



Full wwPDB X-ray Structure Validation Report ⓘ

Feb 12, 2017 – 08:11 pm GMT

PDB ID : 1JOM
Title : THE CRYSTAL STRUCTURE OF THE BINARY COMPLEX BETWEEN
FOLINIC ACID (LEUCOVORIN) AND E. COLI DIHYDROFOLATE RE-
DUCTASE
Authors : Reyes, V.M.; Lee, H.; Kraut, J.
Deposited on : 1996-02-25
Resolution : 1.90 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

<http://wwpdb.org/validation/2016/XrayValidationReportHelp>

with specific help available everywhere you see the ⓘ symbol.

The following versions of software and data (see [references ⓘ](#)) were used in the production of this report:

MolProbity	:	4.02b-467
Mogul	:	1.7.2 (RC1), CSD as538be (2017)
Xtriage (Phenix)	:	NOT EXECUTED
EDS	:	NOT EXECUTED
Percentile statistics	:	20161228.v01 (using entries in the PDB archive December 28th 2016)
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, RNA)	:	Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP)	:	recalc28949

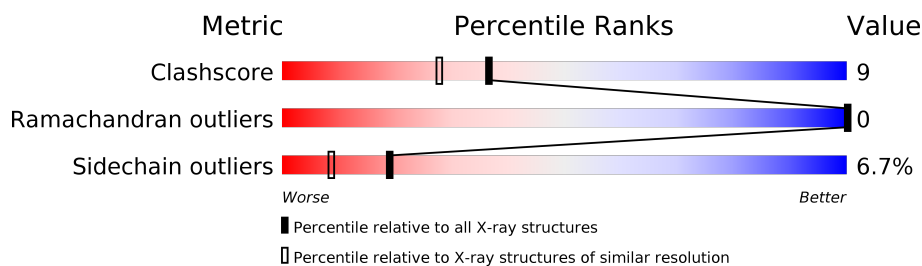
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 1.90 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)	Similar resolution (#Entries, resolution range(Å))
Clashscore	112137	5731 (1.90-1.90)
Ramachandran outliers	110173	5669 (1.90-1.90)
Sidechain outliers	110143	5670 (1.90-1.90)

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 on the lower bar indicate the fraction of residues that contain outliers for ≥ 3 , 2, 1 and 0 types of geometric quality criteria. 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 $\leq 5\%$. The upper red bar (where present) indicates the fraction of residues that have poor fit to the electron density. The numeric value is given above the bar.

Note EDS was not executed.

Mol	Chain	Length	Quality of chain
1	A	159	

2 Entry composition

There are 6 unique types of molecules in this entry. The entry contains 1586 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 DIHYDROFOLATE REDUCTASE.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	159	Total	C	N	O	S	0	3	0
			1298	822	227	242	7			

There is a discrepancy between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	37	ASP	ASN	CONFLICT	UNP P0ABQ4

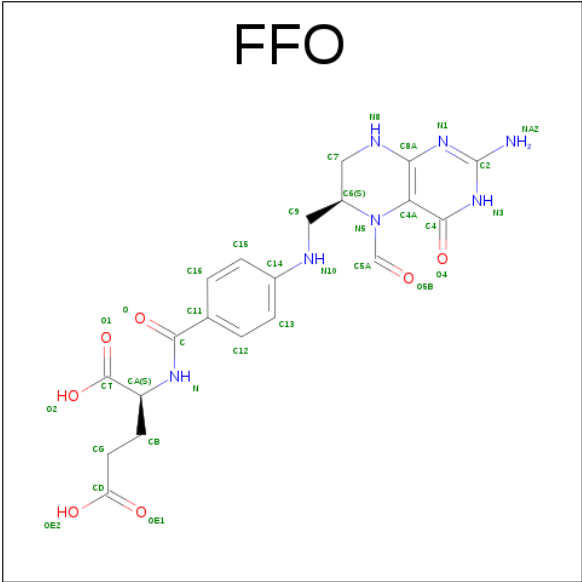
- Molecule 2 is CHLORIDE ION (three-letter code: CL) (formula: Cl).

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
2	A	1	Total	Cl	0	0
			1	1		

- Molecule 3 is CALCIUM ION (three-letter code: CA) (formula: Ca).

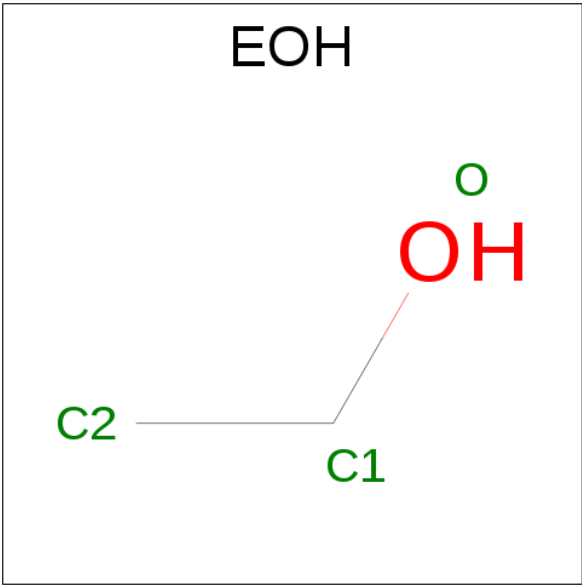
Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
3	A	1	Total	Ca	0	0
			1	1		

- Molecule 4 is 5-FORMYL-6-HYDROFOLIC ACID (three-letter code: FFO) (formula: C₂₀H₂₃N₇O₇).



Mol	Chain	Residues	Atoms				ZeroOcc	AltConf
4	A	1	Total	C	N	O	0	1
			68	40	14	14		

- Molecule 5 is ETHANOL (three-letter code: EOH) (formula: C₂H₆O).



Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
5	A	1	Total	C	O	0	0
			2	1	1		
5	A	1	Total	C	O	0	0
			2	1	1		
5	A	1	Total	C	O	0	0
			3	2	1		

- Molecule 6 is water.

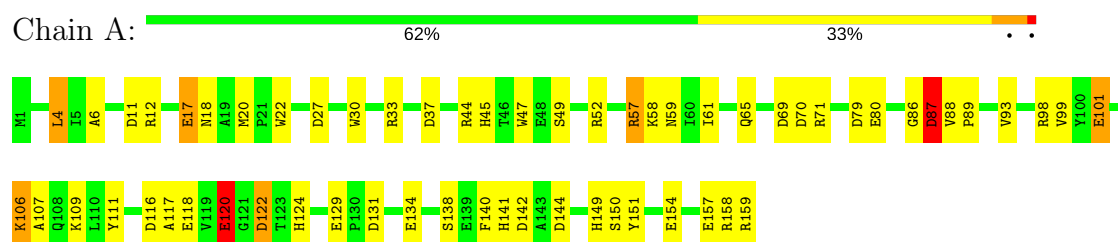
Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
6	A	211	Total 211	O 211	0	0

3 Residue-property plots [i](#)

These plots are drawn for all protein, RNA and DNA 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 and electron density. 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. A red dot above a residue indicates a poor fit to the electron density ($RSRZ > 2$). 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: DIHYDROFOLATE REDUCTASE



4 Data and refinement statistics

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

Property	Value	Source
Space group	P 65	Depositor
Cell constants a, b, c, α , β , γ	96.86Å 96.86Å 35.02Å 90.00° 90.00° 120.00°	Depositor
Resolution (Å)	(Not available) – 1.90	Depositor
% Data completeness (in resolution range)	(Not available) ((Not available)-1.90)	Depositor
R_{merge}	(Not available)	Depositor
R_{sym}	(Not available)	Depositor
Refinement program	TNT	Depositor
R, R_{free}	(Not available) , (Not available)	Depositor
Estimated twinning fraction	No twinning to report.	Xtriage
Total number of atoms	1586	wwPDB-VP
Average B, all atoms (Å ²)	18.0	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: FFO, CA, EOH, CL

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	1.25	9/1331 (0.7%)	1.73	31/1806 (1.7%)

All (9) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	A	134	GLU	CD-OE2	7.85	1.34	1.25
1	A	101	GLU	CD-OE1	7.38	1.33	1.25
1	A	120	GLU	CD-OE1	7.13	1.33	1.25
1	A	129	GLU	CD-OE2	6.97	1.33	1.25
1	A	17	GLU	CD-OE2	6.96	1.33	1.25
1	A	118	GLU	CD-OE1	6.79	1.33	1.25
1	A	157	GLU	CD-OE1	5.85	1.32	1.25
1	A	154	GLU	CD-OE2	-5.14	1.20	1.25
1	A	80	GLU	CD-OE2	5.13	1.31	1.25

All (31) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	44	ARG	NE-CZ-NH1	11.33	125.96	120.30
1	A	11	ASP	CB-CG-OD1	10.78	128.00	118.30
1	A	11	ASP	CB-CG-OD2	-10.40	108.94	118.30
1	A	144	ASP	CB-CG-OD2	-10.34	109.00	118.30
1	A	144	ASP	CB-CG-OD1	8.93	126.34	118.30
1	A	44	ARG	NE-CZ-NH2	-7.80	116.40	120.30
1	A	111	TYR	CB-CG-CD2	-7.76	116.34	121.00
1	A	44	ARG	CD-NE-CZ	7.31	133.83	123.60
1	A	98	ARG	NE-CZ-NH2	-6.92	116.84	120.30
1	A	6	ALA	CB-CA-C	-6.54	100.29	110.10
1	A	70	ASP	CB-CG-OD2	-6.50	112.45	118.30
1	A	98	ARG	NE-CZ-NH1	6.47	123.54	120.30

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Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	109	LYS	N-CA-CB	6.43	122.17	110.60
1	A	122	ASP	CB-CG-OD2	6.42	124.08	118.30
1	A	57[A]	ARG	NE-CZ-NH2	-6.37	117.11	120.30
1	A	57[B]	ARG	NE-CZ-NH2	-6.37	117.11	120.30
1	A	37	ASP	CB-CG-OD1	6.30	123.97	118.30
1	A	79	ASP	CB-CG-OD2	-6.20	112.72	118.30
1	A	65	GLN	CA-CB-CG	-6.15	99.86	113.40
1	A	99	VAL	CG1-CB-CG2	-5.77	101.67	110.90
1	A	138	SER	N-CA-CB	-5.67	102.00	110.50
1	A	37	ASP	CB-CG-OD2	-5.61	113.25	118.30
1	A	27	ASP	CB-CG-OD1	5.56	123.30	118.30
1	A	131	ASP	CB-CA-C	-5.49	99.42	110.40
1	A	70	ASP	CB-CG-OD1	5.29	123.06	118.30
1	A	122	ASP	N-CA-CB	-5.25	101.15	110.60
1	A	87	ASP	CB-CA-C	5.16	120.72	110.40
1	A	45	HIS	CA-CB-CG	-5.15	104.85	113.60
1	A	142	ASP	CB-CG-OD2	-5.05	113.76	118.30
1	A	69	ASP	CB-CG-OD2	-5.02	113.78	118.30
1	A	71	ARG	CD-NE-CZ	-5.01	116.59	123.60

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	1298	0	1251	23	8
2	A	1	0	0	0	0
3	A	1	0	0	0	0
4	A	68	0	41	2	0
5	A	7	0	5	1	1
6	A	211	0	0	7	19
All	All	1586	0	1297	24	19

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 9.

All (24) 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)
5:A:174:EOH:H12	6:A:266:HOH:O	1.77	0.83
1:A:120:GLU:HA	1:A:120:GLU:OE1	1.88	0.71
1:A:107:ALA:O	1:A:158[A]:ARG:NH1	2.25	0.69
1:A:107:ALA:O	1:A:158[B]:ARG:HD2	1.95	0.67
1:A:124:HIS:HD2	6:A:410:HOH:O	1.84	0.60
1:A:30:TRP:HE3	1:A:33[B]:ARG:HH21	1.50	0.58
1:A:106:LYS:NZ	6:A:368:HOH:O	2.26	0.53
1:A:17:GLU:N	4:A:161[B]:FFO:O5B	2.45	0.49
1:A:33[A]:ARG:NH2	6:A:337:HOH:O	2.41	0.47
1:A:117:ALA:HB2	1:A:149:HIS:CD2	2.49	0.47
1:A:57[B]:ARG:NH1	4:A:161[B]:FFO:O1	2.30	0.47
1:A:17:GLU:HA	6:A:352:HOH:O	2.15	0.47
1:A:20:MET:HE2	1:A:22:TRP:CH2	2.50	0.46
1:A:151:TYR:N	1:A:151:TYR:CD1	2.83	0.46
1:A:140:PHE:CG	1:A:141:HIS:N	2.84	0.46
1:A:47:TRP:HB2	1:A:61:ILE:HD12	1.99	0.45
1:A:20:MET:CE	1:A:22:TRP:CH2	3.00	0.44
1:A:88:VAL:HB	1:A:89:PRO:HD2	2.00	0.44
1:A:106:LYS:HG2	1:A:106:LYS:HZ3	1.47	0.43
1:A:12:ARG:HB3	6:A:403:HOH:O	2.19	0.42
1:A:87:ASP:HB2	6:A:339:HOH:O	2.19	0.42
1:A:122:ASP:N	1:A:122:ASP:OD1	2.43	0.42
1:A:88:VAL:HA	1:A:89:PRO:HD3	1.84	0.41
1:A:4:LEU:HD12	1:A:93:VAL:HB	2.03	0.41

All (19) symmetry-related close contacts are listed below. The label for Atom-2 includes the symmetry operator and encoded unit-cell translations to be applied.

Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
6:A:216:HOH:O	6:A:474:HOH:O[6_554]	0.68	1.52
6:A:293:HOH:O	6:A:294:HOH:O[4_664]	0.97	1.23
1:A:86:GLY:CA	6:A:456:HOH:O[4_664]	1.07	1.13
5:A:171:EOH:C1	6:A:442:HOH:O[3_565]	1.15	1.05
6:A:403:HOH:O	6:A:420:HOH:O[3_565]	1.27	0.93
6:A:253:HOH:O	6:A:255:HOH:O[4_665]	1.52	0.68
6:A:207:HOH:O	6:A:209:HOH:O[2_664]	1.56	0.64
1:A:86:GLY:C	6:A:456:HOH:O[4_664]	1.62	0.58
6:A:347:HOH:O	6:A:348:HOH:O[2_664]	1.65	0.55
1:A:86:GLY:N	6:A:456:HOH:O[4_664]	1.67	0.53

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
6:A:331:HOH:O	6:A:332:HOH:O[4_664]	1.81	0.39
6:A:324:HOH:O	6:A:325:HOH:O[2_664]	1.83	0.37
1:A:52:ARG:NH2	6:A:473:HOH:O[5_555]	1.86	0.34
1:A:58:LYS:NZ	6:A:431:HOH:O[4_664]	1.90	0.30
6:A:300:HOH:O	6:A:305:HOH:O[2_664]	2.06	0.14
1:A:101:GLU:OE1	6:A:475:HOH:O[2_664]	2.07	0.13
6:A:262:HOH:O	6:A:331:HOH:O[4_665]	2.10	0.10
1:A:116:ASP:CB	6:A:419:HOH:O[3_565]	2.12	0.08
1:A:116:ASP:OD1	6:A:333:HOH:O[3_565]	2.15	0.05

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	160/159 (101%)	157 (98%)	3 (2%)	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 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	138/136 (102%)	129 (94%)	9 (6%)	20	9

All (9) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	4	LEU
1	A	18	ASN
1	A	49	SER
1	A	59	ASN
1	A	87	ASP
1	A	106	LYS
1	A	120	GLU
1	A	150	SER
1	A	159	ARG

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

Mol	Chain	Res	Type
1	A	18	ASN
1	A	124	HIS

5.3.3 RNA [i](#)

There are no RNA molecules in this entry.

5.4 Non-standard residues in protein, DNA, RNA chains [i](#)

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

5.5 Carbohydrates [i](#)

There are no carbohydrates in this entry.

5.6 Ligand geometry [i](#)

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
4	FFO	A	161[A]	-	24,36,36	2.56	11 (45%)	29,50,50	2.99	16 (55%)
4	FFO	A	161[B]	-	24,36,36	2.38	12 (50%)	29,50,50	2.86	14 (48%)
5	EOH	A	171	-	1,1,2	0.28	0	0,0,1	0.00	-
5	EOH	A	173	-	1,1,2	0.34	0	0,0,1	0.00	-
5	EOH	A	174	3	2,2,2	0.38	0	1,1,1	2.06	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
4	FFO	A	161[A]	-	-	0/18/37/37	0/2/3/3
4	FFO	A	161[B]	-	-	1/18/37/37	0/2/3/3
5	EOH	A	171	-	-	0/0/0/0	0/0/0/0
5	EOH	A	173	-	-	0/0/0/0	0/0/0/0
5	EOH	A	174	3	-	0/0/0/0	0/0/0/0

All (23) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
4	A	161[A]	FFO	C15-C14	-3.37	1.33	1.39
4	A	161[A]	FFO	C2-NA2	-3.17	1.27	1.34
4	A	161[B]	FFO	C2-NA2	-2.78	1.28	1.34
4	A	161[B]	FFO	C15-C14	-2.68	1.34	1.39
4	A	161[A]	FFO	C4A-C8A	-2.59	1.35	1.41
4	A	161[B]	FFO	C4A-C8A	-2.05	1.37	1.41
4	A	161[B]	FFO	CB-CG	2.01	1.62	1.53
4	A	161[B]	FFO	C4-N3	2.11	1.36	1.33
4	A	161[A]	FFO	C9-N10	2.14	1.49	1.45
4	A	161[B]	FFO	CB-CA	2.34	1.56	1.53
4	A	161[A]	FFO	CB-CA	2.41	1.56	1.53
4	A	161[B]	FFO	C13-C14	2.59	1.43	1.39
4	A	161[A]	FFO	C4-N3	2.65	1.37	1.33
4	A	161[A]	FFO	C13-C14	2.66	1.43	1.39
4	A	161[B]	FFO	CA-N	2.82	1.50	1.46
4	A	161[B]	FFO	C9-N10	3.31	1.51	1.45
4	A	161[A]	FFO	C2-N3	3.39	1.41	1.35
4	A	161[B]	FFO	C8A-N1	3.77	1.41	1.34
4	A	161[B]	FFO	C2-N3	3.99	1.42	1.35
4	A	161[A]	FFO	C8A-N1	4.13	1.41	1.34
4	A	161[A]	FFO	CA-N	4.57	1.53	1.46

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Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
4	A	161[B]	FFO	C4-C4A	6.20	1.48	1.41
4	A	161[A]	FFO	C4-C4A	6.77	1.49	1.41

All (31) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
4	A	161[A]	FFO	CB-CA-CT	-6.36	103.04	112.28
4	A	161[B]	FFO	C4A-C4-N3	-5.19	115.23	123.37
4	A	161[A]	FFO	C4A-N5-C6	-4.53	111.43	119.40
4	A	161[B]	FFO	O-C-N	-3.95	115.24	122.46
4	A	161[B]	FFO	N3-C2-N1	-3.94	119.06	125.45
4	A	161[A]	FFO	C4A-C4-N3	-3.92	117.22	123.37
4	A	161[A]	FFO	N3-C2-N1	-3.88	119.17	125.45
4	A	161[B]	FFO	C4A-N5-C6	-3.78	112.75	119.40
4	A	161[B]	FFO	C16-C15-C14	-3.65	116.03	120.30
4	A	161[A]	FFO	O-C-N	-3.25	116.52	122.46
4	A	161[B]	FFO	C13-C14-N10	-3.12	114.74	121.03
4	A	161[A]	FFO	C13-C14-N10	-3.08	114.82	121.03
4	A	161[A]	FFO	C16-C15-C14	-2.95	116.85	120.30
4	A	161[A]	FFO	C13-C12-C11	-2.64	117.84	120.79
4	A	161[B]	FFO	CA-N-C	-2.44	118.80	122.15
4	A	161[A]	FFO	C6-C9-N10	-2.39	105.49	111.89
4	A	161[A]	FFO	C15-C14-N10	2.05	125.16	121.03
5	A	174	EOH	O-C1-C2	2.06	139.55	114.18
4	A	161[B]	FFO	CB-CA-N	2.08	113.39	110.22
4	A	161[A]	FFO	C11-C-N	2.29	121.20	116.97
4	A	161[B]	FFO	C11-C-N	2.82	122.16	116.97
4	A	161[B]	FFO	C9-C6-N5	2.93	116.94	110.94
4	A	161[A]	FFO	C2-N1-C8A	3.09	121.46	114.51
4	A	161[B]	FFO	C15-C16-C11	3.32	124.50	120.79
4	A	161[A]	FFO	C15-C16-C11	3.69	124.91	120.79
4	A	161[A]	FFO	C4-N3-C2	4.38	122.36	116.06
4	A	161[B]	FFO	NA2-C2-N1	4.66	124.69	117.24
4	A	161[B]	FFO	C4-C4A-C8A	4.97	118.39	114.43
4	A	161[A]	FFO	C4-C4A-C8A	5.23	118.59	114.43
4	A	161[A]	FFO	NA2-C2-N1	5.36	125.81	117.24
4	A	161[B]	FFO	C4-N3-C2	6.14	124.90	116.06

There are no chirality outliers.

All (1) torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
4	A	161[B]	FFO	O5B-C5A-N5-C6

There are no ring outliers.

3 monomers are involved in 4 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
4	A	161[B]	FFO	2	0
5	A	171	EOH	0	1
5	A	174	EOH	1	0

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.