



Full wwPDB X-ray Structure Validation Report ⓘ

Mar 9, 2026 – 08:39 AM UTC

PDB ID : 1C9N / pdb_00001c9n
Title : BACILLUS LENTUS SUBSTITILISIN VARIANT (SER 87) K27R/V104Y/N1
23S/T274A
Authors : Bott, R.
Deposited on : 1999-08-02
Resolution : 1.50 Å(reported)

This is a Full wwPDB X-ray Structure Validation Report for a publicly released PDB entry.

We welcome your comments at validation@mail.wwpdb.org

A user guide is available at

<https://www.wwpdb.org/validation/2017/XrayValidationReportHelp>

with specific help available everywhere you see the ⓘ symbol.

The types of validation reports are described at

<http://www.wwpdb.org/validation/2017/FAQs#types>.

The following versions of software and data (see [references ⓘ](#)) were used in the production of this report:

MolProbity	:	4-5-2 with Phenix2.0
Mogul	:	2022.3.0, CSD as543be (2022)
Xtriage (Phenix)	:	NOT EXECUTED
EDS	:	NOT EXECUTED
Percentile statistics	:	20250101.v01 (using entries in the PDB archive January 1st 2025)
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, RNA)	:	Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP)	:	2.49

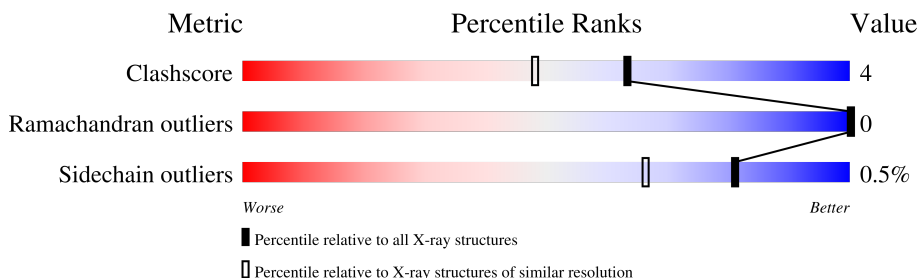
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 1.50 Å.

Percentile scores (ranging between 0-100) for global validation metrics of the entry are shown in the following graphic. The table shows the number of entries on which the scores are based.



Metric	Whole archive (#Entries)	Similar resolution (#Entries, resolution range(Å))
Clashscore	190562	4235 (1.50-1.50)
Ramachandran outliers	187476	4153 (1.50-1.50)
Sidechain outliers	187428	4150 (1.50-1.50)

The table below summarises the geometric issues observed across the polymeric chains and their fit to the electron density. The red, orange, yellow and green segments of the lower bar indicate the fraction of residues that contain outliers for ≥ 3 , 2, 1 and 0 types of geometric quality criteria respectively. A grey segment represents the fraction of residues that are not modelled. The numeric value for each fraction is indicated below the corresponding segment, with a dot representing fractions $\leq 5\%$.

Note EDS was not executed.

Mol	Chain	Length	Quality of chain
1	A	269	

2 Entry composition [i](#)

There are 5 unique types of molecules in this entry. The entry contains 2031 atoms, of which 0 are hydrogens and 0 are deuteriums.

In the tables below, the ZeroOcc column contains the number of atoms modelled with zero occupancy, the AltConf column contains the number of residues with at least one atom in alternate conformation and the Trace column contains the number of residues modelled with at most 2 atoms.

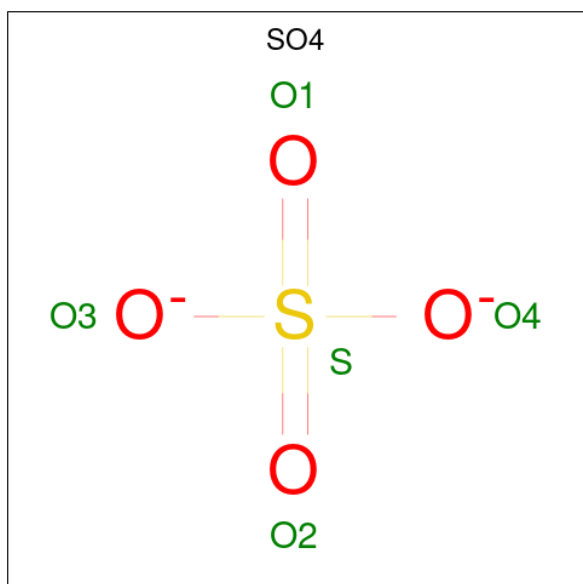
- Molecule 1 is a protein called Subtilisin Savinase.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	269	Total	C	N	O	S	0	0	0
			1883	1152	348	380	3			

There are 4 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	27	ARG	LYS	engineered mutation	UNP P29600
A	102	TYR	VAL	engineered mutation	UNP P29600
A	121	SER	ASN	engineered mutation	UNP P29600
A	268	ALA	THR	engineered mutation	UNP P29600

- Molecule 2 is SULFATE ION (CCD ID: SO4) (formula: O₄S).

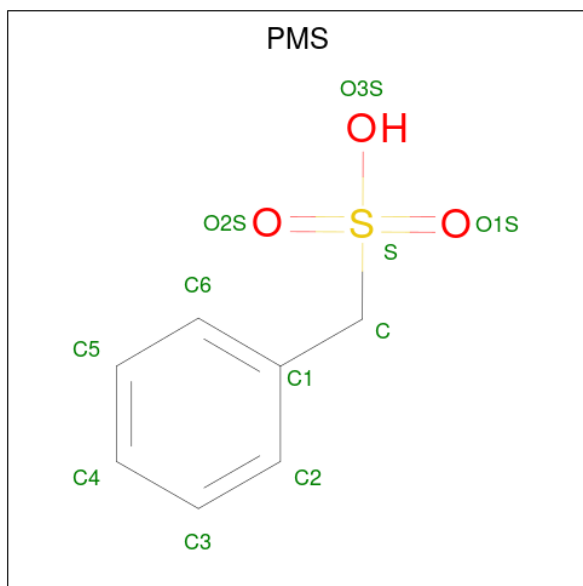


Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
2	A	1	Total	O	S	0	0
			5	4	1		

- Molecule 3 is CALCIUM ION (CCD ID: CA) (formula: Ca).

Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
3	A	2	Total	Ca		0	0
			2	2			

- Molecule 4 is phenylmethanesulfonic acid (CCD ID: PMS) (formula: C₇H₈O₃S).



Mol	Chain	Residues	Atoms				ZeroOcc	AltConf
4	A	1	Total	C	O	S	0	0
			10	7	2	1		

- Molecule 5 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
5	A	131	Total	O	0	0
			131	131		

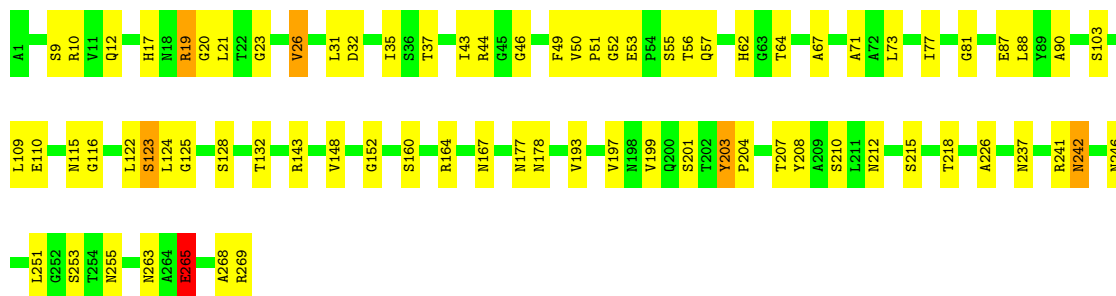
3 Residue-property plots [i](#)

These plots are drawn for all protein, RNA, DNA and oligosaccharide chains in the entry. The first graphic for a chain summarises the proportions of the various outlier classes displayed in the second graphic. The second graphic shows the sequence view annotated by issues in geometry. Residues are color-coded according to the number of geometric quality criteria for which they contain at least one outlier: green = 0, yellow = 1, orange = 2 and red = 3 or more. Stretches of 2 or more consecutive residues without any outlier are shown as a green connector. Residues present in the sample, but not in the model, are shown in grey.

Note EDS was not executed.

• Molecule 1: Subtilisin Savinase

Chain A:  71% 26% .



4 Data and refinement statistics

Xtriage (Phenix) and EDS were not executed - this section is therefore incomplete.

Property	Value	Source
Space group	P 21 21 21	Depositor
Cell constants a, b, c, α , β , γ	48.25Å 54.15Å 84.50Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	10.00 – 1.50	Depositor
% Data completeness (in resolution range)	77.0 (10.00-1.50)	Depositor
R_{merge}	0.06	Depositor
R_{sym}	(Not available)	Depositor
Refinement program	PROLSQ	Depositor
R, R_{free}	0.163 , (Not available)	Depositor
Estimated twinning fraction	No twinning to report.	Xtriage
Total number of atoms	2031	wwPDB-VP
Average B, all atoms (Å ²)	17.0	wwPDB-VP

5 Model quality [i](#)

5.1 Standard geometry [i](#)

Bond lengths and bond angles in the following residue types are not validated in this section: PMS, SO4, CA

The Z score for a bond length (or angle) is the number of standard deviations the observed value is removed from the expected value. A bond length (or angle) with $|Z| > 5$ is considered an outlier worth inspection. RMSZ is the root-mean-square of all Z scores of the bond lengths (or angles).

Mol	Chain	Bond lengths		Bond angles	
		RMSZ	$\# Z > 5$	RMSZ	$\# Z > 5$
1	A	1.27	3/1918 (0.2%)	2.15	68/2619 (2.6%)

All (3) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	A	46	GLY	N-CA	6.60	1.51	1.45
1	A	81	GLY	N-CA	5.64	1.51	1.45
1	A	152	GLY	N-CA	5.46	1.50	1.45

All (68) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	19	ARG	CD-NE-CZ	25.87	160.62	124.40
1	A	164	ARG	CD-NE-CZ	12.47	141.85	124.40
1	A	242	ASN	CA-CB-CG	-9.78	102.82	112.60
1	A	10	ARG	NE-CZ-NH1	9.45	130.95	121.50
1	A	265	GLU	CB-CG-CD	-9.32	96.76	112.60
1	A	110	GLU	CB-CG-CD	9.25	128.32	112.60
1	A	128	SER	O-C-N	9.20	130.49	121.57
1	A	124	LEU	CA-C-N	-8.50	116.31	122.18
1	A	124	LEU	C-N-CA	-8.50	116.31	122.18
1	A	10	ARG	NH1-CZ-NH2	-7.93	109.00	119.30
1	A	203	TYR	O-C-N	7.80	127.31	121.85
1	A	246	ASN	CA-C-O	-7.70	111.40	120.10
1	A	177	ASN	CB-CG-ND2	7.54	127.72	116.40
1	A	143	ARG	CD-NE-CZ	-7.51	113.89	124.40
1	A	215	SER	CB-CA-C	7.08	124.61	110.17
1	A	71	ALA	CA-C-O	-6.93	113.25	120.32
1	A	32	ASP	CA-C-O	-6.93	115.20	120.19
1	A	215	SER	CA-CB-OG	6.91	124.93	111.10

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Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	62	HIS	CA-CB-CG	-6.88	106.92	113.80
1	A	77	ILE	O-C-N	6.85	130.55	122.95
1	A	237	ASN	CA-CB-CG	6.53	119.13	112.60
1	A	253	SER	N-CA-C	6.49	120.24	110.64
1	A	73	LEU	O-C-N	6.47	130.76	122.81
1	A	255	ASN	OD1-CG-ND2	6.43	129.03	122.60
1	A	115	ASN	OD1-CG-ND2	6.34	128.94	122.60
1	A	17	HIS	O-C-N	6.30	128.64	122.09
1	A	125	GLY	CA-C-O	-6.20	115.53	121.11
1	A	160	SER	CA-CB-OG	-6.16	98.78	111.10
1	A	263	ASN	CA-CB-CG	-6.11	106.49	112.60
1	A	37	THR	CA-CB-OG1	-6.11	100.43	109.60
1	A	53	GLU	N-CA-CB	6.09	120.62	110.99
1	A	19	ARG	NE-CZ-NH1	6.01	127.52	121.50
1	A	88	LEU	N-CA-CB	-6.01	100.24	110.16
1	A	20	GLY	CA-C-O	-6.00	112.16	119.06
1	A	49	PHE	CA-CB-CG	-6.00	107.80	113.80
1	A	132	THR	CA-CB-OG1	-5.97	100.64	109.60
1	A	241	ARG	NE-CZ-NH1	-5.96	115.54	121.50
1	A	51	PRO	CA-C-N	-5.93	113.20	122.51
1	A	51	PRO	C-N-CA	-5.93	113.20	122.51
1	A	53	GLU	CA-CB-CG	5.81	125.72	114.10
1	A	23	GLY	CA-C-O	5.75	125.39	119.01
1	A	51	PRO	CA-C-O	-5.72	115.11	121.23
1	A	56	THR	CA-C-O	-5.72	112.36	119.28
1	A	19	ARG	NE-CZ-NH2	-5.69	114.08	119.20
1	A	50	VAL	CA-C-O	5.66	125.06	119.62
1	A	57	GLN	N-CA-CB	5.56	118.18	110.17
1	A	12	GLN	CA-CB-CG	-5.54	103.01	114.10
1	A	251	LEU	O-C-N	5.54	129.17	122.35
1	A	207	THR	CA-CB-OG1	-5.48	101.38	109.60
1	A	212	ASN	OD1-CG-ND2	-5.45	117.15	122.60
1	A	197	VAL	O-C-N	5.40	129.01	123.18
1	A	178	ASN	CB-CG-ND2	-5.38	108.33	116.40
1	A	55	SER	CA-CB-OG	5.35	121.79	111.10
1	A	64	THR	O-C-N	5.25	127.69	122.12
1	A	90	ALA	CA-C-O	-5.23	114.98	120.58
1	A	87	GLU	CA-C-O	-5.23	114.98	120.58
1	A	116	GLY	O-C-N	5.23	128.06	122.41
1	A	193	VAL	CA-C-O	5.18	127.11	121.67
1	A	52	GLY	O-C-N	5.16	128.74	122.60
1	A	177	ASN	N-CA-C	-5.15	106.58	112.92

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Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	9	SER	CB-CA-C	-5.12	100.83	110.67
1	A	67	ALA	CA-C-N	5.12	125.63	120.00
1	A	67	ALA	C-N-CA	5.12	125.63	120.00
1	A	123	SER	CA-CB-OG	-5.10	100.90	111.10
1	A	62	HIS	CE1-NE2-CD2	5.08	114.08	109.00
1	A	167	ASN	CA-CB-CG	-5.06	107.54	112.60
1	A	26	VAL	O-C-N	5.03	128.61	123.03
1	A	103	SER	CA-C-O	-5.03	114.19	119.97

There are no chirality outliers.

There are no planarity outliers.

5.2 Too-close contacts

In the following table, the Non-H and H(model) columns list the number of non-hydrogen atoms and hydrogen atoms in the chain respectively. The H(added) column lists the number of hydrogen atoms added and optimized by MolProbity. The Clashes column lists the number of clashes within the asymmetric unit, whereas Symm-Clashes lists symmetry-related clashes.

Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
1	A	1883	0	1834	15	1
2	A	5	0	0	0	1
3	A	2	0	0	0	0
4	A	10	0	7	1	0
5	A	131	0	0	0	0
All	All	2031	0	1841	15	1

The all-atom clashscore is defined as the number of clashes found per 1000 atoms (including hydrogen atoms). The all-atom clashscore for this structure is 4.

All (15) close contacts within the same asymmetric unit are listed below, sorted by their clash magnitude.

Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:19:ARG:NH1	1:A:265:GLU:HG2	1.99	0.77
1:A:19:ARG:HH11	1:A:265:GLU:HG2	1.58	0.69
1:A:123:SER:HB3	4:A:304:PMS:H2	1.86	0.56
1:A:19:ARG:HH11	1:A:265:GLU:CG	2.24	0.50
1:A:19:ARG:NH2	1:A:269:ARG:HA	2.28	0.49
1:A:203:TYR:CD2	1:A:204:PRO:HD2	2.49	0.47
1:A:148:VAL:HG12	1:A:218:THR:HG23	1.97	0.46

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:21:LEU:HD13	1:A:268:ALA:HB1	1.97	0.45
1:A:35:ILE:HG22	1:A:43:ILE:HD11	2.00	0.43
1:A:44:ARG:HD3	1:A:44:ARG:HA	1.81	0.42
1:A:199:VAL:O	1:A:210:SER:HA	2.19	0.42
1:A:201:SER:O	1:A:208:TYR:HA	2.20	0.42
1:A:26:VAL:HG11	1:A:226:ALA:HA	2.02	0.41
1:A:31:LEU:HD22	1:A:122:LEU:HD11	2.03	0.41
1:A:109:LEU:HD21	1:A:122:LEU:HD11	2.03	0.40

All (1) symmetry-related close contacts are listed below. The label for Atom-2 includes the symmetry operator and encoded unit-cell translations to be applied.

Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:242:ASN:OD1	2:A:301:SO4:O1[4_465]	2.02	0.18

5.3 Torsion angles [i](#)

5.3.1 Protein backbone [i](#)

In the following table, the Percentiles column shows the percent Ramachandran outliers of the chain as a percentile score with respect to all X-ray entries followed by that with respect to entries of similar resolution.

The Analysed column shows the number of residues for which the backbone conformation was analysed, and the total number of residues.

Mol	Chain	Analysed	Favoured	Allowed	Outliers	Percentiles	
1	A	267/269 (99%)	260 (97%)	7 (3%)	0	100	100

There are no Ramachandran outliers to report.

5.3.2 Protein sidechains [i](#)

In the following table, the Percentiles column shows the percent sidechain outliers of the chain as a percentile score with respect to all X-ray entries followed by that with respect to entries of similar resolution.

The Analysed column shows the number of residues for which the sidechain conformation was analysed, and the total number of residues.

Mol	Chain	Analysed	Rotameric	Outliers	Percentiles	
1	A	193/193 (100%)	192 (100%)	1 (0%)	81	66

All (1) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	265	GLU

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (8) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	12	GLN
1	A	18	ASN
1	A	42	ASN
1	A	135	GLN
1	A	138	ASN
1	A	167	ASN
1	A	232	ASN
1	A	255	ASN

5.3.3 RNA ⓘ

There are no RNA molecules in this entry.

5.4 Non-standard residues in protein, DNA, RNA chains ⓘ

There are no non-standard protein/DNA/RNA residues in this entry.

5.5 Carbohydrates ⓘ

There are no oligosaccharides in this entry.

5.6 Ligand geometry ⓘ

Of 4 ligands modelled in this entry, 2 are monoatomic - leaving 2 for Mogul analysis.

In the following table, the Counts columns list the number of bonds (or angles) for which Mogul statistics could be retrieved, the number of bonds (or angles) that are observed in the model and the number of bonds (or angles) that are defined in the Chemical Component Dictionary. The Link column lists molecule types, if any, to which the group is linked. The Z score for a bond length (or angle) is the number of standard deviations the observed value is removed from the

expected value. A bond length (or angle) with $|Z| > 2$ is considered an outlier worth inspection. RMSZ is the root-mean-square of all Z scores of the bond lengths (or angles).

Mol	Type	Chain	Res	Link	Bond lengths			Bond angles		
					Counts	RMSZ	$\# Z > 2$	Counts	RMSZ	$\# Z > 2$
4	PMS	A	304	1	7,10,11	2.22	3 (42%)	11,12,15	2.13	6 (54%)
2	SO4	A	301	-	4,4,4	0.84	0	6,6,6	0.75	0

In the following table, the Chirals column lists the number of chiral outliers, the number of chiral centers analysed, the number of these observed in the model and the number defined in the Chemical Component Dictionary. Similar counts are reported in the Torsion and Rings columns. '-' means no outliers of that kind were identified.

Mol	Type	Chain	Res	Link	Chirals	Torsions	Rings
4	PMS	A	304	1	-	1/4/4/5	0/1/1/1

All (3) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
4	A	304	PMS	C2-C1	3.96	1.46	1.38
4	A	304	PMS	C-C1	2.95	1.55	1.50
4	A	304	PMS	C5-C4	2.13	1.42	1.38

All (6) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
4	A	304	PMS	C3-C2-C1	-3.64	115.50	120.61
4	A	304	PMS	O2S-S-C	2.94	110.62	105.55
4	A	304	PMS	C6-C1-C2	2.81	122.41	118.23
4	A	304	PMS	C4-C5-C6	-2.40	117.28	120.24
4	A	304	PMS	C-C1-C6	-2.37	117.98	120.56
4	A	304	PMS	C5-C4-C3	2.28	122.99	119.87

There are no chirality outliers.

All (1) torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
4	A	304	PMS	C1-C-S-O1S

There are no ring outliers.

2 monomers are involved in 2 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
4	A	304	PMS	1	0
2	A	301	SO4	0	1

5.7 Other polymers [i](#)

There are no such residues in this entry.

5.8 Polymer linkage issues [i](#)

There are no chain breaks in this entry.

6 Fit of model and data

6.1 Protein, DNA and RNA chains

EDS was not executed - this section is therefore empty.

6.2 Non-standard residues in protein, DNA, RNA chains

EDS was not executed - this section is therefore empty.

6.3 Carbohydrates

EDS was not executed - this section is therefore empty.

6.4 Ligands

EDS was not executed - this section is therefore empty.

6.5 Other polymers

EDS was not executed - this section is therefore empty.