



Full wwPDB X-ray Structure Validation Report ⓘ

Mar 9, 2026 – 11:02 PM UTC

PDB ID : 1C9M / pdb_00001c9m
Title : BACILLUS LENTUS SUBTILISIN (SER 87) N76D/S103A/V104I
Authors : Bott, R.
Deposited on : 1999-08-02
Resolution : 1.67 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

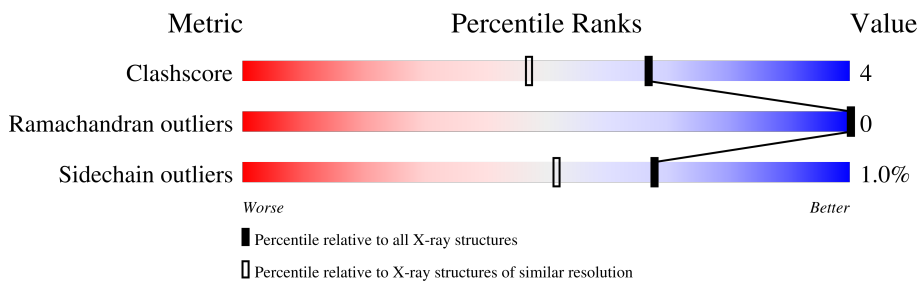
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 1.67 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	1078 (1.68-1.68)
Ramachandran outliers	187476	1068 (1.68-1.68)
Sidechain outliers	187428	1067 (1.68-1.68)

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 4 unique types of molecules in this entry. The entry contains 2001 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 SERINE PROTEASE.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	269	Total	C	N	O	S	0	0	0
			1890	1158	346	382	4			

- 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 water.

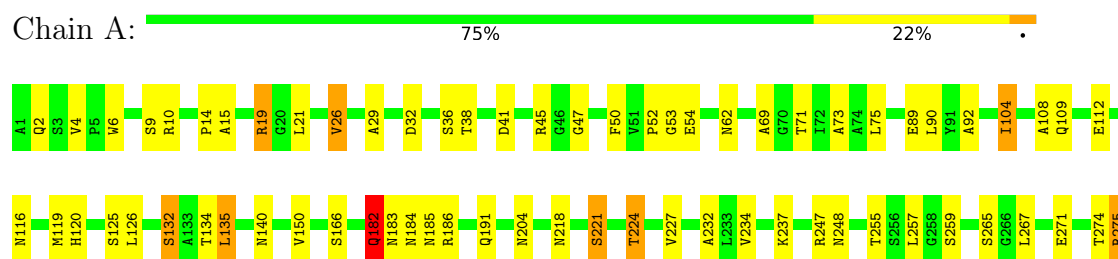
Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
4	A	104	Total 104	O 104	0	0

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: SERINE PROTEASE



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	53.25Å 61.25Å 75.05Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	10.00 – 1.67	Depositor
% Data completeness (in resolution range)	91.0 (10.00-1.67)	Depositor
R_{merge}	0.04	Depositor
R_{sym}	(Not available)	Depositor
Refinement program	PROLSQ	Depositor
R, R_{free}	0.168 , (Not available)	Depositor
Estimated twinning fraction	No twinning to report.	Xtriage
Total number of atoms	2001	wwPDB-VP
Average B, all atoms (Å ²)	15.0	wwPDB-VP

5 Model quality

5.1 Standard geometry

Bond lengths and bond angles in the following residue types are not validated in this section: SO4, SEB, 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	1.19	2/1907 (0.1%)	2.17	71/2603 (2.7%)

Chiral center outliers are detected by calculating the chiral volume of a chiral center and verifying if the center is modelled as a planar moiety or with the opposite hand. A planarity outlier is detected by checking planarity of atoms in a peptide group, atoms in a mainchain group or atoms of a sidechain that are expected to be planar.

Mol	Chain	#Chirality outliers	#Planarity outliers
1	A	0	1

All (2) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	A	224	THR	CA-CB	6.23	1.59	1.54
1	A	255	THR	CA-CB	5.00	1.60	1.53

All (71) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	19	ARG	CD-NE-CZ	17.68	149.16	124.40
1	A	19	ARG	NE-CZ-NH2	-12.75	107.72	119.20
1	A	186	ARG	NE-CZ-NH1	9.81	131.31	121.50
1	A	247	ARG	NE-CZ-NH1	-8.40	113.09	121.50
1	A	204	ASN	CA-CB-CG	-7.87	104.73	112.60
1	A	73	ALA	N-CA-CB	-7.80	100.73	111.65
1	A	248	ASN	OD1-CG-ND2	7.70	130.30	122.60
1	A	116	ASN	OD1-CG-ND2	-7.64	114.96	122.60
1	A	109	GLN	OE1-CD-NE2	7.54	130.14	122.60
1	A	38	THR	CA-CB-OG1	-7.42	98.46	109.60
1	A	10	ARG	NE-CZ-NH2	7.25	125.73	119.20

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Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	182	GLN	CB-CG-CD	7.22	124.87	112.60
1	A	248	ASN	CB-CG-ND2	-7.10	105.75	116.40
1	A	116	ASN	CB-CG-ND2	7.08	127.02	116.40
1	A	120	HIS	CA-CB-CG	-6.95	106.85	113.80
1	A	53	GLY	CA-C-N	6.91	130.45	122.85
1	A	53	GLY	C-N-CA	6.91	130.45	122.85
1	A	140	ASN	OD1-CG-ND2	6.81	129.41	122.60
1	A	10	ARG	NH1-CZ-NH2	-6.76	110.51	119.30
1	A	265	SER	CA-CB-OG	-6.75	97.61	111.10
1	A	132	SER	CA-C-O	-6.73	111.99	120.20
1	A	52	PRO	CA-C-N	-6.51	111.84	122.20
1	A	52	PRO	C-N-CA	-6.51	111.84	122.20
1	A	9	SER	CB-CA-C	6.51	123.16	110.67
1	A	108	ALA	CA-C-O	-6.50	113.66	120.55
1	A	204	ASN	CA-C-O	-6.45	114.36	121.84
1	A	166	SER	CA-CB-OG	-6.45	98.21	111.10
1	A	183	ASN	CA-CB-CG	-6.39	106.21	112.60
1	A	54	GLU	O-C-N	6.28	126.32	121.23
1	A	204	ASN	O-C-N	6.28	130.33	122.55
1	A	14	PRO	CA-C-N	6.22	128.52	120.44
1	A	14	PRO	C-N-CA	6.22	128.52	120.44
1	A	140	ASN	CB-CG-OD1	-6.00	108.79	120.80
1	A	248	ASN	CA-CB-CG	-6.00	106.60	112.60
1	A	191	GLN	O-C-N	-5.99	115.50	122.87
1	A	183	ASN	O-C-N	5.90	130.51	122.37
1	A	41	ASP	CA-CB-CG	-5.85	106.75	112.60
1	A	275	ARG	CD-NE-CZ	-5.85	116.21	124.40
1	A	227	VAL	CA-C-O	-5.77	114.54	120.71
1	A	62	ASN	CA-C-N	5.72	129.37	123.30
1	A	62	ASN	C-N-CA	5.72	129.37	123.30
1	A	204	ASN	CB-CA-C	-5.60	103.94	111.89
1	A	75	LEU	O-C-N	5.59	129.75	122.87
1	A	50	PHE	CA-CB-CG	-5.55	108.25	113.80
1	A	36	SER	CA-CB-OG	-5.52	100.06	111.10
1	A	186	ARG	CD-NE-CZ	5.50	132.10	124.40
1	A	218	ASN	O-C-N	5.48	130.35	123.23
1	A	26	VAL	CA-C-O	-5.48	114.67	120.48
1	A	19	ARG	NE-CZ-NH1	5.46	126.95	121.50
1	A	71	THR	CA-C-O	5.45	126.19	120.42
1	A	259	SER	N-CA-C	5.45	118.37	110.42
1	A	4	VAL	O-C-N	5.42	125.91	120.92
1	A	6	TRP	CA-C-O	-5.39	114.84	120.55

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Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	45	ARG	NE-CZ-NH2	-5.33	114.40	119.20
1	A	134	THR	CA-CB-OG1	-5.32	101.62	109.60
1	A	135	LEU	N-CA-CB	-5.31	102.31	110.12
1	A	2	GLN	CA-C-N	-5.29	114.50	122.81
1	A	2	GLN	C-N-CA	-5.29	114.50	122.81
1	A	73	ALA	N-CA-C	5.20	117.11	110.61
1	A	234	VAL	CA-C-O	-5.18	115.56	120.95
1	A	104	ILE	CB-CA-C	-5.14	105.31	112.04
1	A	186	ARG	NE-CZ-NH2	-5.13	114.59	119.20
1	A	112	GLU	CB-CG-CD	5.12	121.30	112.60
1	A	184	ASN	OD1-CG-ND2	5.11	127.71	122.60
1	A	54	GLU	N-CA-CB	5.08	117.39	110.79
1	A	185	ASN	OD1-CG-ND2	5.04	127.64	122.60
1	A	15	ALA	N-CA-C	-5.04	105.67	111.07
1	A	271	GLU	O-C-N	5.04	127.53	122.09
1	A	32	ASP	N-CA-CB	-5.04	104.37	109.51
1	A	32	ASP	CA-CB-CG	5.02	117.62	112.60
1	A	89	GLU	CG-CD-OE2	-5.02	106.86	118.40

There are no chirality outliers.

All (1) planarity outliers are listed below:

Mol	Chain	Res	Type	Group
1	A	275	ARG	Sidechain

5.2 Too-close contacts [i](#)

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	1890	0	1843	14	0
2	A	5	0	0	0	0
3	A	2	0	0	0	0
4	A	104	0	0	0	0
All	All	2001	0	1843	14	0

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 (14) 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:182:GLN:HE21	1:A:182:GLN:H	1.42	0.66
1:A:125:SER:O	1:A:221:SEB:HH2	1.96	0.65
1:A:182:GLN:H	1:A:182:GLN:NE2	2.03	0.56
1:A:21:LEU:CD1	1:A:274:THR:HB	2.37	0.54
1:A:132:SER:HB3	1:A:135:LEU:HB3	1.89	0.54
1:A:26:VAL:HG11	1:A:232:ALA:HA	1.94	0.50
1:A:150:VAL:HG12	1:A:224:THR:HG23	1.95	0.47
1:A:126:LEU:C	1:A:126:LEU:HD12	2.39	0.47
1:A:237:LYS:HE3	1:A:274:THR:O	2.17	0.45
1:A:29:ALA:HB2	1:A:119:MET:HG3	2.01	0.43
1:A:104:ILE:HD13	1:A:104:ILE:HA	1.89	0.42
1:A:257:LEU:HD11	1:A:267:LEU:HB2	2.02	0.42
1:A:47:GLY:HA3	1:A:92:ALA:O	2.20	0.41
1:A:69:ALA:HB1	1:A:90:LEU:HD21	2.03	0.40

There are no symmetry-related clashes.

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	266/269 (99%)	256 (96%)	10 (4%)	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	192/192 (100%)	190 (99%)	2 (1%)	68	52

All (2) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	19	ARG
1	A	182	GLN

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (7) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	109	GLN
1	A	117	ASN
1	A	140	ASN
1	A	173	ASN
1	A	182	GLN
1	A	204	ASN
1	A	261	ASN

5.3.3 RNA ⓘ

There are no RNA molecules in this entry.

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

1 non-standard protein/DNA/RNA residue is modelled in this entry.

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	$\# Z > 2$
1	SEB	A	221	1	15,16,17	1.03	0	16,21,23	2.35	4 (25%)

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
1	SEB	A	221	1	-	2/10/13/15	0/1/1/1

There are no bond length outliers.

All (4) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	221	SEB	OG-CB-CA	5.30	114.12	107.63
1	A	221	SEB	OD1-SD-CE	4.81	119.33	108.71
1	A	221	SEB	CB-OG-SD	-3.91	110.88	119.30
1	A	221	SEB	OD2-SD-CE	-2.73	102.68	108.71

There are no chirality outliers.

All (2) torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
1	A	221	SEB	CB-OG-SD-OD1
1	A	221	SEB	CZ-CE-SD-OG

There are no ring outliers.

1 monomer is involved in 1 short contact:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
1	A	221	SEB	1	0

5.5 Carbohydrates [i](#)

There are no oligosaccharides in this entry.

5.6 Ligand geometry [i](#)

Of 3 ligands modelled in this entry, 2 are monoatomic - leaving 1 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	$\# Z > 2$
2	SO4	A	276	-	4,4,4	0.75	0	6,6,6	0.31	0

There are no bond length outliers.

There are no bond angle outliers.

There are no chirality outliers.

There are no torsion outliers.

There are no ring outliers.

No monomer is involved in short contacts.

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.