NS3 L52F, NS7a V82A, NS8 T26I, NSP2 K500N, NSP3 A1526V, NSP3 T1830I, NSP5 A194S, NSP6 A117V, NSP12 P323L	—
104538	Control 28 ²	EPI_ISL_2695467	Portugal/PT9543/2021	AY.1	Spike D614G, Spike D950N, Spike E156G, Spike F157del, Spike K417N, Spike L452R, Spike P681R, Spike R158del, Spike T19R, Spike T95I, Spike T478K, Spike W258L, M I82T, N D63G, N D377Y, N G215C, N R203M, NS3 S26L, NS7a T120I, NS7a V82A, NS7b T40I, NSP3 A488S, NSP3 P1228L, NSP3 P1469S, NSP4 T295I, NSP4 T492I, NSP4 V167L, NSP6 T77A, NSP12 G671S, NSP12 P323L, NSP13 P77L, NSP14 A394V, NSP14 I474V	Delta
104539	Control 29	EPI_ISL_2693246	USA/WA-CDC-UW21061750277/2021	AY.2	Spike A222V, Spike D614G, Spike D950N, Spike E156G, Spike F157del, Spike K417N, Spike L452R, Spike P681R, Spike R158del, Spike T19R, Spike T478K, Spike V70F, M I82T, N D63G, N D377Y, N R203M, NS3 L85F, NS3 S26L, NS7a T120I, NS7a V82A, NSP3 A328T, NSP3 P822L, NSP4 A446V, NSP6 T181I, NSP6 V149A, NSP12 G671S, NSP12 P323L, NSP13 P77L, NSP13 T367I	Delta



PART NUMBER	CONTROL NUMBER	GENBANK/ GISAID ID	GISAID NAME	PANGO LINEAGE	AMINO ACID SUBSTITUTIONS	WHO LABEL
105204	Control 48 ²	EPI_ISL_6841980	Hong Kong/HKU-211129-001/2021	B.1.1.529 BA.1	Spike A67V, Spike D614G, Spike D796Y, Spike E484A, Spike G142D, Spike G339D, Spike G446S, Spike G496S, Spike H69del, Spike H655Y, Spike ins214EPE, Spike K417N, Spike L212I, Spike L981F, Spike N211del, Spike N440K, Spike N501Y, Spike N679K, Spike N764K, Spike N856K, Spike N969K, Spike P681H, Spike Q493R, Spike Q498R, Spike Q954H, Spike S371L, Spike S373P, Spike S375F, Spike S477N, Spike T95I, Spike T478K, Spike T547K, Spike V70del, Spike V143del, Spike Y144del, Spike Y145del, Spike Y505H, E T9I, M A63T, M D3G, M Q19E, N E31del, N G204R, N P13L, N R32del, N R203K, N S33del, NSP3 A1892T, NSP3 K38R, NSP3 L1266I, NSP3 S1265del, NSP4 T492I, NSP5 P132H, NSP6 G107del, NSP6 I189V, NSP6 L105del, NSP6 S106del, NSP12 P323L, NSP14 I42V	Omicron
105345	Control 50	PI_ISL_7190366	Australia/QLD2568/202	B.1.1.529 BA.2	Spike A27S, Spike D405N, Spike D614G, Spike D796Y, Spike E484A, Spike G142D, Spike G339D, Spike H655Y, Spike K417N, Spike L24del, Spike N440K, Spike N501Y, Spike N679K, Spike N764K, Spike N969K, Spike P25del, Spike P26del, Spike P681H, Spike Q493R, Spike Q498R, Spike Q954H, Spike R408S, Spike S371F, Spike S373P, Spike S375F, Spike S477N, Spike T19I, Spike T376A, Spike T478K, Spike V213G, Spike Y505H, E T9I, M A63T, M Q19E, N E31del, N G204R, N P13L, N R32del, N R203K, N S33del, N S413R, NS3 T223I, NSP1 S135R, NSP3 G489S, NSP3 T24I, NSP4 L264F, NSP4 L438F, NSP4 T327I, NSP4 T492I, NSP5 P132H, NSP6 F108del, NSP6 G107del, NSP6 S106del, NSP12 P323L, NSP13 R392C, NSP14 I42V, NSP15 T112I	Omicron
105346	Control 51	EPI_ISL_7718520	England/MILK-2DF642C/2021	B.1.1.529 BA.2	Spike A27S, Spike D405N, Spike D614G, Spike D796Y, Spike E484A, Spike G142D, Spike G339D, Spike H655Y, Spike K417N, Spike L24del, Spike N440K, Spike N501Y, Spike N679K, Spike N764K, Spike N969K, Spike P25del, Spike P26del, Spike P681H, Spike Q493R, Spike Q498R, Spike Q954H, Spike R408S, Spike S371F, Spike S373P, Spike S375F, Spike S477N, Spike T19I, Spike T376A, Spike T478K, Spike V213G, Spike Y505H, E T9I, M A63T, M Q19E, N E31del, N G204R, N P13L, N R32del, N R203K, N S33del, N S413R, NS3 T223I, NSP1 S135R, NSP3 G489S, NSP3 T24I, NSP4 L264F, NSP4 T327I, NSP4 T492I, NSP5 P132H, NSP6 F108del, NSP6 G107del, NSP6 S106del, NSP12 F694Y, NSP12 P323L, NSP13 R392C, NSP14 I42V, NSP15 T112I	Omicron
105865	Control 62	EPI_ISL_12248637.1	hCoV-19/Denmark/DCGC-493190/2022	BA.2.12.1	Spike A27S, Spike D405N, Spike D614G, Spike D796Y, Spike E484A, Spike G142D, Spike G339D, Spike H655Y, Spike K417N, Spike L24del, Spike L452Q, Spike N440K, Spike N501Y, Spike N679K, Spike N764K, Spike N969K, Spike P25del, Spike P26del, Spike P681H, Spike Q493R, Spike Q498R, Spike Q954H, Spike R408S, Spike S371F, Spike S373P, Spike S375F, Spike S477N, Spike S704L, Spike T19I, Spike T376A, Spike T478K, Spike V213G, Spike Y505H, E T9I, M A63T, M Q19E, N E31del, N G204R, N P13L, N R32del, N R203K, N S33del, N S413R, NS3 T223I, NSP1 S135R, NSP3 G489S, NSP3 T24I, NSP4 L264F, NSP4 L438F, NSP4 S137L, NSP4 T327I, NSP4 T492I, NSP5 P132H, NSP6 F108del, NSP6 G107del, NSP6 S106del, NSP12 P323L, NSP13 R392C, NSP14 I42V, NSP15 T112I	Omicron

¹Indicates controls that are also available in the Assay Ready format²Indicates controls that are also available in the Encapsulated format



PART NUMBER	CONTROL NUMBER	GENBANK/ GISAID ID	GISAID NAME	PANGO LINEAGE	AMINO ACID SUBSTITUTIONS	WHO LABEL
105857	Control 63	EPI_ISL_12303256.1	hCoV-19/USA/NY-CDC-LC0579415/2022	BA.2.12.1	Spike A27S, Spike D405N, Spike D614G, Spike D796Y, Spike E484A, Spike G142D, Spike G339D, Spike H655Y, Spike K417N, Spike L24del, Spike L452Q, Spike N440K, Spike N501Y, Spike N679K, Spike N764K, Spike N969K, Spike P25del, Spike P26del, Spike P681H, Spike Q493R, Spike Q498R, Spike Q954H, Spike R408S, Spike S371F, Spike S373P, Spike S375F, Spike S477N, Spike S704L, Spike T19I, Spike T376A, Spike T478K, Spike V213G, Spike Y505H, E T9I, M A63T, M Q19E, N E31del, N G204R, N P13L, N R32del, N R203K, N S33del, N S413R, NS3 T223I, NSP1 S135R, NSP3 G489S, NSP3 T24I, NSP4 L264F, NSP4 L438F, NSP4 T327I, NSP4 T492I, NSP5 P132H, NSP6 F108del, NSP6 G107del, NSP6 S106del, NSP12 P323L, NSP13 R392C, NSP14 I42V, NSP15 T112I	Omicron
106196	Control 64 (BA.5)	EPI_ISL_12516495	hCoV-19/England/LSPA-3DC1269/2022	BF.1	Spike A27S, Spike D405N, Spike D614G, Spike D796Y, Spike E484A, Spike F486V, Spike G142D, Spike G339D, Spike H69del, Spike H655Y, Spike K417N, Spike L24del, Spike L452R, Spike N440K, Spike N501Y, Spike N679K, Spike N764K, Spike N969K, Spike P25del, Spike P26del, Spike P681H, Spike Q498R, Spike Q954H, Spike R408S, Spike S371F, Spike S373P, Spike S375F, Spike S477N, Spike T19I, Spike T376A, Spike T478K, Spike V70del, Spike V213G, Spike Y505H, E T9I, M A63T, M D3N, M Q19E, N E31del, N G204R, N P13L, N R32del, N R203K, N S33del, N S413R, NS3 T223I, NSP1 S135R, NSP3 G489S, NSP3 T24I, NSP4 L264F, NSP4 T327I, NSP4 T492I, NSP5 P132H, NSP6 F108del, NSP6 G107del, NSP6 S106del, NSP12 P323L, NSP13 R392C, NSP14 I42V, NSP15 T112I, NSP16 V288F	Omicron
106197	Control 65 (BA.5)	EPI_ISL_12620611	hCoV-19/USA/TN-ASC-210769476/2022	BA.5.5	Spike A27S, Spike D405N, Spike D614G, Spike D796Y, Spike E484A, Spike F486V, Spike G142D, Spike G339D, Spike H69del, Spike H655Y, Spike K417N, Spike L24del, Spike L452R, Spike N440K, Spike N501Y, Spike N679K, Spike N764K, Spike N969K, Spike P25del, Spike P26del, Spike P681H, Spike Q498R, Spike Q954H, Spike R408S, Spike S371F, Spike S373P, Spike S375F, Spike S477N, Spike T19I, Spike T76I, Spike T376A, Spike T478K, Spike V70del, Spike V213G, Spike Y505H, E T9I, M A63T, M D3N, M Q19E, N E31del, N G204R, N P13L, N R32del, N R203K, N S33del, N S413R, NS3 T223I, NSP1 S135R, NSP3 G489S, NSP3 T24I, NSP4 L264F, NSP4 T327I, NSP4 T492I, NSP5 P132H, NSP6 F108del, NSP6 G107del, NSP6 S106del, NSP12 P323L, NSP13 R392C, NSP14 I42V, NSP15 T112I	Omicron
106198	Control 66 (BA.4)	EPI_ISL_12454576	hCoV-19/USA/TX-HMH-M-96682/2022	BA.4.1	Spike A27S, Spike D405N, Spike D614G, Spike D796Y, Spike E484A, Spike F486V, Spike G142D, Spike G339D, Spike H69del, Spike H655Y, Spike K417N, Spike L24del, Spike L452R, Spike N440K, Spike N501Y, Spike N679K, Spike N764K, Spike N969K, Spike P25del, Spike P26del, Spike P681H, Spike Q498R, Spike Q954H, Spike R408S, Spike S371F, Spike S373P, Spike S375F, Spike S477N, Spike T19I, Spike T376A, Spike T478K, Spike V3G, Spike V70del, Spike V213G, Spike Y505H, E T9I, M A63T, M Q19E, N E31del, N G204R, N P13L, N P151S, N R32del, N R203K, N S33del, N S413R, NS3 T223I, NS7b L11F, NSP1 F143del, NSP1 K141del, NSP1 S135R, NSP1 S142del, NSP3 G489S, NSP3 T24I, NSP4 L264F, NSP4 T327I, NSP4 T492I, NSP5 P132H, NSP6 F108del, NSP6 G107del, NSP6 S106del, NSP12 P323L, NSP13 R392C, NSP14 I42V, NSP15 T112I	Omicron



Part Number	Control Number	Genbank / GISAID ID	GISAID Name	Pango Lineage	Amino Acid Substitutions	WHO Label
106199	Control 67 (BA.4)	EPI_ISL_12605687	hCoV-19/ USA/CA-CDC-QDX36065390/202	BA.4.1	Spike A27S, Spike D405N, Spike D614G, Spike D796Y, Spike E484A, Spike F486V, Spike G142D, Spike G339D, Spike H69del, Spike H655Y, Spike K417N, Spike L24del, Spike L452R, Spike N440K, Spike N501Y, Spike N679K, Spike N764K, Spike N969K, Spike P25del, Spike P26del, Spike P681H, Spike Q498R, Spike Q954H, Spike R408S, Spike S371F, Spike S373P, Spike S375F, Spike S477N, Spike T19I, Spike T376A, Spike T478K, Spike V3G, Spike V70del, Spike V213G, Spike Y505H, E T9I, M A63T, M Q19E, N E31del, N G204R, N P13L, N P151S, N R32del, N R203K, N S33del, N S413R, NS3 T223I, NS7b L11F, NSP1 F143del, NSP1 K141del, NSP1 S135R, NSP1 S142del, NSP3 G489S, NSP3 T24I, NSP4 L264F, NSP4 T327I, NSP4 T492I, NSP5 P132H, NSP6 F108del, NSP6 G107del, NSP6 S106del, NSP12 P323L, NSP13 R392C, NSP14 I42V, NSP15 T112I	Omicron