WORLDWIDE wwPDB PROTEIN DATA BANK

Full wwPDB X-ray Structure Validation Report ⓘ

Dec 3, 2023 – 09:04 am GMT

PDB ID	:	1GQY
Title	:	MURC - CRYSTAL STRUCTURE OF THE ENZYME FROM HAEMOPHILUS INFLUENZAE COMPLEXED WITH AMPPCP
Authors	:	Skarzynski, T.; Cleasby, A.; Domenici, E.; Gevi, M.; Shaw, J.
Deposited on	:	2001-12-06
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	:	4.02b-467
Mogul	:	1.8.4, CSD as541be (2020)
Xtriage (Phenix)	:	NOT EXECUTED
EDS	:	NOT EXECUTED
buster-report	:	1.1.7 (2018)
Percentile statistics	:	20191225.v01 (using entries in the PDB archive December 25th 2019)
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, RNA)	:	Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP)	:	2.36

PERCENTILES INFOmissingINFO

1 Entry composition (i)

There are 4 unique types of molecules in this entry. The entry contains 8186 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 UDP-N-ACETYLMURAMATE-L-ALANINE LIGASE.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	468	Total 3595	C 2263	N 634	O 681	S 17	0	0	0
1	B	469	Total 3602	C 2268	N 631	O 686	S 17	0	0	0

- Molecule 2 is PHOSPHOMETHYLPHOSPHONIC ACID ADENYLATE ESTER (three-letter code: ACP) (formula: $C_{11}H_{18}N_5O_{12}P_3$).
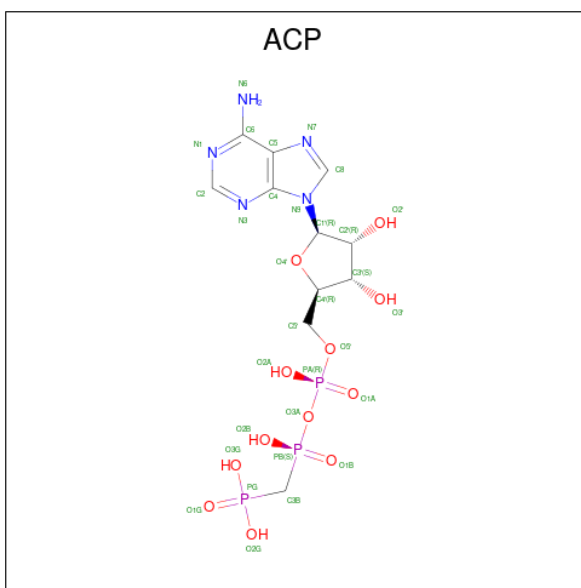
Mol	Chain	Residues	Atoms					ZeroOcc	AltConf
2	A	1	Total 31	C 11	N 5	O 12	P 3	0	0
2	B	1	Total 31	C 11	N 5	O 12	P 3	0	0

- Molecule 3 is MAGNESIUM ION (three-letter code: MG) (formula: Mg).

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
3	A	1	Total 1	Mg 1	0	0
3	B	1	Total 1	Mg 1	0	0

- Molecule 4 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
4	A	413	Total 413	O 413	0	0
4	B	512	Total 512	O 512	0	0

SEQUENCE-PLOTS INFOmissingINFO

2 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	71.60Å 93.20Å 86.80Å 90.00° 101.40° 90.00°	Depositor
Resolution (Å)	20.00 – 1.80	Depositor
% Data completeness (in resolution range)	89.5 (20.00-1.80)	Depositor
R_{merge}	0.07	Depositor
R_{sym}	(Not available)	Depositor
Refinement program	REFMAC	Depositor
R, R_{free}	0.184 , 0.233	Depositor
Estimated twinning fraction	No twinning to report.	Xtriage
Total number of atoms	8186	wwPDB-VP
Average B, all atoms (Å^2)	30.0	wwPDB-VP

3 Model quality ⓘ

3.1 Standard geometry ⓘ

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

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	1.02	4/3656 (0.1%)	1.01	14/4942 (0.3%)
1	B	1.01	4/3664 (0.1%)	1.02	11/4956 (0.2%)
All	All	1.02	8/7320 (0.1%)	1.02	25/9898 (0.3%)

All (8) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	B	355	VAL	CB-CG1	-11.46	1.28	1.52
1	A	271	TYR	CD2-CE2	6.42	1.49	1.39
1	A	346	TYR	CD1-CE1	6.25	1.48	1.39
1	B	420	CYS	CB-SG	-5.85	1.72	1.81
1	B	271	TYR	CD1-CE1	5.45	1.47	1.39
1	A	149	PHE	CE1-CZ	5.19	1.47	1.37
1	A	302	VAL	CB-CG1	5.15	1.63	1.52
1	B	273	VAL	CB-CG1	5.13	1.63	1.52

All (25) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	B	228	MET	CG-SD-CE	-11.49	81.81	100.20
1	A	228	MET	CG-SD-CE	-9.96	84.27	100.20
1	B	442	ASP	CB-CG-OD2	8.01	125.50	118.30
1	A	261	ASP	CB-CG-OD2	7.05	124.65	118.30
1	A	377	ARG	NE-CZ-NH2	-6.65	116.97	120.30
1	A	396	ASP	CB-CG-OD2	6.59	124.23	118.30
1	B	261	ASP	CB-CG-OD2	6.36	124.03	118.30
1	B	396	ASP	CB-CG-OD2	6.23	123.91	118.30
1	B	445	ASP	CB-CG-OD2	6.17	123.85	118.30
1	A	387	ASP	CB-CG-OD2	5.86	123.57	118.30
1	A	386	ASP	CB-CG-OD2	5.71	123.44	118.30

Continued from previous page...

Mol	Chain	Res	Type	Atoms	Z	Observed(^{o})	Ideal(^{o})
1	A	402	ASP	CB-CG-OD2	5.61	123.35	118.30
1	B	452	ASP	CB-CG-OD1	5.61	123.35	118.30
1	B	382	ARG	NE-CZ-NH2	-5.53	117.53	120.30
1	B	387	ASP	CB-CG-OD2	5.49	123.24	118.30
1	A	430	ASP	CB-CG-OD1	5.46	123.21	118.30
1	A	232	ASP	CB-CG-OD2	5.39	123.15	118.30
1	B	49	ASP	CB-CG-OD2	5.39	123.15	118.30
1	A	110	MET	CG-SD-CE	-5.35	91.64	100.20
1	B	90	ASP	CB-CG-OD2	5.34	123.11	118.30
1	A	89	ASP	CB-CG-OD2	5.34	123.10	118.30
1	A	450	ASP	CB-CG-OD2	5.25	123.02	118.30
1	A	453	LEU	CB-CG-CD2	-5.15	102.24	111.00
1	B	356	THR	OG1-CB-CG2	-5.14	98.18	110.00
1	A	231	ASP	CB-CG-OD2	5.11	122.90	118.30

There are no chirality outliers.

There are no planarity outliers.

3.2   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	3595	0	3602	45	0
1	B	3602	0	3598	46	0
2	A	31	0	14	0	0
2	B	31	0	14	0	0
3	A	1	0	0	0	0
3	B	1	0	0	0	0
4	A	413	0	0	11	0
4	B	512	0	0	9	0
All	All	8186	0	7228	91	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 (91) 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:180:SER:HA	4:B:2116:HOH:O	1.85	0.76
1:B:176:GLU:HB3	4:B:2215:HOH:O	1.88	0.72
1:B:330:LEU:HD12	1:B:342:LEU:HD13	1.74	0.70
1:A:449:GLN:NE2	4:A:2393:HOH:O	2.21	0.70
1:B:329:GLN:HB3	4:B:2393:HOH:O	1.91	0.69
1:B:8:ILE:HD13	1:B:41:GLU:HG2	1.74	0.69
1:A:400:MET:HG3	1:A:420:CYS:SG	2.33	0.68
1:B:449:GLN:NE2	4:B:2498:HOH:O	2.26	0.68
1:A:72:GLU:CG	1:A:96:THR:HG21	2.25	0.67
1:A:376:HIS:ND1	1:A:380:ARG:NH2	2.42	0.66
1:A:311:GLU:OE1	4:A:2258:HOH:O	2.12	0.66
1:A:91:ASN:O	1:A:95:VAL:HG12	1.95	0.65
1:A:7:GLU:OE1	1:A:10:LYS:NZ	2.30	0.64
1:A:168:ARG:HD3	4:A:2143:HOH:O	1.97	0.64
1:A:258:ARG:NE	1:A:260:GLU:OE2	2.28	0.63
1:A:92:PRO:O	1:A:96:THR:HG23	2.00	0.62
1:B:8:ILE:HD12	1:B:164:LEU:HD11	1.81	0.61
1:A:475:ASN:ND2	1:A:475:ASN:C	2.52	0.60
1:B:291:HIS:ND1	1:B:355:VAL:HG13	2.18	0.59
1:B:179:ALA:O	1:B:180:SER:C	2.41	0.58
1:A:1:MET:SD	1:A:6:GLU:HG2	2.43	0.58
1:A:142:GLN:NE2	1:A:315:GLU:OE1	2.36	0.56
1:A:84:SER:O	1:A:87:ILE:HG13	2.05	0.56
1:B:8:ILE:CD1	1:B:41:GLU:HG2	2.34	0.55
4:A:2254:HOH:O	1:B:16:ARG:HD3	2.06	0.55
1:B:263:GLU:HG3	4:B:2313:HOH:O	2.08	0.54
1:A:49:ASP:O	1:A:68:ILE:HA	2.09	0.52
1:A:475:ASN:C	1:A:475:ASN:HD22	2.13	0.52
1:A:156:LYS:NZ	4:A:2129:HOH:O	2.43	0.52
1:B:109:GLN:OE1	4:B:2125:HOH:O	2.19	0.52
1:A:197:ASP:HB2	4:A:2163:HOH:O	2.09	0.52
1:B:324:GLY:O	1:B:325:ARG:HB2	2.10	0.52
1:B:335:ARG:HD2	1:B:473:TRP:CE2	2.45	0.52
1:B:330:LEU:HD12	1:B:342:LEU:CD1	2.40	0.51
1:A:87:ILE:HD12	1:A:87:ILE:O	2.10	0.50
1:A:249:TYR:CZ	1:A:298:ALA:HB2	2.47	0.50
1:A:311:GLU:HG2	4:A:2259:HOH:O	2.10	0.50
1:B:159:GLY:C	1:B:160:LYS:HG2	2.32	0.50
1:A:109:GLN:OE1	1:A:183:HIS:CD2	2.65	0.50
1:B:364:TRP:CE2	1:B:453:LEU:HB2	2.46	0.50
1:A:179:ALA:HB1	1:A:182:LEU:HD12	1.93	0.50
1:A:116:ARG:HD3	4:A:2090:HOH:O	2.11	0.49

Continued on next page...

Continued from previous page...

Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:B:11:ILE:HG22	1:B:12:ILE:CD1	2.43	0.49
1:A:181:PHE:HE2	1:A:212:THR:HG22	1.77	0.48
1:A:332:GLU:OE2	4:A:2283:HOH:O	2.20	0.48
1:B:439:GLN:O	1:B:443:VAL:HG23	2.12	0.48
1:B:270:HIS:CE1	1:B:284:LEU:HD13	2.48	0.48
1:B:14:GLU:HG2	4:B:2009:HOH:O	2.13	0.48
1:B:70:HIS:HA	1:B:93:GLU:OE2	2.14	0.48
1:A:258:ARG:NH2	1:A:260:GLU:OE2	2.45	0.48
1:A:72:GLU:HG3	1:A:96:THR:HG21	1.94	0.47
1:A:58:ARG:NH1	4:A:2048:HOH:O	2.37	0.47
1:A:377:ARG:NH1	1:A:408:GLU:OE2	2.39	0.47
1:A:75:ILE:O	1:A:75:ILE:HG23	2.13	0.47
1:A:1:MET:HE2	1:A:5:HIS:C	2.35	0.47
1:A:394:GLN:OE1	1:A:428:LYS:NZ	2.45	0.47
1:B:181:PHE:HE2	1:B:212:THR:HG22	1.80	0.46
1:A:72:GLU:CD	1:A:96:THR:HG21	2.35	0.46
1:B:56:THR:HG22	1:B:66:ILE:HG21	1.98	0.46
1:B:419:LEU:O	1:B:423:ILE:HG13	2.16	0.45
1:A:109:GLN:OE1	1:A:183:HIS:HD2	1.99	0.45
1:A:358:LYS:NZ	4:A:2308:HOH:O	2.47	0.44
1:B:53:GLY:O	1:B:57:GLN:HG2	2.16	0.44
1:B:14:GLU:HG2	1:B:14:GLU:H	1.54	0.44
1:B:448:ILE:HG23	1:B:449:GLN:N	2.32	0.44
1:A:230:ALA:HB2	1:A:248:THR:HB	1.99	0.44
1:A:1:MET:HE3	1:A:5:HIS:HB3	1.99	0.43
1:B:335:ARG:HD3	1:B:445:ASP:OD1	2.17	0.43
1:B:372:ILE:HD11	1:B:444:LEU:HD11	1.99	0.43
1:B:9:ARG:HA	1:B:12:ILE:O	2.19	0.43
1:B:56:THR:CG2	1:B:66:ILE:HG21	2.49	0.43
1:B:241:LYS:HD3	4:B:2093:HOH:O	2.19	0.43
1:B:274:ILE:HD12	1:B:280:ARG:HG2	2.00	0.43
1:B:291:HIS:CE1	1:B:355:VAL:HG13	2.54	0.43
1:B:448:ILE:CG2	1:B:449:GLN:N	2.81	0.42
1:A:54:VAL:O	1:A:58:ARG:HB2	2.20	0.42
1:A:274:ILE:N	1:A:274:ILE:HD12	2.35	0.42
1:B:320:PHE:CE2	1:B:322:GLY:HA2	2.55	0.42
1:B:50:ILE:HD12	1:B:50:ILE:HA	1.85	0.42
1:A:1:MET:CE	1:A:5:HIS:HB3	2.51	0.41
1:A:52:ASP:OD1	1:A:57:GLN:NE2	2.51	0.41
1:B:52:ASP:OD1	1:B:57:GLN:NE2	2.54	0.41
1:A:197:ASP:C	1:A:197:ASP:OD1	2.58	0.41

Continued on next page...

Continued from previous page...

Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:B:286:ASN:HB2	1:B:318:ALA:O	2.20	0.41
1:B:300:LEU:HD23	1:B:300:LEU:C	2.41	0.40
1:A:2:LYS:HE2	1:A:2:LYS:HB3	1.61	0.40
1:A:133:THR:HG23	1:A:171:ILE:HG22	2.03	0.40
1:B:182:LEU:HB2	4:B:2217:HOH:O	2.21	0.40
1:B:178:ASP:C	1:B:180:SER:N	2.75	0.40
1:B:291:HIS:CG	1:B:355:VAL:CG1	3.05	0.40
1:B:291:HIS:CG	1:B:355:VAL:HG13	2.56	0.40

There are no symmetry-related clashes.

3.3 Torsion angles ⓘ

3.3.1 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 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	464/475 (98%)	453 (98%)	10 (2%)	1 (0%)	47	33
1	B	467/475 (98%)	460 (98%)	6 (1%)	1 (0%)	47	33
All	All	931/950 (98%)	913 (98%)	16 (2%)	2 (0%)	47	33

All (2) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	B	181	PHE
1	A	196	PRO

3.3.2 Protein sidechains ⓘ

There are no protein residues with a non-rotameric sidechain to report in this entry.

3.3.3 RNA ⓘ

There are no RNA molecules in this entry.

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

There are no non-standard protein/DNA/RNA residues in this entry.

3.5 Carbohydrates ⓘ

There are no monosaccharides in this entry.

3.6 Ligand geometry ⓘ

Of 4 ligands modelled in this entry, 2 are monoatomic - leaving 2 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	ACP	B	1475	3	27,33,33	1.96	7 (25%)	32,52,52	1.90	8 (25%)
2	ACP	A	1476	3	27,33,33	2.82	9 (33%)	32,52,52	2.13	14 (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
2	ACP	B	1475	3	-	1/15/38/38	0/3/3/3
2	ACP	A	1476	3	-	2/15/38/38	0/3/3/3

All (16) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
2	A	1476	ACP	O4'-C1'	8.80	1.53	1.41

Continued on next page...

Continued from previous page...

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
2	A	1476	ACP	PG-O1G	-6.30	1.37	1.50
2	B	1475	ACP	O4'-C1'	5.14	1.48	1.41
2	A	1476	ACP	C2-N3	4.08	1.38	1.32
2	A	1476	ACP	PB-O1B	-4.05	1.41	1.51
2	B	1475	ACP	O2'-C2'	3.93	1.52	1.43
2	B	1475	ACP	PB-O1B	-3.88	1.42	1.51
2	A	1476	ACP	O2'-C2'	3.58	1.51	1.43
2	A	1476	ACP	PA-O2A	-3.13	1.40	1.55
2	A	1476	ACP	C3'-C4'	2.99	1.60	1.53
2	B	1475	ACP	C3'-C4'	2.76	1.60	1.53
2	B	1475	ACP	PB-O2B	-2.43	1.50	1.56
2	B	1475	ACP	C6-C5	-2.36	1.34	1.43
2	A	1476	ACP	C6-C5	-2.33	1.34	1.43
2	A	1476	ACP	PG-O2G	-2.23	1.49	1.54
2	B	1475	ACP	PA-O2A	-2.18	1.45	1.55

All (22) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
2	A	1476	ACP	C5-C6-N6	6.14	129.69	120.35
2	B	1475	ACP	C5-C6-N6	5.18	128.23	120.35
2	B	1475	ACP	N6-C6-N1	-3.63	111.05	118.57
2	B	1475	ACP	O2'-C2'-C1'	-3.45	98.13	110.85
2	A	1476	ACP	O2'-C2'-C3'	-3.29	101.16	111.82
2	B	1475	ACP	O3G-PG-O2G	3.26	117.61	108.08
2	A	1476	ACP	O3G-PG-O1G	-3.26	103.76	112.39
2	A	1476	ACP	N6-C6-N1	-3.09	112.16	118.57
2	B	1475	ACP	O2'-C2'-C3'	-2.78	102.82	111.82
2	A	1476	ACP	O2G-PG-O1G	2.76	119.70	112.39
2	B	1475	ACP	C3'-C2'-C1'	2.69	105.02	100.98
2	A	1476	ACP	O4'-C4'-C3'	2.33	109.72	105.11
2	A	1476	ACP	O2'-C2'-C1'	-2.29	102.39	110.85
2	A	1476	ACP	C4-C5-N7	-2.29	107.02	109.40
2	A	1476	ACP	O2B-PB-C3B	2.23	115.71	106.58
2	A	1476	ACP	N3-C2-N1	2.23	132.16	128.68
2	A	1476	ACP	O5'-PA-O1A	-2.22	100.38	109.07
2	B	1475	ACP	O4'-C1'-C2'	-2.20	103.71	106.93
2	A	1476	ACP	O2A-PA-O5'	2.16	117.78	107.75
2	A	1476	ACP	O3G-PG-O2G	2.14	114.32	108.08
2	B	1475	ACP	O1G-PG-C3B	-2.01	106.91	111.24
2	A	1476	ACP	O3G-PG-C3B	-2.00	101.55	106.40

There are no chirality outliers.

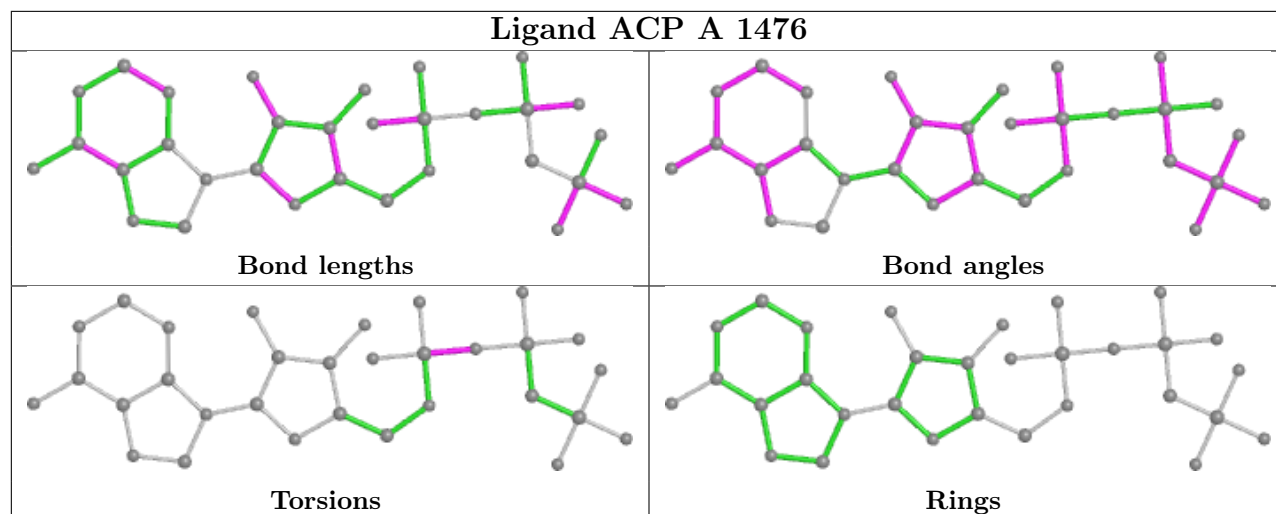All (3) torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
2	A	1476	ACP	PB-O3A-PA-O2A
2	A	1476	ACP	PB-O3A-PA-O1A
2	B	1475	ACP	PB-O3A-PA-O1A

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 then 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.

Ligand ACP B 1475

Bond lengths

Bond angles

Torsions

Rings

Ligand ACP A 1476

Bond lengths

Bond angles

Torsions

Rings
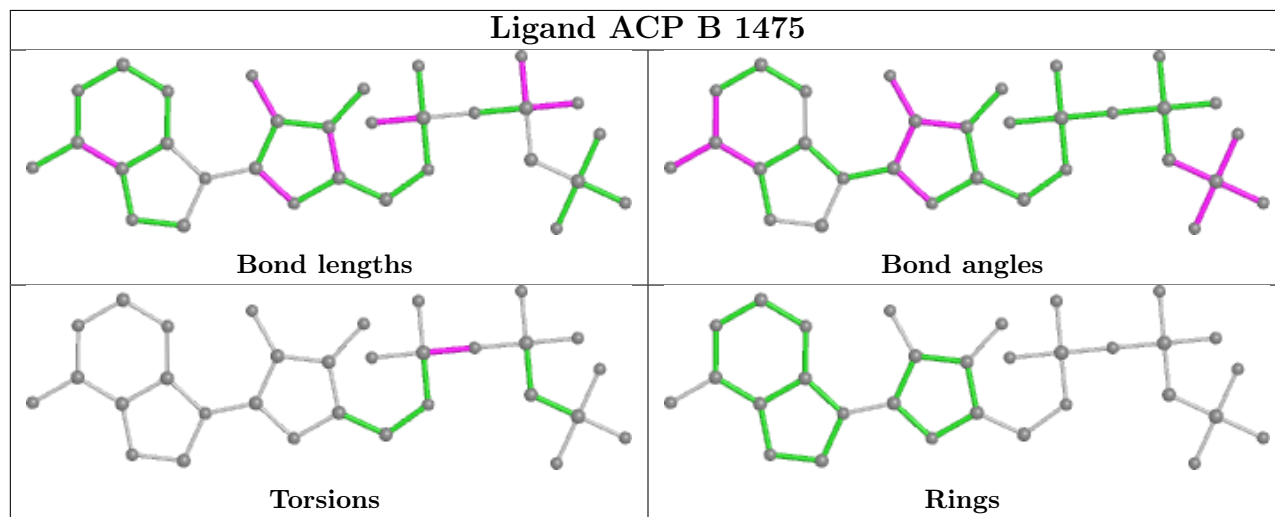
3.7 Other polymers ⓘ

There are no such residues in this entry.

3.8 Polymer linkage issues ⓘ

There are no chain breaks in this entry.

4 Fit of model and data ⓘ

4.1 Protein, DNA and RNA chains ⓘ

EDS was not executed - this section is therefore empty.

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

EDS was not executed - this section is therefore empty.

4.3 Carbohydrates ⓘ

EDS was not executed - this section is therefore empty.

4.4 Ligands ⓘ

EDS was not executed - this section is therefore empty.

4.5 Other polymers ⓘ

EDS was not executed - this section is therefore empty.