



Full wwPDB EM Validation Report ⓘ

Jun 26, 2025 – 12:09 AM JST

PDB ID : 8K1P / pdb_00008k1p
EMDB ID : EMD-36798
Title : mycobacterial efflux pump, ADP+vanadate bound state
Authors : Wang, Y.; Wu, F.; Zhang, L.; Rao, Z.
Deposited on : 2023-07-11
Resolution : 3.40 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

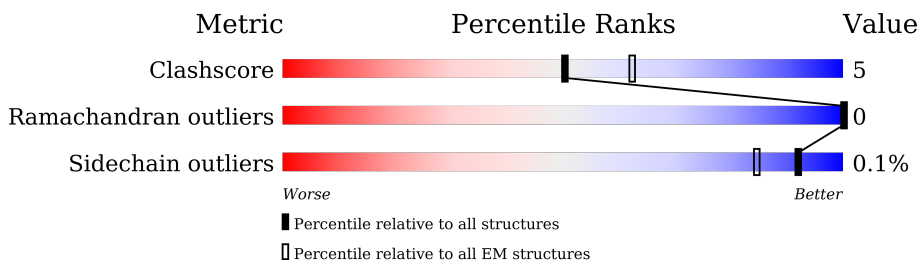
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

ELECTRON MICROSCOPY

The reported resolution of this entry is 3.40 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 7 unique types of molecules in this entry. The entry contains 7139 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.

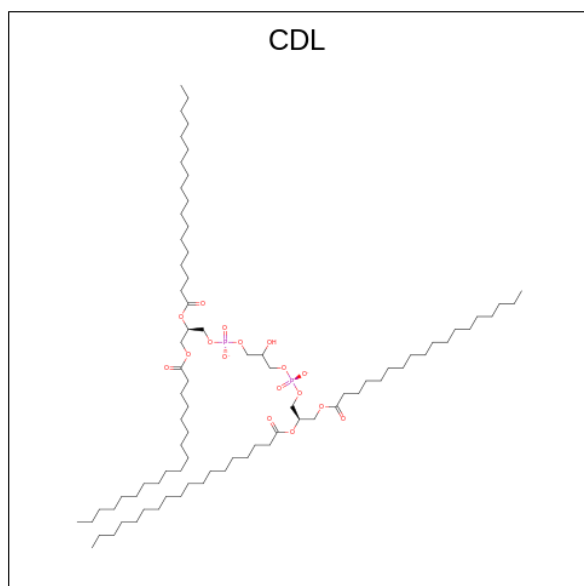
- Molecule 1 is a protein called Multidrug efflux system permease protein Rv1217c.

Mol	Chain	Residues	Atoms					AltConf	Trace
1	A	509	Total	C	N	O	S	0	0
			3711	2411	646	641	13		

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

Mol	Chain	Residues	Atoms					AltConf	Trace
2	B	213	Total	C	N	O	S	0	0
			1606	1005	293	304	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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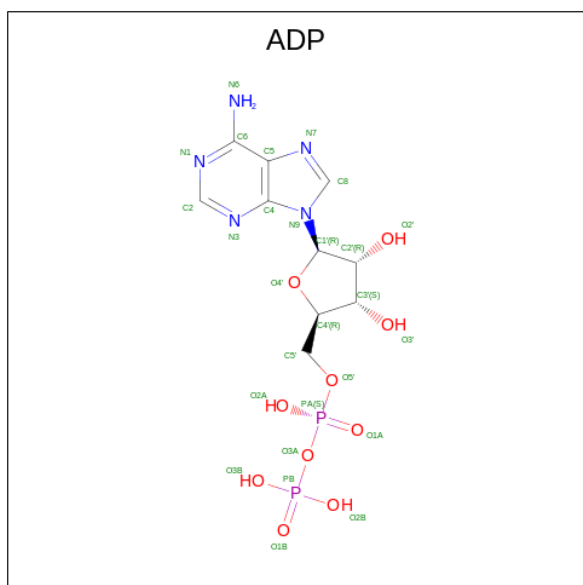
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Mol	Chain	Residues	Atoms				AltConf
3	A	1	Total	C	O	P	0
			80	61	17	2	

- Molecule 4 is MAGNESIUM ION (CCD ID: MG) (formula: Mg).

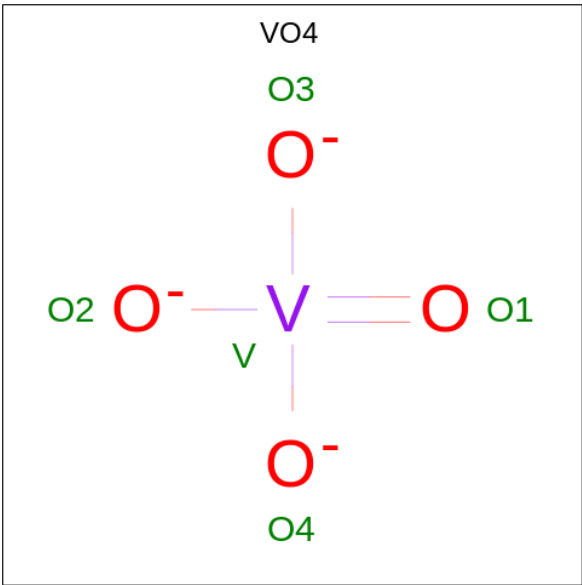
Mol	Chain	Residues	Atoms		AltConf
4	B	1	Total	Mg	0
			1	1	
4	C	1	Total	Mg	0
			1	1	

- Molecule 5 is ADENOSINE-5'-DIPHOSPHATE (CCD ID: ADP) (formula: C₁₀H₁₅N₅O₁₀P₂).



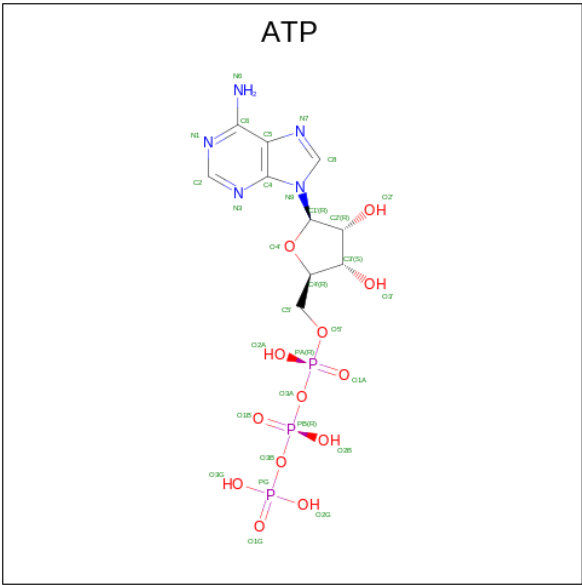
Mol	Chain	Residues	Atoms					AltConf
5	B	1	Total	C	N	O	P	0
			27	10	5	10	2	

- Molecule 6 is VANADATE ION (CCD ID: VO4) (formula: O₄V).



Mol	Chain	Residues	Atoms			AltConf
			Total	O	V	
6	B	1	5	4	1	0

- Molecule 7 is ADENOSINE-5'-TRIPHOSPHATE (CCD ID: ATP) (formula: C₁₀H₁₆N₅O₁₃P₃).



Mol	Chain	Residues	Atoms					AltConf
			Total	C	N	O	P	
7	C	1	31	10	5	13	3	0

4 Experimental information

Property	Value	Source
EM reconstruction method	SINGLE PARTICLE	Depositor
Imposed symmetry	POINT, C1	Depositor
Number of particles used	190347	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 [i](#)

5.1 Standard geometry [i](#)

Bond lengths and bond angles in the following residue types are not validated in this section: CDL, VO4, ADP, ATP, MG

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	0.27	0/3791	0.46	2/5180 (0.0%)
2	B	0.26	0/1629	0.42	0/2203
2	C	0.27	0/1620	0.52	0/2191
All	All	0.27	0/7040	0.47	2/9574 (0.0%)

There are no bond length outliers.

All (2) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	60	VAL	N-CA-C	-6.20	107.82	113.71
1	A	402	ARG	CB-CA-C	5.95	118.60	111.22

There are no chirality outliers.

There are no planarity outliers.

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	3711	0	3852	45	0
2	B	1606	0	1652	16	0
2	C	1597	0	1643	20	0
3	A	160	0	214	1	0
4	B	1	0	0	0	0
4	C	1	0	0	0	0

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Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
5	B	27	0	12	1	0
6	B	5	0	0	1	0
7	C	31	0	12	0	0
All	All	7139	0	7385	79	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 5.

All (79) 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:274:ARG:NE	1:A:277:ARG:HH11	1.66	0.93
2:C:204:LYS:HA	2:C:217:GLY:O	1.75	0.87
1:A:137:THR:HG22	1:A:138:VAL:H	1.50	0.77
1:A:410:LEU:HD12	1:A:465:VAL:HG21	1.70	0.74
1:A:274:ARG:CD	1:A:277:ARG:HH11	2.01	0.72
1:A:274:ARG:HD2	1:A:277:ARG:HE	1.53	0.71
1:A:274:ARG:NH1	1:A:279:VAL:HG22	2.06	0.69
1:A:274:ARG:CD	1:A:277:ARG:HE	2.06	0.68
2:C:15:LEU:HD11	2:C:54:ILE:HD13	1.75	0.67
1:A:67:ARG:HA	1:A:70:ARG:HH21	1.61	0.66
2:C:171:GLU:OE2	2:C:175:GLN:NE2	2.34	0.59
2:C:46:ALA:HB1	2:C:208:ILE:HG13	1.83	0.59
1:A:223:ARG:HH11	1:A:243:LEU:HD11	1.67	0.58
1:A:240:GLY:O	1:A:244:GLN:HG2	2.04	0.58
2:B:77:ALA:O	2:B:81:HIS:ND1	2.33	0.58
2:B:193:HIS:NE2	6:B:403:VO4:O3	2.35	0.57
1:A:109:LEU:HD22	3:A:601:CDL:H382	1.85	0.56
2:B:23:ARG:HD3	2:B:26:ASP:OD1	2.08	0.54
2:C:160:ASP:O	2:C:191:SER:HB2	2.08	0.54
1:A:132:GLU:OE2	2:C:53:ARG:NH1	2.31	0.54
1:A:118:VAL:HG21	1:A:192:THR:HG23	1.89	0.54
1:A:274:ARG:HH12	1:A:279:VAL:HG22	1.71	0.53
2:B:49:SER:O	2:B:52:LEU:N	2.42	0.53
1:A:170:THR:HG22	1:A:171:ASP:H	1.74	0.52
1:A:274:ARG:NE	1:A:277:ARG:NH1	2.49	0.52
1:A:274:ARG:HH12	1:A:279:VAL:CG2	2.23	0.52
1:A:299:GLU:HG2	1:A:300:PRO:HD2	1.92	0.51
2:C:197:GLU:O	2:C:201:LEU:HB2	2.11	0.51
1:A:330:VAL:HG23	1:A:360:PHE:HD2	1.76	0.50
1:A:472:PRO:HG3	1:A:544:ARG:NH1	2.27	0.50

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
2:C:11:GLU:HB2	2:C:67:ARG:HB3	1.93	0.50
2:C:98:THR:HG22	2:C:99:GLY:H	1.76	0.50
2:C:28:LEU:HD23	2:C:30:LEU:H	1.78	0.49
2:C:84:ILE:HG12	2:C:156:LEU:HD23	1.93	0.49
2:B:49:SER:O	2:B:50:THR:C	2.54	0.48
1:A:134:ILE:HG22	1:A:139:VAL:HG21	1.94	0.48
1:A:125:ASP:OD1	1:A:126:GLU:N	2.47	0.48
2:B:15:LEU:HD23	2:B:25:LEU:HD13	1.95	0.48
2:B:138:LYS:O	2:B:138:LYS:HG2	2.15	0.47
2:C:48:LYS:HG2	2:C:208:ILE:HD11	1.96	0.47
1:A:119:ILE:HG21	1:A:209:ARG:HG3	1.97	0.47
1:A:149:LEU:HD11	1:A:196:ALA:HB2	1.97	0.47
2:B:84:ILE:HG12	2:B:156:LEU:HD23	1.97	0.46
2:C:120:GLU:HA	2:C:123:GLU:HG2	1.97	0.46
1:A:324:LEU:HD12	1:A:431:ALA:HB2	1.96	0.46
1:A:131:ALA:HB1	1:A:279:VAL:HG11	1.97	0.46
1:A:252:ARG:O	1:A:255:VAL:HG12	2.15	0.45
1:A:278:ASP:O	1:A:279:VAL:C	2.58	0.45
2:C:208:ILE:HG22	2:C:213:THR:HG22	1.99	0.45
2:C:107:ALA:HB1	2:C:113:ILE:HB	1.98	0.45
1:A:330:VAL:HG23	1:A:360:PHE:CD2	2.52	0.45
2:B:34:GLU:O	2:B:34:GLU:HG3	2.17	0.45
1:A:274:ARG:CD	1:A:277:ARG:NH1	2.77	0.45
1:A:170:THR:HG22	1:A:171:ASP:N	2.32	0.45
1:A:138:VAL:O	1:A:138:VAL:HG12	2.17	0.44
1:A:190:VAL:HG11	1:A:238:PRO:HB3	1.98	0.44
1:A:274:ARG:HD3	1:A:277:ARG:HH11	1.80	0.44
2:C:163:SER:O	2:C:163:SER:OG	2.30	0.44
1:A:24:THR:O	1:A:140:GLY:N	2.43	0.43
1:A:376:ALA:HB1	1:A:461:SER:OG	2.17	0.43
1:A:43:LEU:HD23	1:A:43:LEU:HA	1.86	0.43
2:B:137:SER:C	2:B:139:GLY:H	2.26	0.43
1:A:29:LEU:HD23	1:A:32:LEU:HD21	1.99	0.43
1:A:41:LEU:HB3	1:A:42:PRO:HD3	2.00	0.43
2:B:18:HIS:CD2	2:B:23:ARG:HG2	2.54	0.43
1:A:130:ARG:HH11	2:C:95:PRO:HD3	1.84	0.43
1:A:27:LEU:O	1:A:31:ARG:HG3	2.18	0.43
2:B:47:GLY:HA2	5:B:402:ADP:H5'1	2.01	0.43
2:C:143:LYS:HE2	2:C:170:MET:HG3	2.01	0.42
1:A:137:THR:HG22	1:A:138:VAL:N	2.27	0.42
1:A:300:PRO:HD2	1:A:404:HIS:HE1	1.85	0.42

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
2:C:201:LEU:HD12	2:C:201:LEU:HA	1.89	0.42
2:C:25:LEU:HD12	2:C:25:LEU:HA	1.87	0.41
2:B:204:LYS:HA	2:B:218:SER:HA	2.03	0.41
2:B:8:VAL:O	2:B:8:VAL:HG13	2.21	0.41
2:B:204:LYS:HA	2:B:217:GLY:O	2.20	0.41
1:A:330:VAL:HG22	1:A:357:GLU:OE1	2.22	0.40
2:B:33:ARG:HB3	2:B:33:ARG:NH1	2.35	0.40
1:A:134:ILE:HD13	1:A:134:ILE:HA	1.90	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 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	505/548 (92%)	477 (94%)	28 (6%)	0	100	100
2	B	211/311 (68%)	188 (89%)	23 (11%)	0	100	100
2	C	210/311 (68%)	191 (91%)	19 (9%)	0	100	100
All	All	926/1170 (79%)	856 (92%)	70 (8%)	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 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	361/391 (92%)	361 (100%)	0	100	100
2	B	173/256 (68%)	173 (100%)	0	100	100
2	C	172/256 (67%)	171 (99%)	1 (1%)	84	90
All	All	706/903 (78%)	705 (100%)	1 (0%)	92	97

All (1) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
2	C	58	LEU

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (1) such sidechains are listed below:

Mol	Chain	Res	Type
2	B	83	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 ⓘ

There are no oligosaccharides in this entry.

5.6 Ligand geometry ⓘ

Of 7 ligands modelled in this entry, 2 are monoatomic - leaving 5 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
5	ADP	B	402	-	24,29,29	0.67	0	29,45,45	0.77	1 (3%)
3	CDL	A	602	-	79,79,99	0.37	0	85,91,111	0.47	1 (1%)
3	CDL	A	601	-	79,79,99	0.39	0	85,91,111	0.50	1 (1%)
7	ATP	C	402	4	26,33,33	0.95	1 (3%)	31,52,52	0.99	2 (6%)
6	VO4	B	403	4	1,4,4	4.81	1 (100%)	-		

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
3	CDL	A	602	-	-	28/90/90/110	-
3	CDL	A	601	-	-	29/90/90/110	-
5	ADP	B	402	-	-	2/12/32/32	0/3/3/3
7	ATP	C	402	4	-	4/18/38/38	0/3/3/3

All (2) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
6	B	403	VO4	O1-V	4.81	1.91	1.63
7	C	402	ATP	PG-O2G	-2.04	1.47	1.54

All (5) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
7	C	402	ATP	PB-O3B-PG	-3.13	122.10	132.83
3	A	602	CDL	OB6-CB5-C51	2.44	116.77	111.50
7	C	402	ATP	C5-C6-N6	2.37	123.96	120.35
3	A	601	CDL	OB6-CB5-C51	2.26	116.36	111.50
5	B	402	ADP	C5-C6-N6	2.24	123.76	120.35

There are no chirality outliers.

All (63) torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
3	A	601	CDL	CA3-OA5-PA1-OA2
3	A	601	CDL	CA3-OA5-PA1-OA4
3	A	601	CDL	CB2-OB2-PB2-OB3

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Mol	Chain	Res	Type	Atoms
3	A	601	CDL	CB3-OB5-PB2-OB3
3	A	602	CDL	CB2-C1-CA2-OA2
3	A	602	CDL	CA2-OA2-PA1-OA5
3	A	602	CDL	OB7-CB5-OB6-CB4
3	A	602	CDL	C51-CB5-OB6-CB4
7	C	402	ATP	C5'-O5'-PA-O3A
7	C	402	ATP	O4'-C4'-C5'-O5'
3	A	601	CDL	OB9-CB7-OB8-CB6
3	A	602	CDL	OB9-CB7-OB8-CB6
3	A	601	CDL	C71-CB7-OB8-CB6
3	A	602	CDL	C71-CB7-OB8-CB6
3	A	601	CDL	C31-CA7-OA8-CA6
3	A	602	CDL	O1-C1-CA2-OA2
3	A	601	CDL	OA9-CA7-OA8-CA6
7	C	402	ATP	C3'-C4'-C5'-O5'
3	A	602	CDL	C55-C56-C57-C58
3	A	601	CDL	CA2-OA2-PA1-OA5
3	A	602	CDL	C53-C54-C55-C56
3	A	601	CDL	C76-C77-C78-C79
3	A	601	CDL	CB3-OB5-PB2-OB2
3	A	601	CDL	C33-C34-C35-C36
3	A	602	CDL	OB5-CB3-CB4-CB6
3	A	601	CDL	C11-CA5-OA6-CA4
3	A	601	CDL	C36-C37-C38-C39
3	A	601	CDL	C13-C14-C15-C16
3	A	601	CDL	CA3-CA4-CA6-OA8
3	A	601	CDL	OA7-CA5-OA6-CA4
3	A	602	CDL	C11-C12-C13-C14
5	B	402	ADP	PA-O3A-PB-O3B
3	A	601	CDL	CB2-OB2-PB2-OB5
3	A	601	CDL	CA2-OA2-PA1-OA4
3	A	601	CDL	CA3-OA5-PA1-OA3
3	A	602	CDL	CA2-OA2-PA1-OA4
7	C	402	ATP	C5'-O5'-PA-O1A
3	A	602	CDL	OA5-CA3-CA4-OA6
3	A	602	CDL	OB5-CB3-CB4-OB6
3	A	601	CDL	OA6-CA4-CA6-OA8
3	A	602	CDL	C71-C72-C73-C74
3	A	602	CDL	CB6-CB4-OB6-CB5
3	A	602	CDL	CA4-CA3-OA5-PA1
3	A	602	CDL	C12-C13-C14-C15
3	A	602	CDL	C32-C33-C34-C35

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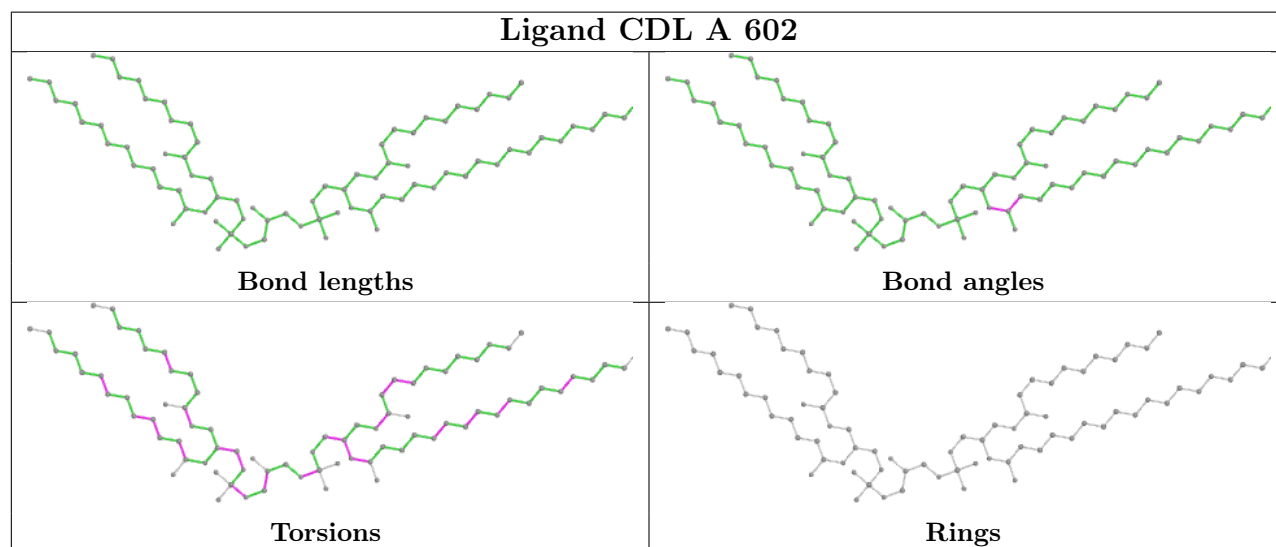
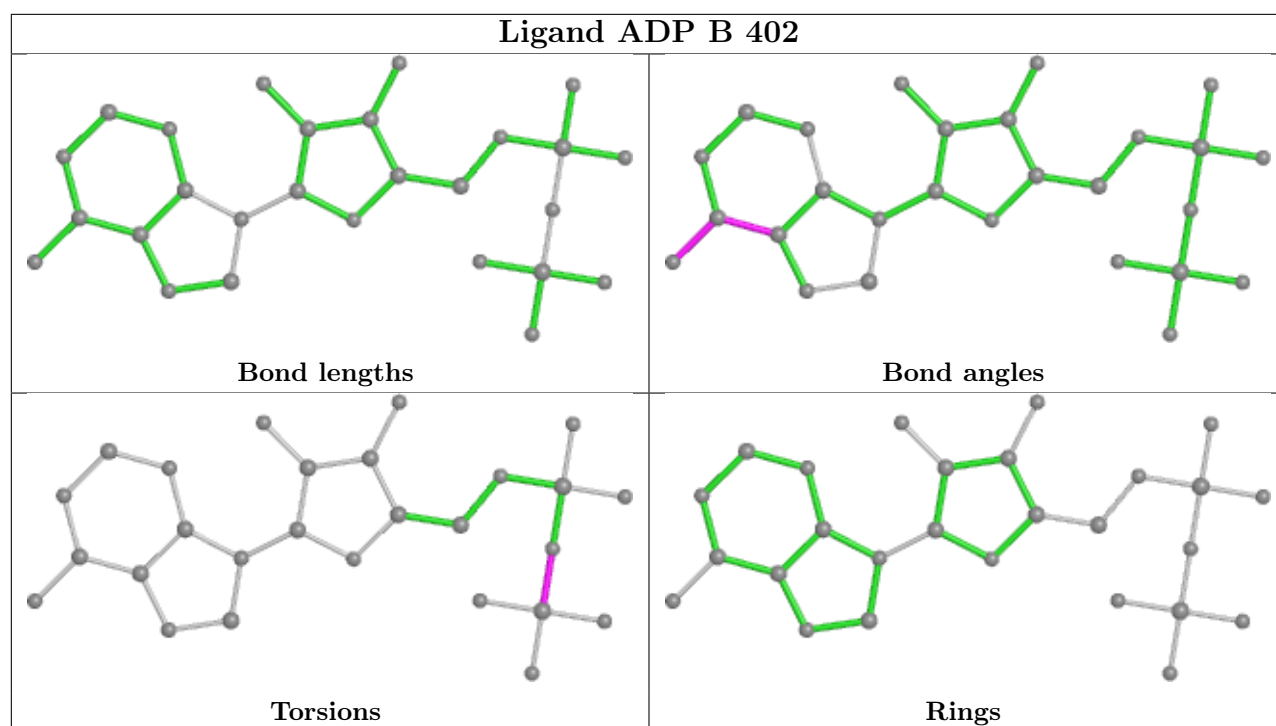
Mol	Chain	Res	Type	Atoms
3	A	602	CDL	CB7-C71-C72-C73
3	A	602	CDL	C61-C62-C63-C64
3	A	602	CDL	C57-C58-C59-C60
3	A	601	CDL	C52-C53-C54-C55
5	B	402	ADP	PA-O3A-PB-O2B
3	A	602	CDL	OA5-CA3-CA4-CA6
3	A	602	CDL	C15-C16-C17-C18
3	A	601	CDL	C79-C80-C81-C82
3	A	601	CDL	C19-C20-C21-C22
3	A	602	CDL	C31-CA7-OA8-CA6
3	A	602	CDL	OA9-CA7-OA8-CA6
3	A	601	CDL	CB3-OB5-PB2-OB4
3	A	602	CDL	CB2-OB2-PB2-OB3
3	A	601	CDL	CB6-CB4-OB6-CB5
3	A	601	CDL	C35-C36-C37-C38
3	A	601	CDL	C84-C85-C86-C87
3	A	602	CDL	C12-C11-CA5-OA6
3	A	601	CDL	C32-C33-C34-C35

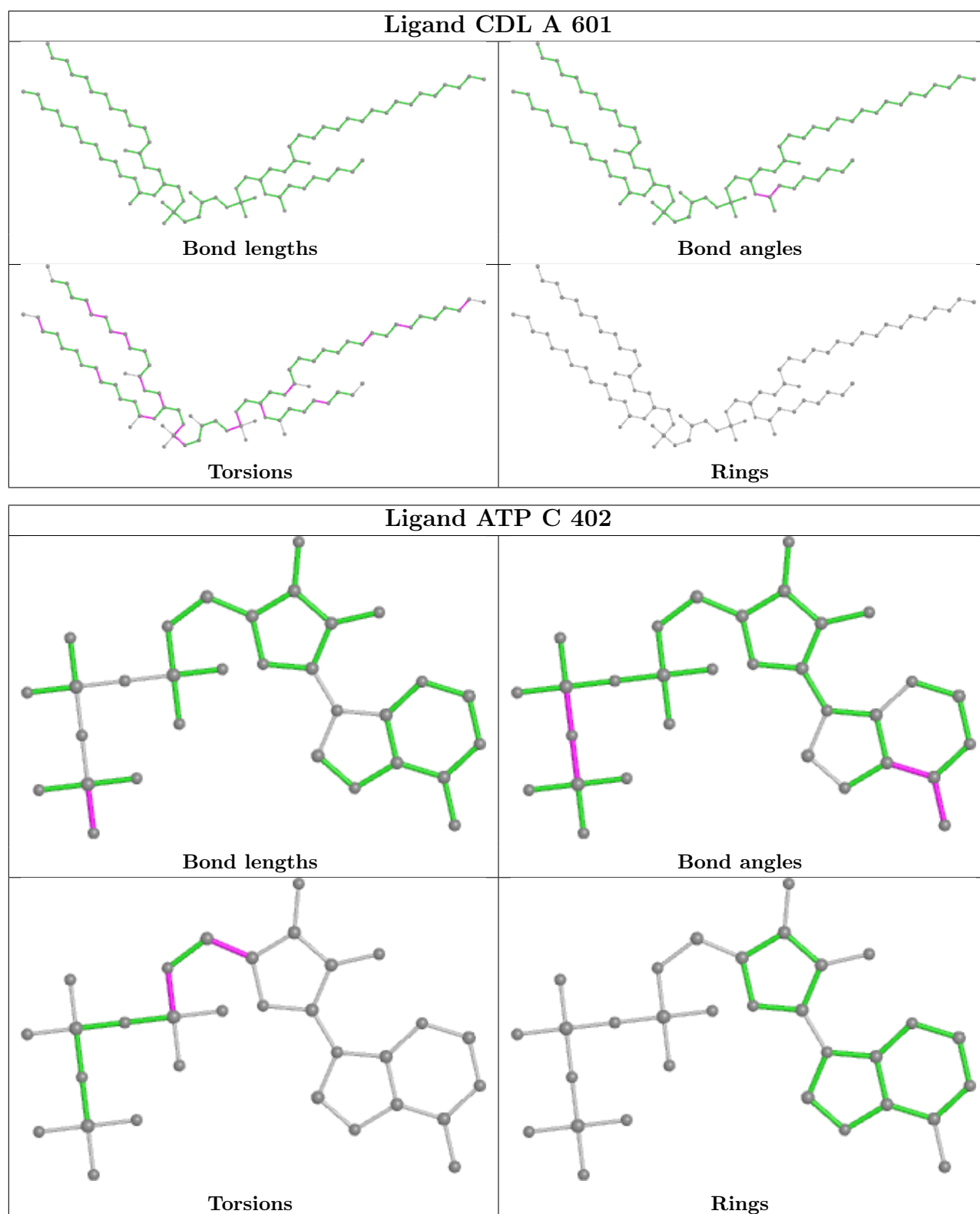
There are no ring outliers.

3 monomers are involved in 3 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
5	B	402	ADP	1	0
3	A	601	CDL	1	0
6	B	403	VO4	1	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.