



Full wwPDB X-ray Structure Validation Report ⓘ

Mar 13, 2026 – 09:59 AM UTC

PDB ID : 1REJ / pdb_00001rej
Title : Crystal structure of cAMP-dependent protein kinase complexed with balanol analog 1
Authors : Akamine, P.; Madhusudan; Brunton, L.L.; Ou, H.D.; Canaves, J.M.; Xuong, N.H.; Taylor, S.S.
Deposited on : 2003-11-06
Resolution : 2.20 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
Buster-report	:	wwPDB partial adaption of 1.1.7 (2018)
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

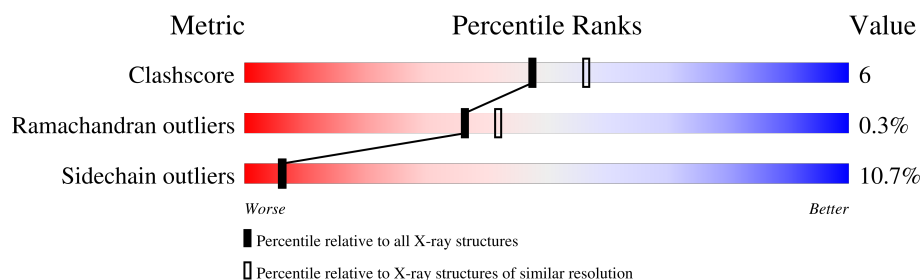
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 2.20 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	6851 (2.20-2.20)
Ramachandran outliers	187476	6768 (2.20-2.20)
Sidechain outliers	187428	6769 (2.20-2.20)

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	350	 69% 21% 6% .

2 Entry composition [i](#)

There are 3 unique types of molecules in this entry. The entry contains 2744 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.

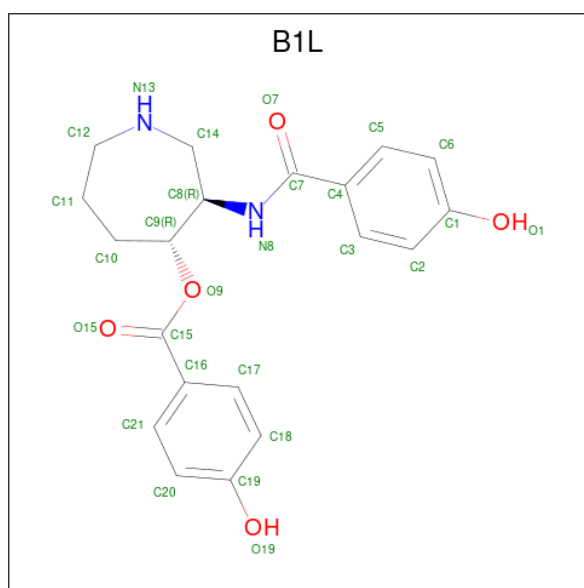
- Molecule 1 is a protein called cAMP-dependent protein kinase, alpha-catalytic subunit.

Mol	Chain	Residues	Atoms						ZeroOcc	AltConf	Trace
			Total	C	N	O	P	S			
1	A	335	2635	1704	438	483	2	8	0	0	0

There are 2 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	197	TPO	THR	modified residue	UNP P05132
A	338	SEP	SER	modified residue	UNP P05132

- Molecule 2 is 3-[(4-HYDROXYBENZOYL)AMINO]AZEPAN-4-YL 4-HYDROXYBENZOATE (CCD ID: B1L) (formula: C₂₀H₂₂N₂O₅).



Mol	Chain	Residues	Atoms				ZeroOcc	AltConf
			Total	C	N	O		
2	A	1	27	20	2	5	0	0

- Molecule 3 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
3	A	82	Total	O	0	0
			82	82		

Note EDS was not executed.

- Molecule 1: cAMP-dependent protein kinase, alpha-catalytic subunit



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	53.50Å 72.10Å 97.60Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	50.00 – 2.20	Depositor
% Data completeness (in resolution range)	(Not available) (50.00-2.20)	Depositor
R_{merge}	0.07	Depositor
R_{sym}	(Not available)	Depositor
Refinement program	X-PLOR 3.851	Depositor
R, R_{free}	0.208 , 0.291	Depositor
Estimated twinning fraction	No twinning to report.	Xtriage
Total number of atoms	2744	wwPDB-VP
Average B, all atoms (Å ²)	29.0	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: TPO, B1L, SEP

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	0.91	10/2681 (0.4%)	1.67	47/3637 (1.3%)

All (10) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	A	260	HIS	CD2-NE2	-7.07	1.30	1.37
1	A	131	HIS	CD2-NE2	-6.94	1.30	1.37
1	A	62	HIS	CD2-NE2	-6.52	1.30	1.37
1	A	68	HIS	CD2-NE2	-6.45	1.30	1.37
1	A	119	VAL	CA-CB	6.42	1.61	1.54
1	A	87	HIS	CD2-NE2	-6.39	1.30	1.37
1	A	158	HIS	CD2-NE2	-6.37	1.30	1.37
1	A	142	HIS	CD2-NE2	-5.77	1.31	1.37
1	A	294	HIS	CD2-NE2	-5.72	1.31	1.37
1	A	79	VAL	CA-CB	5.23	1.61	1.54

All (47) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	175	ASP	CA-CB-CG	10.35	122.95	112.60
1	A	41	ASP	CA-CB-CG	9.71	122.31	112.60
1	A	165	ARG	N-CA-C	8.91	124.11	113.23
1	A	328	ASP	CA-CB-CG	8.57	121.17	112.60
1	A	40	LEU	N-CA-C	7.27	119.84	111.11
1	A	277	LEU	N-CA-CB	-7.27	98.66	110.14
1	A	115	ASN	N-CA-C	7.03	120.10	109.41
1	A	142	HIS	CA-CB-CG	6.80	120.60	113.80
1	A	235	TYR	CA-C-N	6.53	124.43	119.66
1	A	235	TYR	C-N-CA	6.53	124.43	119.66
1	A	44	ASP	CA-CB-CG	6.41	119.01	112.60

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Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	131	HIS	CB-CG-CD2	-6.14	123.21	131.20
1	A	296	TRP	CG-CD2-CE3	6.13	140.03	133.90
1	A	124	ALA	N-CA-C	6.05	119.76	112.38
1	A	201	THR	CA-C-N	5.95	127.28	119.84
1	A	201	THR	C-N-CA	5.95	127.28	119.84
1	A	276	ASP	CA-C-N	5.86	128.93	120.38
1	A	276	ASP	C-N-CA	5.86	128.93	120.38
1	A	158	HIS	CB-CG-CD2	-5.75	123.73	131.20
1	A	294	HIS	CB-CG-CD2	-5.75	123.73	131.20
1	A	293	ASN	CA-CB-CG	5.74	118.34	112.60
1	A	296	TRP	CE2-CD2-CG	-5.47	100.64	107.20
1	A	192	LYS	N-CA-C	-5.46	98.86	108.20
1	A	84	GLN	N-CA-C	5.41	120.56	113.20
1	A	301	ASP	CA-CB-CG	5.37	117.97	112.60
1	A	277	LEU	CA-CB-CG	5.33	134.96	116.30
1	A	27	LEU	N-CA-C	5.30	116.74	111.07
1	A	119	VAL	CA-C-O	5.29	126.36	120.59
1	A	196	TRP	CE2-CD2-CG	-5.27	100.88	107.20
1	A	302	TRP	CE2-CD2-CG	-5.25	100.90	107.20
1	A	196	TRP	CG-CD2-CE3	5.22	139.12	133.90
1	A	95	LEU	N-CA-C	5.21	116.96	111.28
1	A	221	TRP	CE2-CD2-CG	-5.18	100.99	107.20
1	A	260	HIS	CB-CG-CD2	-5.14	124.52	131.20
1	A	30	TRP	CE2-CD2-CG	-5.11	101.07	107.20
1	A	37	THR	N-CA-C	5.10	119.49	113.16
1	A	68	HIS	CB-CG-CD2	-5.10	124.57	131.20
1	A	252	SER	N-CA-C	-5.09	105.81	111.36
1	A	195	THR	CA-CB-OG1	-5.07	102.00	109.60
1	A	46	ILE	N-CA-C	5.05	115.61	111.62
1	A	222	TRP	CE2-CD2-CG	-5.05	101.14	107.20
1	A	84	GLN	OE1-CD-NE2	-5.02	117.58	122.60
1	A	32	THR	CA-C-N	5.02	124.95	119.78
1	A	32	THR	C-N-CA	5.02	124.95	119.78
1	A	315	ILE	CA-C-N	5.02	124.93	119.76
1	A	315	ILE	C-N-CA	5.02	124.93	119.76
1	A	221	TRP	CG-CD2-CE3	5.01	138.91	133.90

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	2635	0	2479	29	0
2	A	27	0	20	0	0
3	A	82	0	0	2	0
All	All	2744	0	2499	29	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 (29) 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:51:THR:HA	1:A:56:ARG:HA	1.86	0.58
1:A:80:VAL:HG21	1:A:343:CYS:SG	2.46	0.55
1:A:46:ILE:HD11	1:A:61:LYS:HB2	1.90	0.54
1:A:125:GLY:HA3	1:A:174:ILE:O	2.09	0.53
1:A:176:GLN:H	1:A:176:GLN:CD	2.16	0.52
1:A:144:ARG:HD3	1:A:296:TRP:O	2.10	0.50
1:A:62:HIS:HD2	1:A:65:SER:H	1.60	0.49
1:A:30:TRP:CD1	1:A:190:ARG:HH21	2.30	0.48
1:A:89:LEU:HG	1:A:349:GLU:CG	2.43	0.48
1:A:137:ARG:HD2	3:A:369:HOH:O	2.13	0.48
1:A:125:GLY:O	1:A:131:HIS:HE1	1.97	0.48
1:A:89:LEU:HG	1:A:349:GLU:HG3	1.96	0.47
1:A:131:HIS:HD2	1:A:134:ARG:NH1	2.12	0.47
1:A:30:TRP:NE1	1:A:190:ARG:HH21	2.12	0.47
1:A:158:HIS:HE1	1:A:220:ASP:OD2	1.97	0.47
1:A:128:MET:CE	1:A:180:ILE:HD11	2.46	0.46
1:A:108:PHE:HB2	1:A:119:VAL:HG13	1.98	0.46
1:A:236:PRO:HB2	3:A:371:HOH:O	2.16	0.45
1:A:268:LEU:HG	1:A:272:LEU:HD22	1.97	0.45
1:A:103:LEU:HD12	1:A:182:VAL:HB	1.99	0.45
1:A:59:LEU:HD11	1:A:322:GLY:HA2	2.00	0.44
1:A:49:LEU:HD21	1:A:122:TYR:CE1	2.53	0.43
1:A:112:ASP:HB3	1:A:337:VAL:HG13	2.01	0.42
1:A:183:THR:HG23	1:A:184:ASP:OD1	2.19	0.42

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:345:LYS:O	1:A:348:THR:HG22	2.19	0.42
1:A:224:LEU:O	1:A:228:ILE:HG13	2.19	0.42
1:A:307:GLN:HE21	1:A:309:LYS:HG3	1.86	0.41
1:A:80:VAL:HG23	1:A:347:PHE:HE1	1.86	0.41
1:A:142:HIS:CD2	1:A:313:PRO:HG2	2.57	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	331/350 (95%)	309 (93%)	21 (6%)	1 (0%)	36 42

All (1) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	83	LYS

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	261/303 (86%)	233 (89%)	28 (11%)	6 6

All (28) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	23	LYS
1	A	27	LEU
1	A	31	GLU
1	A	34	SER
1	A	49	LEU
1	A	59	LEU
1	A	74	LEU
1	A	79	VAL
1	A	84	GLN
1	A	89	LEU
1	A	103	LEU
1	A	112	ASP
1	A	119	VAL
1	A	132	LEU
1	A	137	ARG
1	A	152	LEU
1	A	157	LEU
1	A	160	LEU
1	A	180	ILE
1	A	190	ARG
1	A	216	ASN
1	A	241	ASP
1	A	243	PRO
1	A	255	VAL
1	A	272	LEU
1	A	277	LEU
1	A	285	LYS
1	A	349	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	62	HIS
1	A	67	ASN
1	A	99	ASN
1	A	131	HIS
1	A	158	HIS
1	A	181	GLN
1	A	307	GLN
1	A	340	ASN

5.3.3 RNA ⓘ

There are no RNA molecules in this entry.

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

2 non-standard protein/DNA/RNA residues 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	$\# Z > 2$
1	TPO	A	197	1	8,10,11	1.29	0	10,14,16	1.09	0
1	SEP	A	338	1	8,9,10	1.04	0	7,12,14	2.61	2 (28%)

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	TPO	A	197	1	-	1/9/11/13	-
1	SEP	A	338	1	-	3/6/8/10	-

There are no bond length outliers.

All (2) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	338	SEP	OG-CB-CA	6.16	114.14	108.14
1	A	338	SEP	O3P-P-O2P	2.19	116.00	107.80

There are no chirality outliers.

All (4) torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
1	A	197	TPO	O-C-CA-CB
1	A	338	SEP	C-CA-CB-OG

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Mol	Chain	Res	Type	Atoms
1	A	338	SEP	CA-CB-OG-P
1	A	338	SEP	N-CA-CB-OG

There are no ring outliers.

No monomer is involved in short contacts.

5.5 Carbohydrates [i](#)

There are no oligosaccharides in this entry.

5.6 Ligand geometry [i](#)

1 ligand 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$
2	B1L	A	351	-	29,29,29	1.66	3 (10%)	33,39,39	1.32	4 (12%)

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	B1L	A	351	-	-	8/16/28/28	0/3/3/3

All (3) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
2	A	351	B1L	C4-C7	-4.91	1.39	1.50
2	A	351	B1L	C16-C15	-4.79	1.39	1.50
2	A	351	B1L	O9-C15	3.56	1.42	1.34

All (4) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
2	A	351	B1L	O9-C15-C16	5.01	119.96	111.90
2	A	351	B1L	C9-O9-C15	-2.64	111.60	117.33
2	A	351	B1L	O9-C15-O15	-2.44	119.58	123.55
2	A	351	B1L	C10-C11-C12	-2.26	108.91	114.69

There are no chirality outliers.

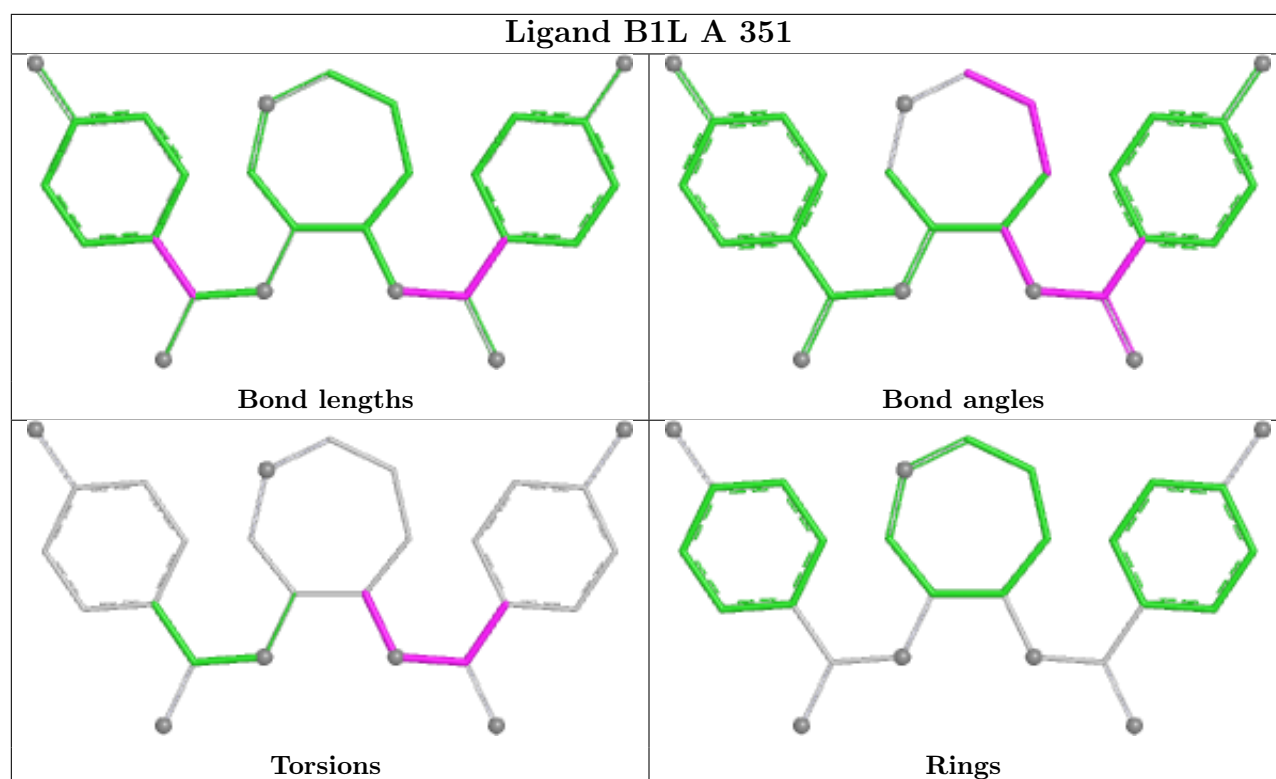
All (8) torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
2	A	351	B1L	C16-C15-O9-C9
2	A	351	B1L	O15-C15-O9-C9
2	A	351	B1L	O9-C15-C16-C21
2	A	351	B1L	O9-C15-C16-C17
2	A	351	B1L	O15-C15-C16-C21
2	A	351	B1L	O15-C15-C16-C17
2	A	351	B1L	C10-C9-O9-C15
2	A	351	B1L	C8-C9-O9-C15

There are no ring outliers.

No monomer is involved in short contacts.

The following is a two-dimensional graphical depiction of Mogul quality analysis of bond lengths, bond angles, torsion angles, and ring geometry for all instances of the Ligand of Interest. In addition, ligands with molecular weight > 250 and outliers as shown on the validation Tables will also be included. For torsion angles, if less than 5% of the Mogul distribution of torsion angles is within 10 degrees of the torsion angle in question, then that torsion angle is considered an outlier. Any bond that is central to one or more torsion angles identified as an outlier by Mogul will be highlighted in the graph. For rings, the root-mean-square deviation (RMSD) between the ring in question and similar rings identified by Mogul is calculated over all ring torsion angles. If the average RMSD is greater than 60 degrees and the minimal RMSD between the ring in question and any Mogul-identified rings is also greater than 60 degrees, then that ring is considered an outlier. The outliers are highlighted in purple. The color gray indicates Mogul did not find sufficient equivalents in the CSD to analyse the geometry.



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.