



Full wwPDB EM Validation Report ⓘ

Jul 7, 2025 – 06:44 PM JST

PDB ID : 8K1O / pdb_00008k1o
EMDB ID : EMD-36797
Title : mycobacterial efflux pump, AMPPNP bound state
Authors : Wang, Y.; Wu, F.; Zhang, L.; Rao, Z.
Deposited on : 2023-07-11
Resolution : 2.90 Å(reported)

This is a Full wwPDB EM 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/EMValidationReportHelp>

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:

EMDB validation analysis : **FAILED**
Mogul : 1.8.5 (274361), CSD as541be (2020)
MolProbity : 4-5-2 with Phenix2.0rc1
buster-report : 1.1.7 (2018)
Percentile statistics : 20231227.v01 (using entries in the PDB archive December 27th 2023)
MapQ : **FAILED**
Ideal geometry (proteins) : Engh & Huber (2001)
Ideal geometry (DNA, RNA) : Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP) : 2.44

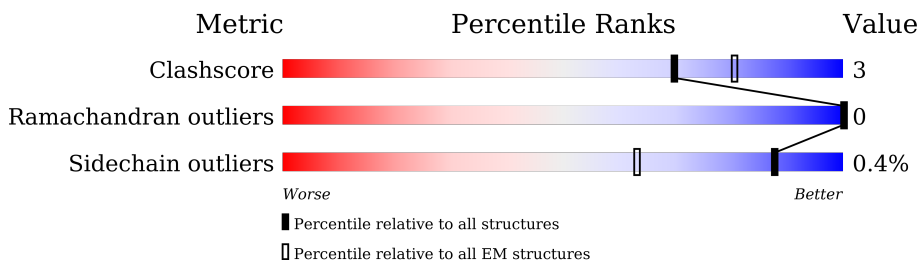
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

ELECTRON MICROSCOPY

The reported resolution of this entry is 2.90 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)	EM structures (#Entries)
Clashscore	210492	15764
Ramachandran outliers	207382	16835
Sidechain outliers	206894	16415

The table below summarises the geometric issues observed across the polymeric chains and their fit to the map. The red, orange, yellow and green segments of the 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 $\leq 5\%$.

Mol	Chain	Length	Quality of chain
1	A	548	
2	B	311	
2	C	311	

2 Entry composition [i](#)

There are 5 unique types of molecules in this entry. The entry contains 7163 atoms, of which 0 are hydrogens and 0 are deuteriums.

In the tables below, 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.

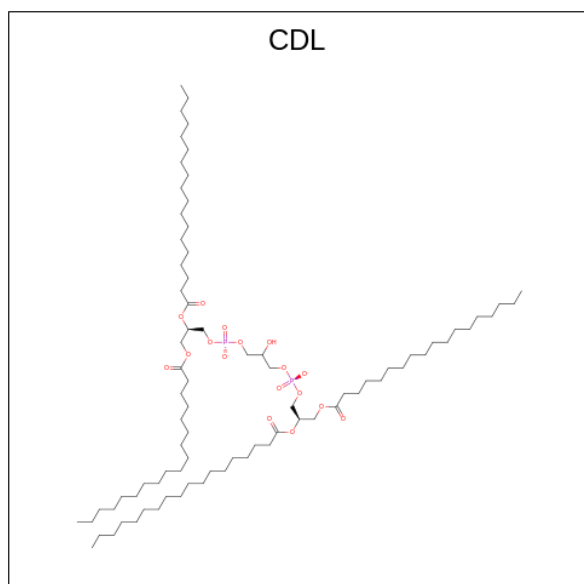
- Molecule 1 is a protein called Multidrug efflux system permease protein Rv1217c.

Mol	Chain	Residues	Atoms					AltConf	Trace
1	A	510	Total	C	N	O	S	0	0
			3718	2415	647	643	13		

- Molecule 2 is a protein called Multidrug efflux system ATP-binding protein Rv1218c.

Mol	Chain	Residues	Atoms					AltConf	Trace
2	B	215	Total	C	N	O	S	0	0
			1624	1015	298	307	4		
2	C	212	Total	C	N	O	S	0	0
			1597	1000	291	302	4		

- Molecule 3 is CARDIOLIPIN (CCD ID: CDL) (formula: $C_{81}H_{156}O_{17}P_2$) (labeled as "Ligand of Interest" by depositor).



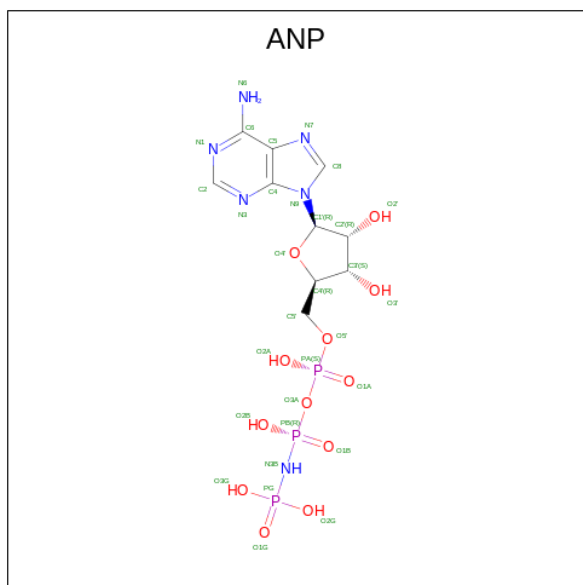
Mol	Chain	Residues	Atoms				AltConf
3	A	1	Total	C	O	P	0
			80	61	17	2	

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Mol	Chain	Residues	Atoms				AltConf
3	A	1	Total	C	O	P	0
			80	61	17	2	

- Molecule 4 is PHOSPHOAMINOPHOSPHONIC ACID-ADENYLATE ESTER (CCD ID: ANP) (formula: $C_{10}H_{17}N_6O_{12}P_3$) (labeled as "Ligand of Interest" by depositor).



Mol	Chain	Residues	Atoms					AltConf
4	B	1	Total	C	N	O	P	0
			31	10	6	12	3	
4	C	1	Total	C	N	O	P	0
			31	10	6	12	3	

- Molecule 5 is MAGNESIUM ION (CCD ID: MG) (formula: Mg) (labeled as "Ligand of Interest" by depositor).

Mol	Chain	Residues	Atoms		AltConf
5	B	1	Total	Mg	0
			1	1	
5	C	1	Total	Mg	0
			1	1	

4 Experimental information

Property	Value	Source
EM reconstruction method	SINGLE PARTICLE	Depositor
Imposed symmetry	POINT, C1	Depositor
Number of particles used	157931	Depositor
Resolution determination method	FSC 0.143 CUT-OFF	Depositor
CTF correction method	PHASE FLIPPING AND AMPLITUDE CORRECTION	Depositor
Microscope	FEI TITAN KRIOS	Depositor
Voltage (kV)	300	Depositor
Electron dose ($e^-/\text{\AA}^2$)	60	Depositor
Minimum defocus (nm)	1200	Depositor
Maximum defocus (nm)	2200	Depositor
Magnification	29000	Depositor
Image detector	GATAN K3 (6k x 4k)	Depositor

5 Model quality

5.1 Standard geometry

Bond lengths and bond angles in the following residue types are not validated in this section: MG, ANP, CDL

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	0.34	2/3798 (0.1%)	0.57	8/5190 (0.2%)
2	B	0.23	0/1648	0.49	2/2229 (0.1%)
2	C	0.18	0/1620	0.50	2/2191 (0.1%)
All	All	0.28	2/7066 (0.0%)	0.54	12/9610 (0.1%)

All (2) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	A	275	ALA	CA-CB	-5.53	1.45	1.53
1	A	399	ALA	CA-CB	-5.06	1.46	1.52

All (12) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	66	ASP	N-CA-C	-8.07	99.12	110.50
1	A	280	GLY	CA-C-N	-6.80	109.67	122.73
1	A	280	GLY	C-N-CA	-6.80	109.67	122.73
2	B	172	ASN	N-CA-C	-6.15	106.31	113.88
1	A	65	PRO	N-CA-C	5.93	124.69	112.47
2	C	14	GLY	N-CA-C	5.83	124.53	115.72
1	A	65	PRO	CB-CA-C	-5.69	102.17	111.56
2	B	34	GLU	N-CA-C	5.69	117.57	110.91
1	A	403	THR	CA-C-N	-5.63	111.75	120.31
1	A	403	THR	C-N-CA	-5.63	111.75	120.31
2	C	44	ASN	N-CA-C	5.43	119.61	113.15
1	A	400	VAL	CB-CA-C	5.31	118.53	110.62

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	3718	0	3859	20	0
2	B	1624	0	1664	10	0
2	C	1597	0	1643	15	0
3	A	160	0	214	7	0
4	B	31	0	13	2	0
4	C	31	0	13	3	0
5	B	1	0	0	0	0
5	C	1	0	0	0	0
All	All	7163	0	7406	50	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 3.

All (50) 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:137:THR:HG22	1:A:138:VAL:H	1.49	0.78
1:A:170:THR:HG22	1:A:171:ASP:H	1.55	0.70
1:A:314:LEU:CD2	3:A:601:CDL:H741	2.24	0.68
1:A:314:LEU:HD21	3:A:601:CDL:H741	1.76	0.67
2:C:54:ILE:HD13	2:C:61:ALA:HB2	1.76	0.67
2:B:44:ASN:ND2	4:B:401:ANP:O1G	2.27	0.66
4:C:401:ANP:O3G	4:C:401:ANP:O2B	2.14	0.65
2:C:44:ASN:ND2	4:C:401:ANP:O1G	2.35	0.59
2:B:85:ALA:HB3	2:B:157:LEU:HD23	1.86	0.57
1:A:373:ALA:HB1	1:A:460:LEU:HD12	1.86	0.56
1:A:366:THR:HG22	1:A:370:MET:HE3	1.88	0.55
2:C:85:ALA:HB3	2:C:157:LEU:HD23	1.89	0.55
2:C:28:LEU:HD23	2:C:30:LEU:H	1.73	0.53
1:A:67:ARG:HG3	1:A:70:ARG:HH12	1.74	0.51
3:A:601:CDL:HB61	3:A:601:CDL:H512	1.93	0.51
1:A:545:ASP:HB3	1:A:547:ARG:HG3	1.93	0.50
2:C:60:LYS:O	2:C:60:LYS:HG3	2.11	0.50
1:A:497:PHE:HB2	1:A:502:LEU:HD21	1.93	0.50
1:A:321:LEU:HD13	3:A:601:CDL:H821	1.94	0.49

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
2:B:34:GLU:O	2:B:34:GLU:HG3	2.13	0.49
2:C:208:ILE:HG22	2:C:213:THR:HA	1.96	0.47
1:A:469:GLY:HA2	1:A:544:ARG:HH11	1.79	0.47
2:C:48:LYS:N	4:C:401:ANP:O1B	2.44	0.47
1:A:118:VAL:HG21	1:A:192:THR:HG23	1.96	0.47
1:A:410:LEU:HD13	1:A:465:VAL:HG21	1.97	0.46
3:A:602:CDL:H542	3:A:602:CDL:H512	1.65	0.46
1:A:119:ILE:HG21	1:A:209:ARG:HG3	1.97	0.45
2:B:203:GLU:HG2	2:B:204:LYS:HG2	1.99	0.45
2:B:125:PHE:HB3	2:B:143:LYS:HD3	1.99	0.44
1:A:474:PHE:O	1:A:477:VAL:HG22	2.18	0.44
1:A:379:LEU:HD23	1:A:379:LEU:HA	1.89	0.44
2:C:37:VAL:HG12	2:C:202:CYS:HB3	2.00	0.43
2:C:137:SER:C	2:C:139:GLY:H	2.26	0.43
1:A:455:PRO:HG2	1:A:523:LEU:HD22	2.00	0.43
2:B:98:THR:HG23	2:B:131:LYS:H	1.83	0.43
2:C:15:LEU:HA	2:C:15:LEU:HD12	1.77	0.43
2:B:121:LEU:HD22	2:B:125:PHE:HE2	1.84	0.42
2:B:46:ALA:HB1	2:B:208:ILE:HG13	2.01	0.42
1:A:80:SER:O	1:A:80:SER:OG	2.38	0.42
3:A:602:CDL:H311	3:A:602:CDL:H342	1.85	0.42
1:A:137:THR:HG22	1:A:138:VAL:N	2.26	0.42
3:A:602:CDL:HB62	3:A:602:CDL:H712	1.66	0.42
2:C:107:ALA:HB2	2:C:113:ILE:HD12	2.01	0.42
2:B:50:THR:OG1	4:B:401:ANP:O2A	2.26	0.41
1:A:57:ILE:HD12	1:A:172:VAL:HG11	2.02	0.41
2:C:60:LYS:HB2	2:C:74:TRP:CZ3	2.55	0.41
2:B:139:GLY:O	2:B:143:LYS:HG3	2.21	0.41
2:C:13:ARG:HD3	2:C:13:ARG:HA	1.96	0.41
2:C:12:ILE:HG12	2:C:66:VAL:HG13	2.03	0.40
2:C:172:ASN:O	2:C:176:GLN:HG2	2.22	0.40

There are no symmetry-related clashes.

5.3 Torsion angles ⓘ

5.3.1 Protein backbone ⓘ

In the following table, the Percentiles column shows the percent Ramachandran outliers of the chain as a percentile score with respect to all PDB entries followed by that with respect to all EM entries.

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	506/548 (92%)	481 (95%)	25 (5%)	0	100	100
2	B	213/311 (68%)	195 (92%)	18 (8%)	0	100	100
2	C	210/311 (68%)	197 (94%)	13 (6%)	0	100	100
All	All	929/1170 (79%)	873 (94%)	56 (6%)	0	100	100

There are no Ramachandran outliers to report.

5.3.2 Protein sidechains ⓘ

In the following table, the Percentiles column shows the percent sidechain outliers of the chain as a percentile score with respect to all PDB entries followed by that with respect to all EM entries.

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	362/391 (93%)	360 (99%)	2 (1%)	84	95
2	B	175/256 (68%)	174 (99%)	1 (1%)	84	95
2	C	172/256 (67%)	172 (100%)	0	100	100
All	All	709/903 (78%)	706 (100%)	3 (0%)	88	97

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

Mol	Chain	Res	Type
1	A	138	VAL
1	A	493	SER
2	B	138	LYS

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (2) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	308	ASN
1	A	499	GLN

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 6 ligands modelled in this entry, 2 are monoatomic - leaving 4 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	ANP	B	401	5	29,33,33	1.03	3 (10%)	31,52,52	1.08	3 (9%)
3	CDL	A	601	-	79,79,99	0.46	0	85,91,111	0.56	1 (1%)
3	CDL	A	602	-	79,79,99	0.42	0	85,91,111	0.54	1 (1%)
4	ANP	C	401	5	29,33,33	1.05	3 (10%)	31,52,52	1.11	3 (9%)

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	ANP	B	401	5	-	2/14/38/38	0/3/3/3
3	CDL	A	601	-	-	29/90/90/110	-
3	CDL	A	602	-	-	32/90/90/110	-
4	ANP	C	401	5	-	4/14/38/38	0/3/3/3

All (6) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
4	C	401	ANP	PB-O3A	-2.57	1.55	1.59
4	B	401	ANP	PB-O3A	-2.53	1.55	1.59
4	C	401	ANP	PG-N3B	2.38	1.69	1.63
4	B	401	ANP	PG-N3B	2.24	1.69	1.63
4	C	401	ANP	PG-O1G	2.09	1.49	1.46
4	B	401	ANP	PG-O1G	2.05	1.49	1.46

All (8) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
4	C	401	ANP	PB-O3A-PA	-3.39	120.67	132.62
4	B	401	ANP	PB-O3A-PA	-3.13	121.58	132.62
3	A	601	CDL	OB6-CB5-C51	2.38	116.63	111.50
3	A	602	CDL	OB6-CB5-C51	2.32	116.51	111.50
4	B	401	ANP	C5-C6-N6	2.28	123.82	120.35
4	C	401	ANP	C5-C6-N6	2.26	123.79	120.35
4	B	401	ANP	O1B-PB-N3B	-2.09	108.69	111.77
4	C	401	ANP	O2G-PG-O1G	-2.04	108.31	113.45

There are no chirality outliers.

All (67) torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
3	A	601	CDL	CB3-OB5-PB2-OB3
3	A	601	CDL	OB7-CB5-OB6-CB4
3	A	601	CDL	C51-CB5-OB6-CB4
3	A	602	CDL	CA2-OA2-PA1-OA3
3	A	602	CDL	C11-CA5-OA6-CA4
3	A	602	CDL	CB2-OB2-PB2-OB3
3	A	602	CDL	CB3-OB5-PB2-OB4
3	A	602	CDL	C51-CB5-OB6-CB4
3	A	602	CDL	OB9-CB7-OB8-CB6
3	A	602	CDL	C71-CB7-OB8-CB6
4	B	401	ANP	PG-N3B-PB-O1B
4	B	401	ANP	PG-N3B-PB-O3A
4	C	401	ANP	PB-N3B-PG-O1G
4	C	401	ANP	PG-N3B-PB-O1B
3	A	602	CDL	OA7-CA5-OA6-CA4
3	A	602	CDL	OB7-CB5-OB6-CB4
3	A	601	CDL	OB9-CB7-OB8-CB6
3	A	601	CDL	C71-CB7-OB8-CB6

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Mol	Chain	Res	Type	Atoms
3	A	601	CDL	C31-CA7-OA8-CA6
3	A	602	CDL	C51-C52-C53-C54
3	A	601	CDL	C79-C80-C81-C82
3	A	601	CDL	OA9-CA7-OA8-CA6
3	A	601	CDL	C33-C34-C35-C36
3	A	602	CDL	C56-C57-C58-C59
3	A	601	CDL	C34-C35-C36-C37
3	A	601	CDL	C14-C15-C16-C17
3	A	601	CDL	C37-C38-C39-C40
3	A	601	CDL	C32-C33-C34-C35
3	A	601	CDL	C11-CA5-OA6-CA4
3	A	601	CDL	OA7-CA5-OA6-CA4
3	A	602	CDL	CA2-OA2-PA1-OA5
3	A	602	CDL	CB2-OB2-PB2-OB5
3	A	602	CDL	CB3-CB4-CB6-OB8
3	A	601	CDL	C13-C14-C15-C16
3	A	602	CDL	C53-C54-C55-C56
3	A	602	CDL	C62-C63-C64-C65
3	A	602	CDL	C52-C53-C54-C55
3	A	601	CDL	CA3-CA4-CA6-OA8
3	A	602	CDL	CA3-CA4-CA6-OA8
3	A	601	CDL	C36-C37-C38-C39
3	A	601	CDL	C71-C72-C73-C74
3	A	602	CDL	C32-C33-C34-C35
3	A	601	CDL	CB3-OB5-PB2-OB2
3	A	602	CDL	OB6-CB4-CB6-OB8
3	A	601	CDL	C74-C75-C76-C77
3	A	602	CDL	C57-C58-C59-C60
3	A	601	CDL	C38-C39-C40-C41
3	A	602	CDL	CA6-CA4-OA6-CA5
3	A	601	CDL	C52-C53-C54-C55
3	A	601	CDL	CA7-C31-C32-C33
3	A	602	CDL	CB3-OB5-PB2-OB2
3	A	601	CDL	CB3-OB5-PB2-OB4
3	A	602	CDL	CA2-OA2-PA1-OA4
3	A	602	CDL	CB2-OB2-PB2-OB4
4	C	401	ANP	C5'-O5'-PA-O1A
3	A	601	CDL	OA6-CA4-CA6-OA8
3	A	602	CDL	OA6-CA4-CA6-OA8
3	A	602	CDL	C17-C18-C19-C20
3	A	602	CDL	C59-C60-C61-C62
4	C	401	ANP	C5'-O5'-PA-O3A

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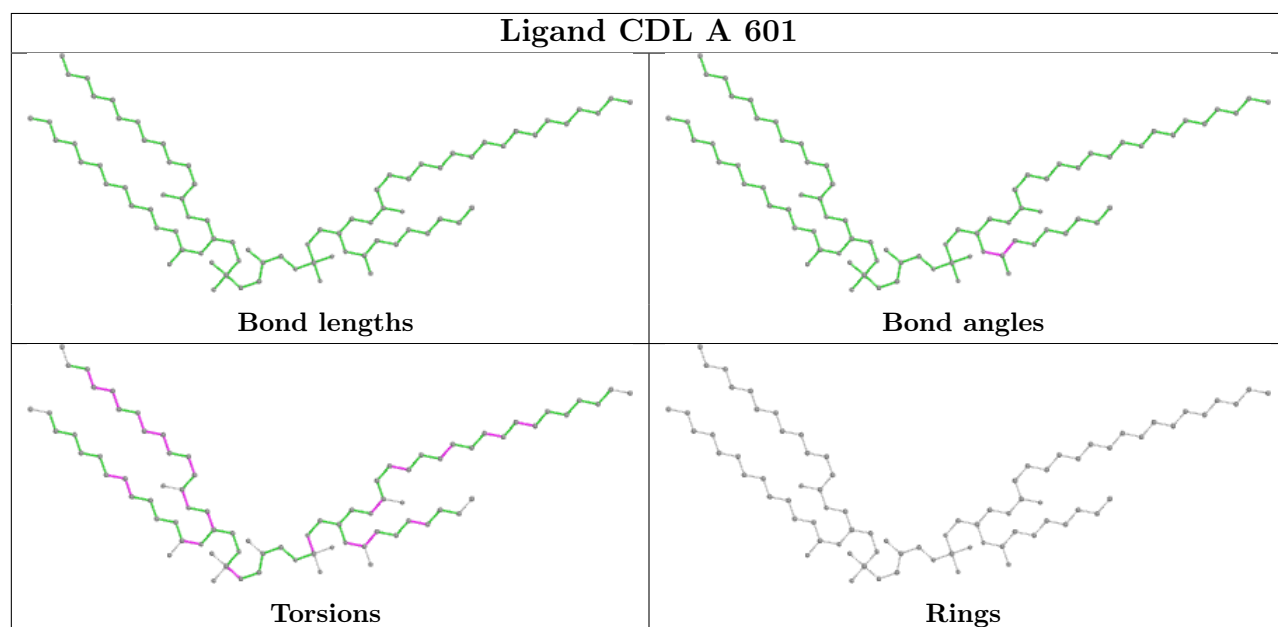
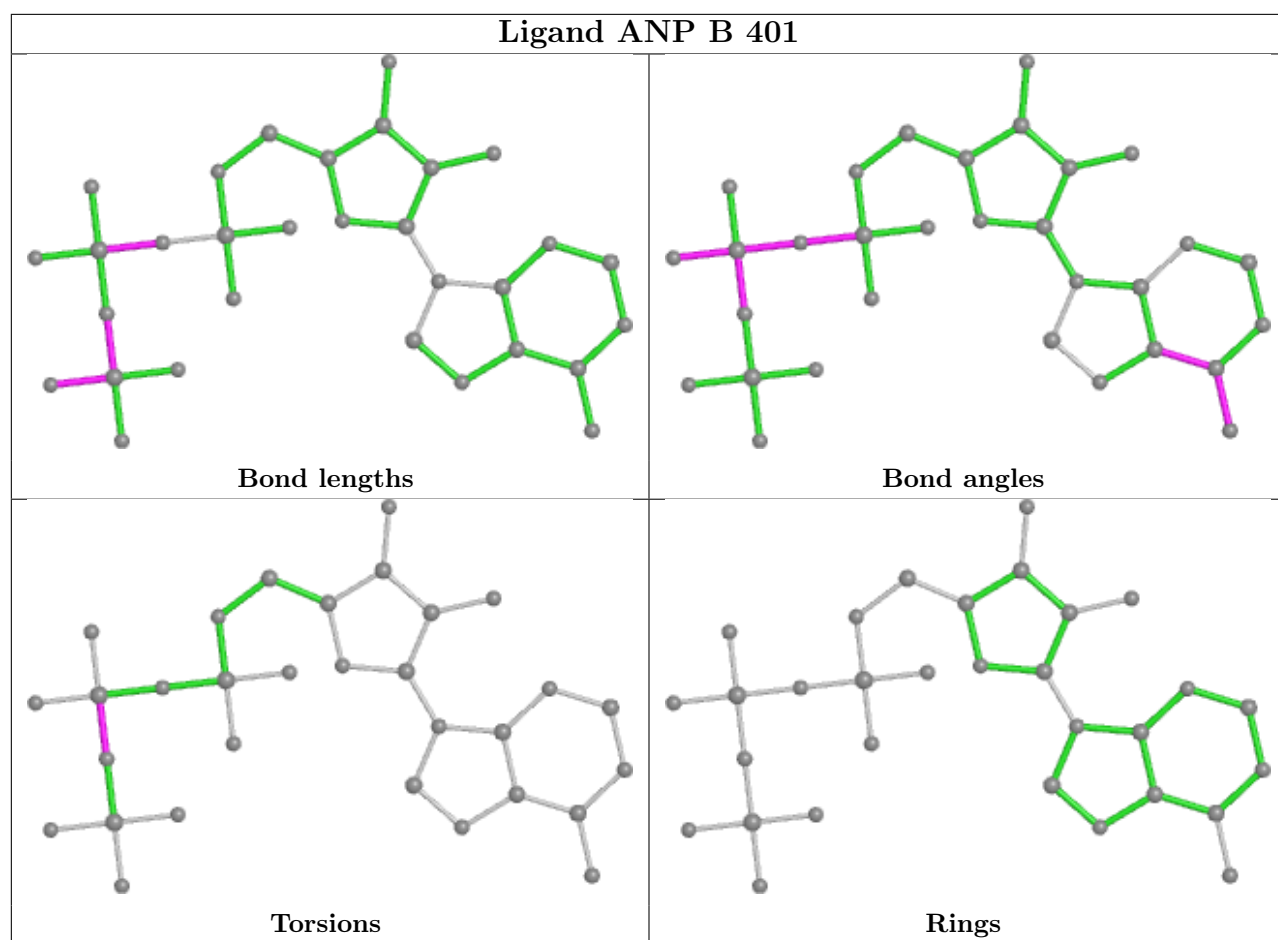
Mol	Chain	Res	Type	Atoms
3	A	601	CDL	C77-C78-C79-C80
3	A	601	CDL	CA2-OA2-PA1-OA3
3	A	602	CDL	CB3-OB5-PB2-OB3
3	A	602	CDL	C60-C61-C62-C63
3	A	601	CDL	C52-C51-CB5-OB6
3	A	602	CDL	C19-C20-C21-C22
3	A	602	CDL	C52-C51-CB5-OB6

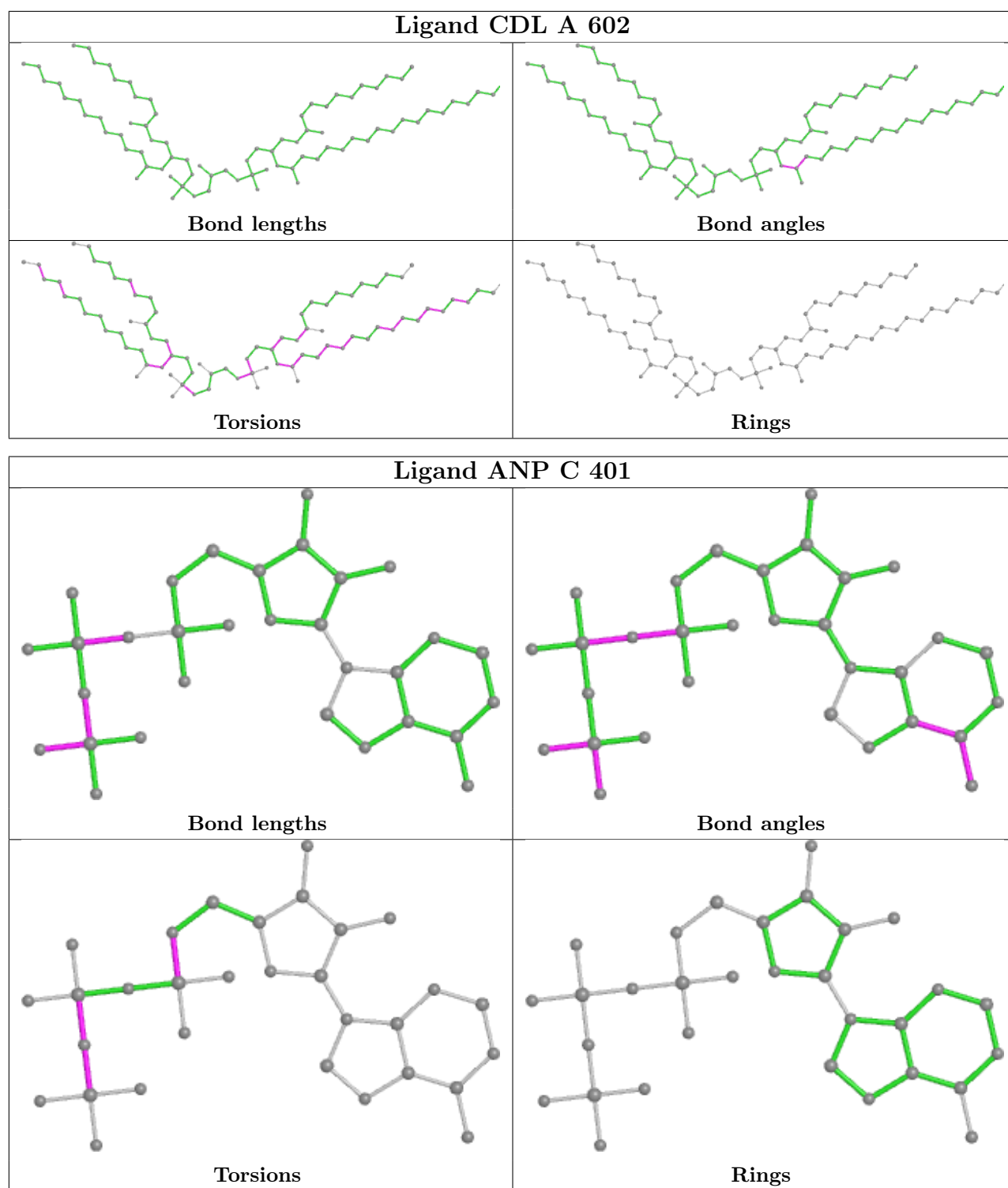
There are no ring outliers.

4 monomers are involved in 12 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
4	B	401	ANP	2	0
3	A	601	CDL	4	0
3	A	602	CDL	3	0
4	C	401	ANP	3	0

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 ⓘ

There are no such residues in this entry.

5.8 Polymer linkage issues ⓘ

There are no chain breaks in this entry.