



Full wwPDB X-ray Structure Validation Report ⓘ

Mar 8, 2026 – 06:54 AM UTC

PDB ID : 1NQM / pdb_00001nqm
Title : Structure of Savm-W120K, streptavidin mutant
Authors : Pazy, Y.; Eisenberg-Domovich, Y.; Laitinen, O.H.; Kulomaa, M.S.; Bayer, E.A.; Wilchek, M.; Livnah, O.
Deposited on : 2003-01-22
Resolution : 1.70 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

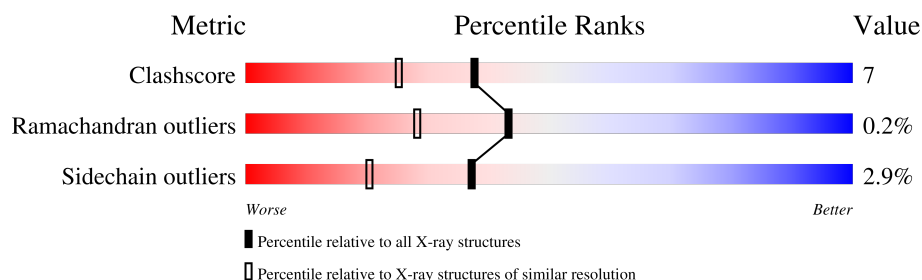
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 1.70 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	5924 (1.70-1.70)
Ramachandran outliers	187476	5846 (1.70-1.70)
Sidechain outliers	187428	5846 (1.70-1.70)

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	136	
1	B	136	
1	C	136	
1	D	136	

2 Entry composition

There are 3 unique types of molecules in this entry. The entry contains 3813 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.

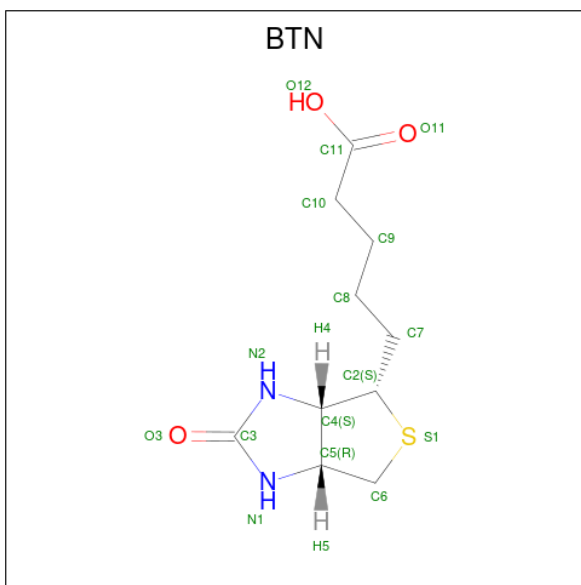
- Molecule 1 is a protein called Streptavidin.

Mol	Chain	Residues	Atoms				ZeroOcc	AltConf	Trace
1	A	118	Total	C	N	O	0	0	0
			873	544	153	176			
1	B	119	Total	C	N	O	0	0	0
			882	550	155	177			
1	C	119	Total	C	N	O	0	0	0
			882	550	155	177			
1	D	120	Total	C	N	O	0	0	0
			889	555	156	178			

There are 4 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	120	LYS	TRP	engineered mutation	UNP P22629
B	320	LYS	TRP	engineered mutation	UNP P22629
C	520	LYS	TRP	engineered mutation	UNP P22629
D	720	LYS	TRP	engineered mutation	UNP P22629

- Molecule 2 is BIOTIN (CCD ID: BTN) (formula: C₁₀H₁₆N₂O₃S).



Mol	Chain	Residues	Atoms					ZeroOcc	AltConf
2	A	1	Total	C	N	O	S	0	0
			16	10	2	3	1		
2	B	1	Total	C	N	O	S	0	0
			16	10	2	3	1		
2	C	1	Total	C	N	O	S	0	0
			16	10	2	3	1		
2	D	1	Total	C	N	O	S	0	0
			16	10	2	3	1		

- Molecule 3 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
3	A	60	Total	O	0	0
			60	60		
3	B	67	Total	O	0	0
			67	67		
3	C	51	Total	O	0	0
			51	51		
3	D	45	Total	O	0	0
			45	45		

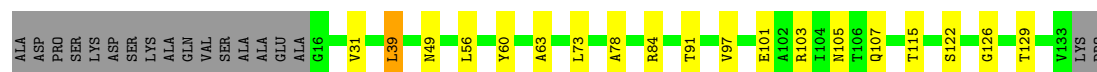
3 Residue-property plots [i](#)

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: Streptavidin

Chain A: 



• Molecule 1: Streptavidin

Chain B: 



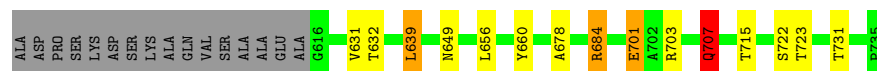
• Molecule 1: Streptavidin

Chain C: 



• Molecule 1: Streptavidin

Chain D: 



4 Data and refinement statistics

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

Property	Value	Source
Space group	P 1 21 1	Depositor
Cell constants a, b, c, α , β , γ	50.43Å 100.41Å 52.51Å 90.00° 112.12° 90.00°	Depositor
Resolution (Å)	40.00 – 1.70	Depositor
% Data completeness (in resolution range)	(Not available) (40.00-1.70)	Depositor
R_{merge}	(Not available)	Depositor
R_{sym}	(Not available)	Depositor
Refinement program	CNS	Depositor
R, R_{free}	0.212 , 0.240	Depositor
Estimated twinning fraction	No twinning to report.	Xtriage
Total number of atoms	3813	wwPDB-VP
Average B, all atoms (Å ²)	28.0	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: BTN

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	0.61	0/893	1.02	7/1221 (0.6%)
1	B	0.60	0/902	1.04	4/1232 (0.3%)
1	C	0.62	0/902	1.08	5/1232 (0.4%)
1	D	0.61	0/910	1.04	6/1244 (0.5%)
All	All	0.61	0/3607	1.05	22/4929 (0.4%)

There are no bond length outliers.

All (22) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	D	678	ALA	N-CA-C	-7.03	97.79	109.24
1	C	466	THR	N-CA-C	-6.75	102.15	110.65
1	A	107	GLN	N-CA-C	-6.69	98.06	109.24
1	B	333	VAL	N-CA-C	6.21	117.52	108.58
1	B	278	ALA	N-CA-C	-6.04	99.39	109.24
1	C	523	THR	N-CA-C	5.97	118.13	108.34
1	B	307	GLN	N-CA-C	-5.92	99.35	109.24
1	D	723	THR	N-CA-C	5.86	117.97	108.41
1	D	707	GLN	N-CA-C	-5.82	100.40	109.72
1	A	78	ALA	N-CA-C	-5.75	99.87	109.24
1	A	115	THR	N-CA-C	-5.63	103.27	110.53
1	A	122	SER	N-CA-C	5.54	119.21	112.23
1	C	478	ALA	N-CA-C	-5.53	100.23	109.24
1	C	522	SER	N-CA-C	5.53	118.23	111.82
1	C	515	THR	N-CA-C	-5.51	103.11	110.55
1	D	722	SER	N-CA-C	5.46	118.15	111.82
1	B	323	THR	N-CA-C	5.33	117.09	108.34
1	D	715	THR	N-CA-C	-5.27	103.73	110.53
1	D	684	ARG	N-CA-C	5.26	116.14	108.14
1	A	63	ALA	CA-C-N	5.19	125.17	120.03

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Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	63	ALA	C-N-CA	5.19	125.17	120.03
1	A	31	VAL	N-CA-C	5.13	117.11	108.81

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	873	0	822	11	0
1	B	882	0	835	13	0
1	C	882	0	835	15	0
1	D	889	0	842	12	0
2	A	16	0	15	0	0
2	B	16	0	15	0	0
2	C	16	0	15	0	0
2	D	16	0	15	0	0
3	A	60	0	0	0	0
3	B	67	0	0	1	0
3	C	51	0	0	0	0
3	D	45	0	0	0	0
All	All	3813	0	3394	49	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 7.

All (49) 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:B:303:ARG:HH11	1:B:303:ARG:HB3	1.35	0.89
1:B:303:ARG:HB3	1:B:303:ARG:NH1	1.92	0.84
1:C:449:ASN:HD21	1:C:484:ARG:HH21	1.24	0.82
1:D:703:ARG:HH11	1:D:703:ARG:HG3	1.44	0.81
1:B:333:VAL:O	1:B:334:LYS:HB2	1.81	0.79
1:C:449:ASN:HD21	1:C:484:ARG:NH2	1.92	0.66

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:D:703:ARG:HG3	1:D:703:ARG:NH1	2.11	0.63
1:C:449:ASN:ND2	1:C:484:ARG:HE	1.96	0.63
1:D:649:ASN:ND2	1:D:684:ARG:HH11	1.98	0.61
1:A:49:ASN:HD22	1:A:84:ARG:HH11	1.49	0.61
1:B:303:ARG:NH1	1:B:303:ARG:CB	2.63	0.61
1:D:649:ASN:HD22	1:D:684:ARG:HH11	1.48	0.60
1:B:305:ASN:OD1	1:B:329:THR:HG23	2.04	0.57
1:B:334:LYS:HE2	1:B:334:LYS:CA	2.39	0.53
1:D:639:LEU:HD13	1:D:660:TYR:CD2	2.43	0.53
1:B:249:ASN:HD22	1:B:284:ARG:HH11	1.57	0.53
1:C:439:LEU:HD13	1:C:460:TYR:CD2	2.44	0.52
1:C:533:VAL:O	1:C:534:LYS:HB2	2.09	0.51
1:C:473:LEU:HD12	1:C:473:LEU:C	2.36	0.51
1:C:484:ARG:HB3	1:C:484:ARG:NH1	2.26	0.50
1:D:701:GLU:CG	1:D:703:ARG:HH12	2.24	0.50
1:A:126:GLY:HA2	1:D:707:GLN:OE1	2.12	0.49
1:D:701:GLU:HG3	1:D:703:ARG:HH12	1.77	0.49
1:C:484:ARG:HB3	1:C:484:ARG:HH11	1.77	0.49
1:A:39:LEU:HD13	1:A:60:TYR:CD2	2.49	0.48
1:D:656:LEU:C	1:D:656:LEU:HD12	2.38	0.47
1:A:97:VAL:HG11	1:A:103:ARG:NH1	2.29	0.47
1:A:49:ASN:ND2	1:A:84:ARG:HH11	2.12	0.47
1:B:334:LYS:HE2	1:B:334:LYS:HA	1.97	0.47
1:C:520:LYS:HZ2	1:C:521:LYS:HG2	1.80	0.47
1:B:334:LYS:HE2	1:B:334:LYS:C	2.40	0.46
1:C:533:VAL:HG23	1:C:534:LYS:HG3	1.97	0.46
1:A:103:ARG:NE	1:A:105:ASN:HD21	2.14	0.46
1:C:533:VAL:O	1:C:534:LYS:CB	2.63	0.46
1:C:484:ARG:NH1	1:C:484:ARG:CB	2.79	0.45
1:A:56:LEU:HD12	1:A:56:LEU:C	2.42	0.44
1:A:73:LEU:C	1:A:73:LEU:HD12	2.42	0.44
1:D:639:LEU:HD13	1:D:660:TYR:HD2	1.83	0.44
1:C:456:LEU:C	1:C:456:LEU:HD12	2.43	0.44
1:B:333:VAL:O	1:B:334:LYS:CB	2.58	0.43
1:C:451:GLU:HG2	1:C:484:ARG:HD2	2.01	0.43
1:A:97:VAL:O	1:A:97:VAL:HG13	2.19	0.42
1:A:105:ASN:OD1	1:A:129:THR:HG23	2.18	0.42
1:D:631:VAL:HG22	1:D:632:THR:N	2.34	0.41
1:B:239:LEU:HD13	1:B:260:TYR:CD2	2.56	0.41
1:A:91:THR:HB	1:C:491:THR:HB	2.02	0.40
1:B:240:THR:HG23	3:B:848:HOH:O	2.21	0.40

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:D:703:ARG:HG2	1:D:731:THR:HG22	2.03	0.40
1:B:303:ARG:CB	1:B:303:ARG:CZ	2.99	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	116/136 (85%)	113 (97%)	3 (3%)	0	100	100
1	B	117/136 (86%)	113 (97%)	3 (3%)	1 (1%)	14	4
1	C	117/136 (86%)	113 (97%)	4 (3%)	0	100	100
1	D	118/136 (87%)	113 (96%)	5 (4%)	0	100	100
All	All	468/544 (86%)	452 (97%)	15 (3%)	1 (0%)	43	28

All (1) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	B	300	ALA

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	86/100 (86%)	84 (98%)	2 (2%)	44	27

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Mol	Chain	Analysed	Rotameric	Outliers	Percentiles	
1	B	87/100 (87%)	83 (95%)	4 (5%)	24	9
1	C	87/100 (87%)	86 (99%)	1 (1%)	65	54
1	D	88/100 (88%)	85 (97%)	3 (3%)	32	16
All	All	348/400 (87%)	338 (97%)	10 (3%)	37	20

All (10) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	39	LEU
1	A	101	GLU
1	B	239	LEU
1	B	301	GLU
1	B	303	ARG
1	B	334	LYS
1	C	439	LEU
1	D	639	LEU
1	D	701	GLU
1	D	707	GLN

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (9) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	49	ASN
1	A	105	ASN
1	B	249	ASN
1	B	327	HIS
1	C	449	ASN
1	C	507	GLN
1	C	527	HIS
1	D	649	ASN
1	D	727	HIS

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 [i](#)

There are no oligosaccharides in this entry.

5.6 Ligand geometry [i](#)

4 ligands are 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
2	BTN	C	550	-	17,17,17	1.72	6 (35%)	23,23,23	1.77	8 (34%)
2	BTN	B	350	-	17,17,17	1.99	7 (41%)	23,23,23	1.74	6 (26%)
2	BTN	D	750	-	17,17,17	1.70	4 (23%)	23,23,23	1.74	8 (34%)
2	BTN	A	150	-	17,17,17	1.68	4 (23%)	23,23,23	1.80	8 (34%)

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
2	BTN	C	550	-	-	0/7/28/28	0/2/2/2
2	BTN	B	350	-	-	0/7/28/28	0/2/2/2
2	BTN	D	750	-	-	0/7/28/28	0/2/2/2
2	BTN	A	150	-	-	0/7/28/28	0/2/2/2

All (21) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
2	A	150	BTN	C2-S1	3.82	1.88	1.82
2	B	350	BTN	C2-S1	3.72	1.88	1.82
2	A	150	BTN	C5-C4	3.15	1.64	1.55
2	D	750	BTN	C5-C4	3.12	1.64	1.55
2	B	350	BTN	C5-C4	3.11	1.64	1.55
2	D	750	BTN	C2-S1	2.99	1.87	1.82

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Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
2	B	350	BTN	C6-C5	2.98	1.59	1.53
2	C	550	BTN	C5-C4	2.83	1.63	1.55
2	C	550	BTN	C7-C2	2.73	1.59	1.52
2	C	550	BTN	C8-C9	2.36	1.63	1.51
2	A	150	BTN	C6-C5	2.32	1.57	1.53
2	D	750	BTN	C8-C9	2.27	1.63	1.51
2	A	150	BTN	C7-C2	2.23	1.58	1.52
2	C	550	BTN	C2-S1	2.22	1.86	1.82
2	D	750	BTN	C7-C2	2.16	1.58	1.52
2	B	350	BTN	C5-N1	2.13	1.49	1.46
2	B	350	BTN	C7-C2	2.13	1.58	1.52
2	B	350	BTN	C3-N2	2.07	1.39	1.35
2	B	350	BTN	O3-C3	2.06	1.27	1.23
2	C	550	BTN	C2-C4	-2.04	1.48	1.53
2	C	550	BTN	C6-C5	2.03	1.57	1.53

All (30) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
2	D	750	BTN	C8-C7-C2	-3.67	105.61	114.04
2	C	550	BTN	C2-C4-N2	3.59	117.14	113.34
2	B	350	BTN	C2-C4-N2	3.43	116.97	113.34
2	A	150	BTN	C8-C7-C2	-3.38	106.26	114.04
2	B	350	BTN	C8-C7-C2	-3.29	106.48	114.04
2	A	150	BTN	O11-C11-C10	3.15	133.08	123.09
2	B	350	BTN	O3-C3-N1	-2.95	121.64	125.89
2	D	750	BTN	O11-C11-C10	2.94	132.43	123.09
2	A	150	BTN	N2-C3-N1	2.92	112.22	108.85
2	D	750	BTN	O12-C11-C10	-2.88	104.91	114.00
2	B	350	BTN	C5-C6-S1	-2.84	102.15	106.06
2	A	150	BTN	C2-C4-N2	2.84	116.34	113.34
2	C	550	BTN	O3-C3-N1	-2.83	121.82	125.89
2	C	550	BTN	O11-C11-C10	2.80	131.96	123.09
2	D	750	BTN	N2-C3-N1	2.76	112.04	108.85
2	A	150	BTN	O3-C3-N1	-2.74	121.95	125.89
2	C	550	BTN	C8-C7-C2	-2.71	107.82	114.04
2	A	150	BTN	O12-C11-C10	-2.67	105.56	114.00
2	C	550	BTN	N2-C3-N1	2.65	111.91	108.85
2	A	150	BTN	C5-C6-S1	-2.59	102.49	106.06
2	B	350	BTN	N2-C3-N1	2.58	111.83	108.85
2	D	750	BTN	O3-C3-N1	-2.58	122.18	125.89
2	C	550	BTN	O12-C11-C10	-2.51	106.08	114.00

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Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
2	D	750	BTN	C5-C6-S1	-2.47	102.66	106.06
2	B	350	BTN	O11-C11-C10	2.41	130.74	123.09
2	A	150	BTN	C2-C4-C5	-2.41	105.95	108.89
2	C	550	BTN	C5-C6-S1	-2.33	102.86	106.06
2	D	750	BTN	C2-C4-N2	2.27	115.74	113.34
2	C	550	BTN	C5-C4-N2	-2.24	100.15	102.68
2	D	750	BTN	C2-C4-C5	-2.10	106.33	108.89

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.