



Full wwPDB X-ray Structure Validation Report ⓘ

Mar 9, 2026 – 11:25 AM UTC

PDB ID : 1IAV / pdb_00001iav
Title : STRUCTURE ON NATIVE (ASN 87) SUBTILISIN FROM BACILLUS LENTUS
Authors : Knapp, M.; Bott, R.
Deposited on : 2001-03-23
Resolution : 1.80 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

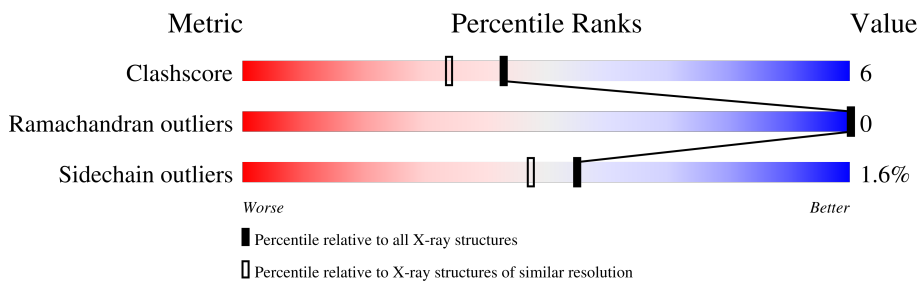
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 1.80 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	8479 (1.80-1.80)
Ramachandran outliers	187476	8391 (1.80-1.80)
Sidechain outliers	187428	8390 (1.80-1.80)

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	 69% 25% 6%

2 Entry composition [i](#)

There are 4 unique types of molecules in this entry. The entry contains 2009 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
			Total	C	N	O	S			
1	A	269	1891	1158	348	381	4	0	0	0

There are 2 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	87	ASN	SER	engineered mutation	UNP P29600
A	221	SEB	SER	modified residue	UNP P29600

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



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

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

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

- Molecule 4 is water.

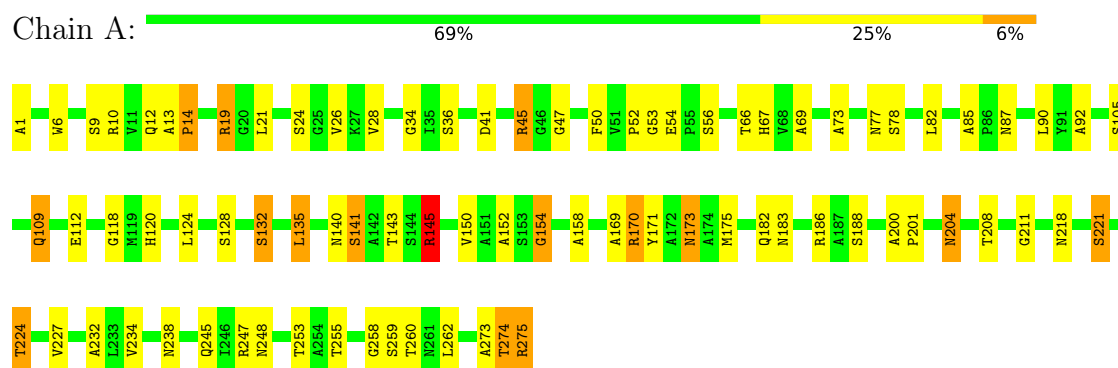
Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
4	A	111	Total 111	O 111	0	0

3 Residue-property plots

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



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	53.30Å 61.50Å 75.10Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	10.00 – 1.80	Depositor
% Data completeness (in resolution range)	73.0 (10.00-1.80)	Depositor
R_{merge}	0.07	Depositor
R_{sym}	(Not available)	Depositor
Refinement program	PROLSQ	Depositor
R, R_{free}	0.148 , (Not available)	Depositor
Estimated twinning fraction	No twinning to report.	Xtriage
Total number of atoms	2009	wwPDB-VP
Average B, all atoms (Å ²)	11.0	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, CA, SEB

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	1.21	1/1908 (0.1%)	2.26	90/2606 (3.5%)

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	3

All (1) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	A	224	THR	CA-CB	5.84	1.59	1.54

All (90) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	19	ARG	CD-NE-CZ	20.07	152.50	124.40
1	A	109	GLN	OE1-CD-NE2	10.17	132.77	122.60
1	A	275	ARG	NE-CZ-NH1	9.79	131.29	121.50
1	A	274	THR	CA-C-O	9.71	131.41	119.95
1	A	186	ARG	NE-CZ-NH1	9.41	130.91	121.50
1	A	208	THR	CA-C-O	8.84	130.92	121.55
1	A	275	ARG	NE-CZ-NH2	-8.35	111.68	119.20
1	A	36	SER	CA-CB-OG	-8.22	94.66	111.10
1	A	34	GLY	CA-C-O	-8.19	114.84	122.13
1	A	238	ASN	O-C-N	8.03	128.49	121.34
1	A	245	GLN	N-CA-CB	8.01	121.62	110.01
1	A	9	SER	CA-C-O	-7.93	110.44	119.79

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Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	19	ARG	NE-CZ-NH2	-7.78	112.20	119.20
1	A	186	ARG	CD-NE-CZ	7.57	135.00	124.40
1	A	50	PHE	O-C-N	7.42	131.87	122.22
1	A	218	ASN	O-C-N	7.39	132.33	123.24
1	A	73	ALA	N-CA-CB	-7.34	100.20	111.66
1	A	67	HIS	CB-CA-C	7.34	122.26	110.96
1	A	132	SER	CA-C-O	-7.29	112.51	120.24
1	A	248	ASN	OD1-CG-ND2	7.21	129.81	122.60
1	A	118	GLY	O-C-N	7.19	129.11	122.57
1	A	53	GLY	CA-C-N	7.03	130.19	122.74
1	A	53	GLY	C-N-CA	7.03	130.19	122.74
1	A	120	HIS	CA-CB-CG	-7.00	106.80	113.80
1	A	183	ASN	CA-CB-CG	-6.93	105.67	112.60
1	A	175	MET	CA-C-N	6.88	131.58	122.30
1	A	175	MET	C-N-CA	6.88	131.58	122.30
1	A	245	GLN	O-C-N	6.85	129.13	122.07
1	A	208	THR	O-C-N	-6.73	114.54	122.81
1	A	77	ASN	OD1-CG-ND2	-6.71	115.89	122.60
1	A	14	PRO	CA-C-N	6.70	129.26	120.28
1	A	14	PRO	C-N-CA	6.70	129.26	120.28
1	A	186	ARG	NE-CZ-NH2	-6.20	113.62	119.20
1	A	262	LEU	N-CA-CB	-6.15	101.10	110.33
1	A	85	ALA	N-CA-CB	-6.14	102.19	111.21
1	A	273	ALA	N-CA-C	6.09	119.97	112.54
1	A	6	TRP	CA-C-O	-6.08	114.43	120.82
1	A	275	ARG	CD-NE-CZ	-6.03	115.96	124.40
1	A	274	THR	CA-CB-OG1	-6.02	100.57	109.60
1	A	275	ARG	CA-C-O	-5.93	110.72	120.80
1	A	28	VAL	CA-C-O	5.86	126.19	120.27
1	A	45	ARG	CA-C-N	5.83	128.47	120.72
1	A	45	ARG	C-N-CA	5.83	128.47	120.72
1	A	54	GLU	O-C-N	5.78	126.09	121.17
1	A	245	GLN	CA-C-O	-5.78	114.75	120.82
1	A	260	THR	N-CA-C	-5.78	106.19	113.18
1	A	1	ALA	N-CA-CB	-5.75	101.77	110.40
1	A	247	ARG	NE-CZ-NH1	-5.75	115.75	121.50
1	A	182	GLN	CB-CG-CD	5.69	122.27	112.60
1	A	82	LEU	CA-C-N	-5.62	115.20	121.83
1	A	82	LEU	C-N-CA	-5.62	115.20	121.83
1	A	87	ASN	CA-CB-CG	-5.60	107.00	112.60
1	A	175	MET	O-C-N	-5.60	116.21	122.93
1	A	10	ARG	NH1-CZ-NH2	-5.57	112.05	119.30

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Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	56	SER	CA-C-O	-5.57	115.14	121.72
1	A	78	SER	CA-C-O	-5.55	113.17	119.78
1	A	140	ASN	OD1-CG-ND2	5.51	128.11	122.60
1	A	218	ASN	CA-C-O	-5.47	114.71	121.11
1	A	248	ASN	CB-CG-ND2	-5.47	108.20	116.40
1	A	218	ASN	CB-CG-ND2	-5.47	108.20	116.40
1	A	112	GLU	CG-CD-OE2	-5.46	105.85	118.40
1	A	188	SER	O-C-N	5.45	127.90	122.12
1	A	173	ASN	CA-CB-CG	-5.43	107.17	112.60
1	A	170	ARG	CD-NE-CZ	-5.40	116.84	124.40
1	A	227	VAL	CA-C-O	-5.38	114.95	120.71
1	A	56	SER	O-C-N	5.37	128.96	122.94
1	A	143	THR	CA-C-N	-5.30	111.24	121.58
1	A	143	THR	C-N-CA	-5.30	111.24	121.58
1	A	154	GLY	N-CA-C	-5.28	106.94	111.95
1	A	52	PRO	CA-C-N	-5.26	114.25	122.51
1	A	52	PRO	C-N-CA	-5.26	114.25	122.51
1	A	141	SER	CB-CA-C	5.24	119.18	110.90
1	A	255	THR	CA-C-O	5.22	126.28	120.43
1	A	66	THR	CA-C-N	5.22	127.54	120.65
1	A	66	THR	C-N-CA	5.22	127.54	120.65
1	A	169	ALA	O-C-N	5.21	128.31	122.22
1	A	253	THR	CA-CB-CG2	5.18	119.30	110.50
1	A	128	SER	N-CA-CB	-5.18	101.87	111.19
1	A	211	GLY	N-CA-C	-5.15	106.63	115.08
1	A	41	ASP	CA-CB-CG	-5.14	107.46	112.60
1	A	145	ARG	CD-NE-CZ	-5.12	117.22	124.40
1	A	82	LEU	CA-C-O	-5.12	113.99	120.28
1	A	135	LEU	N-CA-CB	-5.09	102.64	110.12
1	A	158	ALA	CA-C-O	5.09	127.32	121.47
1	A	52	PRO	N-CA-CB	5.07	107.83	103.27
1	A	87	ASN	OD1-CG-ND2	-5.07	117.53	122.60
1	A	171	TYR	CA-C-O	5.06	126.76	121.19
1	A	12	GLN	CG-CD-NE2	5.04	123.96	116.40
1	A	234	VAL	O-C-N	5.03	127.01	121.83
1	A	204	ASN	CA-CB-CG	-5.02	107.58	112.60

There are no chirality outliers.

All (3) planarity outliers are listed below:

Mol	Chain	Res	Type	Group
1	A	145	ARG	Sidechain

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Mol	Chain	Res	Type	Group
1	A	275	ARG	Sidechain
1	A	45	ARG	Sidechain

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	1891	0	1844	23	0
2	A	5	0	0	0	0
3	A	2	0	0	0	0
4	A	111	0	0	4	0
All	All	2009	0	1844	23	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 6.

All (23) 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:204:ASN:HB2	4:A:351:HOH:O	1.37	1.22
1:A:152:ALA:HB3	1:A:221:SEB:HI1	1.25	1.15
1:A:152:ALA:CB	1:A:221:SEB:HI1	1.97	0.93
1:A:154:GLY:HA2	1:A:221:SEB:CJ	2.17	0.74
1:A:132:SER:HB3	1:A:135:LEU:HB3	1.70	0.73
1:A:21:LEU:CD1	1:A:274:THR:HB	2.22	0.69
1:A:221:SEB:HH1	1:A:221:SEB:OG	1.95	0.66
1:A:204:ASN:CB	4:A:351:HOH:O	2.13	0.60
1:A:141:SER:O	1:A:145:ARG:HG3	2.04	0.56
1:A:204:ASN:O	1:A:204:ASN:OD1	2.27	0.53
1:A:204:ASN:CA	4:A:351:HOH:O	2.54	0.51
1:A:150:VAL:HG12	1:A:224:THR:HG23	1.93	0.49
1:A:105:SER:O	1:A:109:GLN:HG3	2.12	0.49
1:A:26:VAL:HG11	1:A:232:ALA:HA	1.96	0.47
1:A:21:LEU:HD12	1:A:274:THR:HB	1.93	0.47
1:A:47:GLY:HA3	1:A:92:ALA:O	2.16	0.46
1:A:258:GLY:O	1:A:259:SER:C	2.60	0.45

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:173:ASN:HD22	1:A:173:ASN:HA	1.63	0.45
1:A:221:SEB:CH2	4:A:360:HOH:O	2.65	0.43
1:A:13:ALA:HB3	1:A:14:PRO:HD3	2.00	0.42
1:A:69:ALA:HB1	1:A:90:LEU:HD21	2.01	0.42
1:A:200:ALA:HB1	1:A:201:PRO:HD2	2.03	0.41
1:A:170:ARG:HH11	1:A:170:ARG:HD2	1.67	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%)	258 (97%)	8 (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%)	190 (98%)	3 (2%)	55	47

All (3) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	19	ARG
1	A	24	SER
1	A	124	LEU

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (4) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	117	ASN
1	A	140	ASN
1	A	173	ASN
1	A	206	GLN

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	0.83	0	16,21,23	3.10	7 (43%)

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	-	6/10/13/15	0/1/1/1

There are no bond length outliers.

All (7) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	221	SEB	OG-CB-CA	6.40	115.47	107.63
1	A	221	SEB	CE-CZ-CH1	-5.43	114.01	120.56
1	A	221	SEB	CB-OG-SD	-5.33	107.82	119.30
1	A	221	SEB	CE-CZ-CH2	4.95	126.52	120.56
1	A	221	SEB	CJ-CI1-CH1	2.82	123.72	120.24
1	A	221	SEB	CI1-CJ-CI2	-2.61	116.30	119.87
1	A	221	SEB	OG-SD-CE	2.47	110.99	104.18

There are no chirality outliers.

All (6) torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
1	A	221	SEB	SD-CE-CZ-CH2
1	A	221	SEB	SD-CE-CZ-CH1
1	A	221	SEB	CB-OG-SD-CE
1	A	221	SEB	CB-OG-SD-OD1
1	A	221	SEB	CB-OG-SD-OD2
1	A	221	SEB	CA-CB-OG-SD

There are no ring outliers.

1 monomer is involved in 5 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
1	A	221	SEB	5	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	0.74	0	6,6,6	0.23	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.