



Full wwPDB X-ray Structure Validation Report ⓘ

Mar 10, 2026 – 04:29 AM UTC

PDB ID : 1RE7 / pdb_00001re7
Title : DIHYDROFOLATE REDUCTASE COMPLEXED WITH FOLATE
Authors : Sawaya, M.R.
Deposited on : 1996-11-01
Resolution : 2.60 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) : 2.0
EDS : 3.0
Buster-report : wwPDB partial adaption of 1.1.7 (2018)
Percentile statistics : 20250101.v01 (using entries in the PDB archive January 1st 2025)
CCP4 : 9.0.010 (Gargrove)
Density-Fitness : 1.0.12
Ideal geometry (proteins) : Engh & Huber (2001)
Ideal geometry (DNA, RNA) : Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP) : 2.49

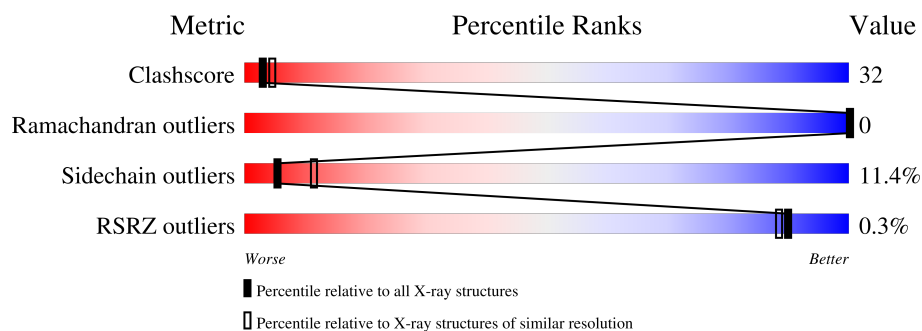
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 2.60 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	4347 (2.60-2.60)
Ramachandran outliers	187476	4277 (2.60-2.60)
Sidechain outliers	187428	4277 (2.60-2.60)
RSRZ outliers	180081	4008 (2.60-2.60)

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 $\leq 5\%$. 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.

Mol	Chain	Length	Quality of chain
1	A	159	
1	B	159	

2 Entry composition [i](#)

There are 3 unique types of molecules in this entry. The entry contains 2618 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.

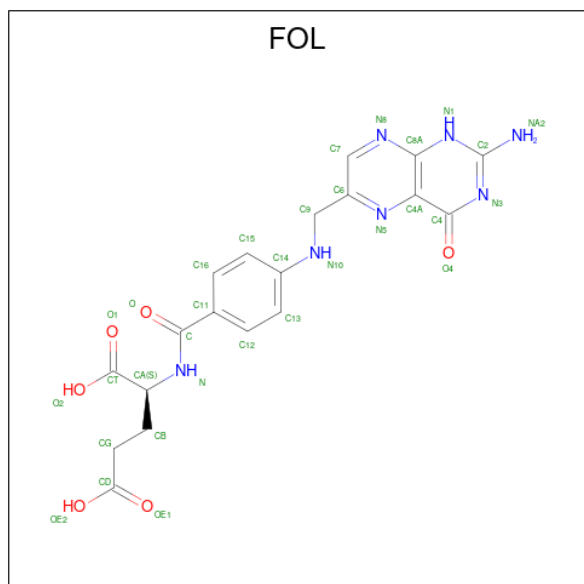
- Molecule 1 is a protein called DIHYDROFOLATE REDUCTASE.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	159	Total	C	N	O	S	6	0	0
			1268	805	216	240	7			
1	B	159	Total	C	N	O	S	6	0	0
			1268	805	216	240	7			

There are 2 discrepancies between the modelled and reference sequences:

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

- Molecule 2 is FOLIC ACID (CCD ID: FOL) (formula: C₁₉H₁₉N₇O₆).



Continued from previous page...

Mol	Chain	Residues	Atoms				ZeroOcc	AltConf
2	B	1	Total	C	N	O	0	0
			32	19	7	6		

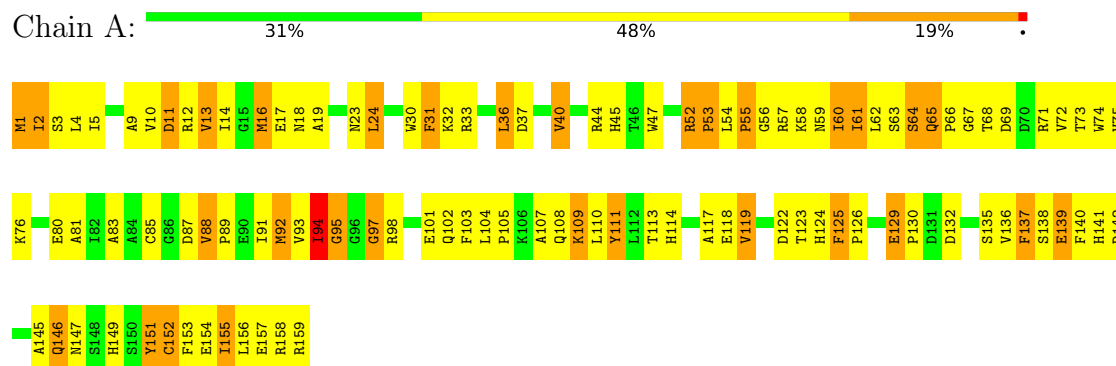
- Molecule 3 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
3	A	9	Total	O	0	0
			9	9		
3	B	9	Total	O	0	0
			9	9		

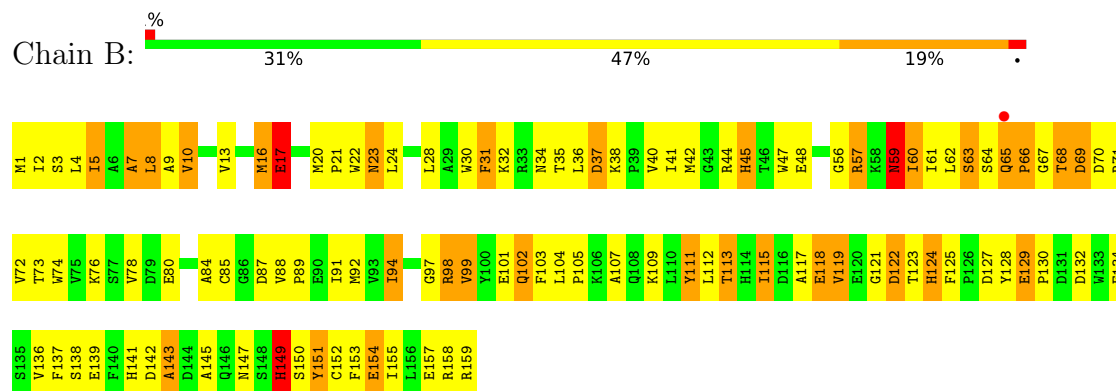
3 Residue-property plots [i](#)

These plots are drawn for all protein, RNA, DNA and oligosaccharide 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.

• Molecule 1: DIHYDROFOLATE REDUCTASE



• Molecule 1: DIHYDROFOLATE REDUCTASE



4 Data and refinement statistics

Property	Value	Source
Space group	P 21 21 21	Depositor
Cell constants a, b, c, α , β , γ	44.38Å 60.91Å 121.97Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	20.00 – 2.60 20.00 – 2.60	Depositor EDS
% Data completeness (in resolution range)	88.0 (20.00-2.60) 87.3 (20.00-2.60)	Depositor EDS
R_{merge}	(Not available)	Depositor
R_{sym}	0.09	Depositor
$\langle I/\sigma(I) \rangle$ ¹	1.62 (at 2.22Å)	Xtriage
Refinement program	TNT 5D	Depositor
R, R_{free}	0.178 , (Not available) (Not available) , (Not available)	Depositor DCC
R_{free} test set	No test flags present.	wwPDB-VP
Wilson B-factor (Å ²)	20.0	Xtriage
Anisotropy	0.428	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.34 , 101.6	EDS
L-test for twinning ²	$\langle L \rangle = 0.46$, $\langle L^2 \rangle = 0.29$	Xtriage
Estimated twinning fraction	No twinning to report.	Xtriage
F_o, F_c correlation	0.94	EDS
Total number of atoms	2618	wwPDB-VP
Average B, all atoms (Å ²)	22.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 5.22% of the height of the origin peak. No significant pseudotranslation is detected.*

¹Intensities estimated from amplitudes.

²Theoretical values of $\langle |L| \rangle$, $\langle L^2 \rangle$ for acentric reflections are 0.5, 0.333 respectively for untwinned datasets, and 0.375, 0.2 for perfectly twinned datasets.

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: FOL

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	1.69	13/1302 (1.0%)	2.15	51/1770 (2.9%)
1	B	1.64	7/1302 (0.5%)	2.12	52/1770 (2.9%)
All	All	1.66	20/2604 (0.8%)	2.13	103/3540 (2.9%)

All (20) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	A	88	VAL	CA-C	-7.44	1.46	1.52
1	A	62	LEU	N-CA	-6.59	1.38	1.46
1	A	93	VAL	CA-CB	-6.44	1.46	1.54
1	A	88	VAL	N-CA	-6.00	1.41	1.46
1	A	157	GLU	CD-OE2	5.90	1.36	1.25
1	B	66	PRO	CA-C	5.79	1.59	1.52
1	A	2	ILE	CA-C	-5.78	1.45	1.52
1	B	37	ASP	CA-C	-5.77	1.45	1.53
1	A	137	PHE	N-CA	-5.71	1.39	1.46
1	A	95	GLY	CA-C	-5.68	1.46	1.52
1	A	111	TYR	N-CA	-5.65	1.39	1.46
1	A	92	MET	CA-C	-5.44	1.46	1.52
1	B	80	GLU	N-CA	-5.42	1.39	1.46
1	A	151	TYR	C-N	-5.41	1.25	1.33
1	A	122	ASP	C-N	5.25	1.40	1.33
1	A	64	SER	N-CA	-5.18	1.39	1.46
1	B	60	ILE	N-CA	-5.16	1.39	1.46
1	B	154	GLU	CD-OE2	5.07	1.34	1.25
1	B	38	LYS	C-N	-5.07	1.27	1.33
1	B	48	GLU	CD-OE2	5.06	1.34	1.25

All (103) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	B	45	HIS	CA-CB-CG	-11.36	102.44	113.80
1	A	94	ILE	N-CA-C	10.59	122.24	112.29
1	A	142	ASP	CA-CB-CG	10.40	123.00	112.60
1	A	11	ASP	CB-CA-C	-8.94	99.47	111.63
1	A	88	VAL	O-C-N	8.24	128.90	121.57
1	B	115	ILE	N-CA-CB	-7.83	102.05	111.21
1	B	127	ASP	CA-CB-CG	-7.77	104.83	112.60
1	A	123	THR	N-CA-C	7.75	122.46	109.76
1	A	129	GLU	CA-C-N	7.72	128.12	119.32
1	A	129	GLU	C-N-CA	7.72	128.12	119.32
1	B	150	SER	N-CA-C	-7.62	100.71	110.53
1	A	155	ILE	CB-CA-C	-7.58	99.81	110.12
1	A	91	ILE	CA-C-N	-7.57	112.31	122.99
1	A	91	ILE	C-N-CA	-7.57	112.31	122.99
1	B	99	VAL	CB-CA-C	-7.56	102.11	112.24
1	A	125	PHE	N-CA-C	-7.46	100.67	110.07
1	B	145	ALA	CA-C-N	-7.33	110.73	122.24
1	B	145	ALA	C-N-CA	-7.33	110.73	122.24
1	A	73	THR	CB-CA-C	-7.29	97.22	109.48
1	A	40	VAL	N-CA-C	6.90	117.98	107.77
1	A	129	GLU	O-C-N	6.81	126.74	121.23
1	A	31	PHE	CA-CB-CG	-6.52	107.28	113.80
1	A	55	PRO	CB-CA-C	-6.43	103.39	111.56
1	B	94	ILE	N-CA-C	6.40	118.42	111.77
1	B	87	ASP	CA-CB-CG	-6.38	106.22	112.60
1	B	69	ASP	N-CA-CB	6.34	118.96	109.19
1	B	125	PHE	CA-C-N	-6.33	114.10	120.31
1	B	125	PHE	C-N-CA	-6.33	114.10	120.31
1	A	109	LYS	CB-CA-C	6.33	121.26	109.86
1	A	30	TRP	N-CA-CB	-6.28	100.63	110.30
1	B	9	ALA	N-CA-C	-6.26	100.16	109.86
1	B	113	THR	N-CA-CB	6.24	120.59	110.42
1	B	111	TYR	CA-C-N	-6.20	112.68	122.73
1	B	111	TYR	C-N-CA	-6.20	112.68	122.73
1	A	11	ASP	CA-CB-CG	6.15	118.75	112.60
1	A	45	HIS	CA-CB-CG	-6.01	107.79	113.80
1	A	68	THR	N-CA-CB	5.97	119.28	110.33
1	B	147	ASN	CB-CA-C	5.96	119.97	110.19
1	B	97	GLY	CA-C-N	5.96	128.26	120.28
1	B	97	GLY	C-N-CA	5.96	128.26	120.28
1	B	124	HIS	CA-CB-CG	-5.93	107.87	113.80
1	B	66	PRO	O-C-N	-5.83	116.57	123.10
1	B	68	THR	N-CA-CB	5.83	118.76	110.13

Continued on next page...

Continued from previous page...

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	B	38	LYS	O-C-N	-5.79	117.80	121.85
1	B	149	HIS	CA-CB-CG	5.77	119.57	113.80
1	A	73	THR	O-C-N	-5.75	116.46	123.19
1	A	66	PRO	CA-C-N	-5.65	116.09	121.46
1	A	66	PRO	C-N-CA	-5.65	116.09	121.46
1	A	60	ILE	CA-C-N	-5.65	115.81	123.10
1	A	60	ILE	C-N-CA	-5.65	115.81	123.10
1	A	9	ALA	N-CA-C	-5.65	101.11	109.86
1	B	38	LYS	CA-C-N	-5.64	114.16	120.14
1	B	38	LYS	C-N-CA	-5.64	114.16	120.14
1	B	7	ALA	CA-C-N	-5.63	115.23	123.00
1	B	7	ALA	C-N-CA	-5.63	115.23	123.00
1	A	107	ALA	N-CA-CB	-5.55	101.87	110.04
1	A	113	THR	CA-C-N	-5.55	115.63	122.84
1	A	113	THR	C-N-CA	-5.55	115.63	122.84
1	B	34	ASN	O-C-N	-5.52	115.21	122.39
1	A	97	GLY	N-CA-C	5.52	119.32	112.64
1	B	65	GLN	CA-C-O	5.47	126.92	120.96
1	B	32	LYS	N-CA-C	5.45	116.90	111.07
1	B	150	SER	CA-C-O	-5.42	115.71	121.94
1	B	17	GLU	O-C-N	5.38	127.84	122.03
1	A	108	GLN	CB-CG-CD	-5.36	103.49	112.60
1	B	59	ASN	N-CA-C	5.35	117.35	108.20
1	A	18	ASN	N-CA-C	-5.34	101.82	110.32
1	A	108	GLN	CB-CA-C	-5.34	100.41	109.38
1	B	122	ASP	CB-CA-C	-5.32	100.79	109.56
1	B	151	TYR	CA-CB-CG	-5.31	104.35	113.90
1	A	53	PRO	CA-C-N	-5.30	114.74	121.74
1	A	53	PRO	C-N-CA	-5.30	114.74	121.74
1	A	88	VAL	CA-C-N	5.29	126.46	119.84
1	A	88	VAL	C-N-CA	5.29	126.46	119.84
1	B	129	GLU	CA-C-N	5.28	126.44	119.84
1	B	129	GLU	C-N-CA	5.28	126.44	119.84
1	A	37	ASP	CB-CA-C	-5.27	104.24	111.73
1	A	1	MET	CA-C-N	-5.27	116.31	123.10
1	A	1	MET	C-N-CA	-5.27	116.31	123.10
1	A	103	PHE	CA-CB-CG	-5.26	108.53	113.80
1	A	19	ALA	N-CA-C	5.26	117.32	110.43
1	B	31	PHE	N-CA-C	-5.26	105.45	111.07
1	B	57	ARG	CA-C-N	5.25	129.39	122.30
1	B	57	ARG	C-N-CA	5.25	129.39	122.30
1	B	119	VAL	N-CA-CB	-5.22	105.22	112.52

Continued on next page...

Continued from previous page...

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	146	GLN	CA-CB-CG	-5.21	103.68	114.10
1	B	8	LEU	N-CA-C	5.21	117.46	109.07
1	A	122	ASP	O-C-N	5.20	129.32	122.30
1	A	58	LYS	CA-C-N	-5.20	115.51	122.42
1	A	58	LYS	C-N-CA	-5.20	115.51	122.42
1	B	101	GLU	CB-CA-C	-5.18	102.98	110.96
1	B	38	LYS	CA-C-O	5.15	125.16	119.91
1	A	67	GLY	CA-C-N	-5.14	112.06	121.52
1	A	67	GLY	C-N-CA	-5.14	112.06	121.52
1	B	143	ALA	N-CA-C	-5.13	103.70	110.43
1	B	34	ASN	N-CA-C	5.11	118.61	112.38
1	B	66	PRO	CA-C-N	-5.10	116.87	122.38
1	B	66	PRO	C-N-CA	-5.10	116.87	122.38
1	A	123	THR	N-CA-CB	5.07	118.89	110.52
1	B	63	SER	N-CA-CB	-5.07	102.10	111.52
1	B	2	ILE	N-CA-C	5.05	115.24	108.17
1	B	102	GLN	CB-CG-CD	-5.01	104.08	112.60
1	A	61	ILE	CB-CA-C	5.01	118.42	110.81

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	1268	0	1221	80	0
1	B	1268	0	1221	80	0
2	A	32	0	17	3	0
2	B	32	0	17	5	0
3	A	9	0	0	1	0
3	B	9	0	0	0	0
All	All	2618	0	2476	161	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 32.

All (161) 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:59:ASN:HD22	1:B:59:ASN:N	1.75	0.83
1:B:64:SER:HB2	1:B:65:GLN:NE2	1.95	0.81
1:A:109:LYS:HE2	1:A:111:TYR:OH	1.87	0.75
1:A:135:SER:HA	1:A:156:LEU:HD23	1.69	0.74
1:B:98:ARG:NH1	1:B:102:GLN:NE2	2.39	0.71
1:B:129:GLU:HG2	1:B:130:PRO:HD2	1.72	0.70
1:B:10:VAL:HB	1:B:117:ALA:O	1.91	0.70
1:B:20:MET:HE3	1:B:22:TRP:CH2	2.27	0.69
1:B:142:ASP:OD1	1:B:143:ALA:N	2.27	0.67
1:A:61:ILE:O	1:A:75:VAL:HG22	1.95	0.67
1:B:139:GLU:HG2	1:B:141:HIS:NE2	2.10	0.67
1:A:138:SER:HA	1:A:153:PHE:O	1.94	0.66
1:A:129:GLU:HG3	1:A:130:PRO:HD2	1.79	0.66
1:B:23:ASN:O	1:B:24:LEU:HD23	1.96	0.66
1:A:88:VAL:HB	1:A:89:PRO:HD2	1.79	0.64
1:B:59:ASN:HD22	1:B:59:ASN:H	1.44	0.64
1:B:111:TYR:O	1:B:112:LEU:HD23	1.98	0.63
1:A:64:SER:O	1:A:76:LYS:NZ	2.29	0.62
1:A:75:VAL:HG21	1:A:81:ALA:HB2	1.81	0.62
1:B:59:ASN:N	1:B:59:ASN:ND2	2.45	0.62
1:A:12:ARG:NH1	1:A:125:PHE:O	2.29	0.61
1:A:97:GLY:O	1:A:101:GLU:HG3	2.00	0.61
1:A:17:GLU:HA	1:A:17:GLU:OE1	1.99	0.61
1:B:143:ALA:HB2	1:B:149:HIS:C	2.25	0.61
1:B:62:LEU:C	1:B:62:LEU:HD12	2.24	0.61
1:B:8:LEU:N	1:B:113:THR:O	2.30	0.60
1:B:62:LEU:HD12	1:B:63:SER:N	2.17	0.60
1:B:134:GLU:OE1	1:B:159:ARG:NH1	2.33	0.60
1:B:129:GLU:CG	1:B:130:PRO:HD2	2.32	0.60
1:B:69:ASP:OD1	1:B:71:ARG:N	2.25	0.59
1:B:136:VAL:CG2	1:B:157:GLU:HG3	2.33	0.59
1:B:98:ARG:NH1	1:B:102:GLN:HE21	2.01	0.59
1:B:10:VAL:HG11	1:B:118:GLU:HG3	1.86	0.58
1:B:139:GLU:HG2	1:B:141:HIS:HE2	1.69	0.58
1:A:4:LEU:HD12	1:A:4:LEU:N	2.19	0.57
1:B:141:HIS:HB2	1:B:151:TYR:CZ	2.40	0.56
1:A:10:VAL:O	1:A:11:ASP:HB2	2.04	0.56
1:B:57:ARG:NH1	2:B:361:FOL:O1	2.29	0.56
1:A:3:SER:C	1:A:4:LEU:HD12	2.29	0.56
1:B:98:ARG:O	1:B:102:GLN:HG3	2.06	0.56
1:A:69:ASP:OD1	1:A:71:ARG:HB2	2.07	0.55

Continued on next page...

Continued from previous page...

Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:98:ARG:HA	1:A:101:GLU:HG3	1.89	0.55
1:A:59:ASN:HD22	1:A:59:ASN:N	2.04	0.55
1:A:61:ILE:CD1	1:A:72:VAL:HB	2.38	0.54
1:B:7:ALA:C	1:B:8:LEU:HD12	2.33	0.54
1:B:42:MET:SD	1:B:47:TRP:HB2	2.47	0.54
1:B:8:LEU:N	1:B:8:LEU:HD12	2.23	0.53
1:B:88:VAL:HB	1:B:89:PRO:HD2	1.89	0.53
1:A:40:VAL:HA	1:A:92:MET:O	2.09	0.53
1:B:63:SER:O	1:B:76:LYS:HD3	2.08	0.53
1:A:24:LEU:HD21	1:A:149:HIS:HB2	1.90	0.53
1:A:72:VAL:HG23	1:A:74:TRP:NE1	2.23	0.53
1:A:32:LYS:HG3	1:A:36:LEU:HD13	1.91	0.53
1:A:13:VAL:HG11	1:A:119:VAL:CG2	2.40	0.52
1:B:44:ARG:HH12	1:B:45:HIS:CE1	2.28	0.52
1:A:145:ALA:C	1:A:146:GLN:HG2	2.34	0.52
1:A:74:TRP:N	1:A:74:TRP:CD1	2.77	0.52
1:A:98:ARG:O	1:A:101:GLU:HB2	2.10	0.52
1:B:136:VAL:HG21	1:B:157:GLU:HG3	1.92	0.51
1:B:3:SER:OG	1:B:109:LYS:HB3	2.10	0.51
1:A:95:GLY:HA3	3:A:413:HOH:O	2.10	0.51
1:A:61:ILE:HD13	1:A:72:VAL:HG21	1.92	0.51
1:A:136:VAL:HG22	1:A:155:ILE:O	2.11	0.51
1:B:35:THR:O	1:B:57:ARG:HG2	2.11	0.51
1:B:31:PHE:CE2	2:B:361:FOL:H16	2.45	0.50
1:A:129:GLU:CG	1:A:130:PRO:HD2	2.40	0.50
1:B:99:VAL:HG12	1:B:103:PHE:CD1	2.47	0.50
1:A:5:ILE:HA	1:A:111:TYR:O	2.12	0.49
1:B:36:LEU:HD12	1:B:57:ARG:NE	2.28	0.49
1:B:103:PHE:C	1:B:105:PRO:HD2	2.38	0.49
1:A:14:ILE:HG21	1:A:125:PHE:HB2	1.93	0.49
1:B:139:GLU:O	1:B:152:CYS:HA	2.11	0.49
1:A:56:GLY:O	1:A:57:ARG:HG3	2.13	0.49
1:A:64:SER:HB2	1:A:65:GLN:NE2	2.27	0.49
1:A:60:ILE:HG22	1:A:61:ILE:N	2.26	0.49
1:B:60:ILE:HD13	1:B:84:ALA:HB3	1.95	0.49
1:A:140:PHE:HA	1:A:152:CYS:HB2	1.94	0.48
1:B:57:ARG:HH12	2:B:361:FOL:CT	2.22	0.48
1:A:64:SER:HB2	1:A:65:GLN:HE22	1.79	0.48
1:B:60:ILE:HD12	1:B:85:CYS:SG	2.54	0.48
1:A:63:SER:OG	1:A:64:SER:N	2.47	0.47
1:A:135:SER:HA	1:A:156:LEU:CD2	2.43	0.47

Continued on next page...

Continued from previous page...

Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:125:PHE:CD1	1:A:126:PRO:HD2	2.50	0.47
1:B:16:MET:HB3	1:B:121:GLY:HA2	1.97	0.47
1:A:64:SER:CB	1:A:65:GLN:NE2	2.77	0.47
1:B:129:GLU:HA	1:B:130:PRO:HD3	1.68	0.47
1:B:99:VAL:HG12	1:B:103:PHE:HD1	1.80	0.47
1:B:136:VAL:HG22	1:B:155:ILE:O	2.15	0.47
1:B:17:GLU:OE1	1:B:17:GLU:HA	2.07	0.46
1:A:63:SER:O	1:A:76:LYS:HD3	2.16	0.46
1:B:61:ILE:HD13	1:B:72:VAL:HG21	1.98	0.46
1:A:12:ARG:O	1:A:124:HIS:HA	2.16	0.46
1:A:61:ILE:HD11	1:A:72:VAL:HB	1.97	0.46
1:A:53:PRO:O	1:A:55:PRO:HD3	2.16	0.45
1:B:124:HIS:CD2	1:B:124:HIS:N	2.83	0.45
1:A:94:ILE:O	2:A:161:FOL:H7	2.16	0.45
1:B:99:VAL:CG1	1:B:103:PHE:CD1	2.99	0.45
1:B:4:LEU:HD13	1:B:107:ALA:HB2	1.98	0.45
1:A:31:PHE:CE2	2:A:161:FOL:H16	2.52	0.45
1:A:60:ILE:CG2	1:A:61:ILE:N	2.79	0.45
1:A:75:VAL:HG21	1:A:81:ALA:CB	2.46	0.45
1:A:139:GLU:CG	1:A:141:HIS:NE2	2.80	0.45
1:A:104:LEU:O	1:A:158:ARG:NH2	2.50	0.45
1:B:78:VAL:HG13	1:B:103:PHE:CZ	2.52	0.45
1:B:44:ARG:HB3	1:B:44:ARG:CZ	2.47	0.45
1:A:110:LEU:HD12	1:A:156:LEU:HD12	1.98	0.44
1:B:67:GLY:HA3	1:B:74:TRP:CE2	2.53	0.44
2:A:161:FOL:C6	2:A:161:FOL:H15	2.47	0.44
1:B:41:ILE:HD12	1:B:91:ILE:CG2	2.47	0.44
1:A:55:PRO:O	1:A:57:ARG:NH2	2.50	0.44
1:B:5:ILE:CG2	1:B:94:ILE:HG22	2.47	0.44
1:A:125:PHE:CG	1:A:126:PRO:HD2	2.53	0.44
1:B:64:SER:HB2	1:B:65:GLN:HE22	1.78	0.44
1:B:151:TYR:CD1	1:B:151:TYR:N	2.85	0.44
1:B:40:VAL:O	1:B:40:VAL:HG23	2.17	0.43
1:A:4:LEU:N	1:A:4:LEU:CD1	2.81	0.43
1:A:65:GLN:NE2	1:A:65:GLN:N	2.65	0.43
1:A:88:VAL:CB	1:A:89:PRO:HD2	2.38	0.43
1:A:47:TRP:HH2	1:A:53:PRO:HD3	1.83	0.43
1:B:37:ASP:N	1:B:56:GLY:O	2.44	0.43
1:A:54:LEU:HD23	1:A:54:LEU:HA	1.73	0.43
1:B:22:TRP:CZ2	1:B:115:ILE:CD1	3.02	0.43
1:B:10:VAL:O	1:B:13:VAL:HG23	2.19	0.43

Continued on next page...

Continued from previous page...

Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:B:31:PHE:CD1	2:B:361:FOL:C8A	3.02	0.43
1:B:107:ALA:O	1:B:158:ARG:NE	2.48	0.43
1:A:10:VAL:HG23	1:A:117:ALA:O	2.19	0.42
1:A:114:HIS:O	1:A:151:TYR:HA	2.19	0.42
1:B:28:LEU:HA	1:B:28:LEU:HD23	1.72	0.42
1:B:122:ASP:HB2	1:B:123:THR:HG23	2.01	0.42
1:B:36:LEU:HD12	1:B:36:LEU:HA	1.86	0.42
1:B:143:ALA:HB2	1:B:149:HIS:CA	2.50	0.42
1:B:128:TYR:CD1	1:B:128:TYR:N	2.88	0.42
1:A:149:HIS:HE1	1:B:21:PRO:HB3	1.85	0.42
1:B:61:ILE:HD12	1:B:72:VAL:HB	2.02	0.42
1:B:41:ILE:CD1	1:B:91:ILE:HG21	2.50	0.42
1:B:3:SER:O	1:B:92:MET:HA	2.20	0.41
1:A:16:MET:HE2	1:A:16:MET:HB2	1.66	0.41
1:A:23:ASN:O	1:A:147:ASN:HA	2.20	0.41
1:A:104:LEU:N	1:A:105:PRO:HD2	2.35	0.41
1:A:33:ARG:O	1:A:33:ARG:HG2	2.19	0.41
1:A:137:PHE:O	1:A:154:GLU:HA	2.20	0.41
1:A:109:LYS:HE2	1:A:111:TYR:CZ	2.54	0.41
1:A:23:ASN:C	1:A:24:LEU:HG	2.45	0.41
1:A:61:ILE:CD1	1:A:72:VAL:CG2	2.98	0.41
1:A:98:ARG:O	1:A:102:GLN:HG3	2.21	0.41
1:A:132:ASP:C	1:A:159:ARG:HG3	2.45	0.41
1:A:80:GLU:O	1:A:83:ALA:N	2.52	0.41
1:A:69:ASP:OD1	1:A:71:ARG:N	2.35	0.41
1:A:154:GLU:CD	1:A:156:LEU:HD21	2.46	0.41
1:A:65:GLN:N	1:A:65:GLN:CD	2.79	0.41
1:B:141:HIS:HB2	1:B:151:TYR:CE2	2.56	0.41
1:A:52:ARG:HH12	1:A:55:PRO:HG3	1.85	0.41
1:B:22:TRP:CZ2	1:B:115:ILE:HD12	2.56	0.41
1:B:104:LEU:N	1:B:105:PRO:CD	2.84	0.41
1:A:56:GLY:C	1:A:57:ARG:HG3	2.46	0.40
1:A:60:ILE:CD1	1:A:85:CYS:SG	3.09	0.40
1:A:61:ILE:CD1	1:A:72:VAL:CB	2.99	0.40
2:B:361:FOL:N5	2:B:361:FOL:C15	2.85	0.40
1:B:138:SER:HA	1:B:153:PHE:O	2.21	0.40
1:B:65:GLN:HB3	1:B:66:PRO:HD2	2.04	0.40
1:B:137:PHE:O	1:B:154:GLU:HA	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 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	157/159 (99%)	145 (92%)	12 (8%)	0	100	100
1	B	157/159 (99%)	148 (94%)	9 (6%)	0	100	100
All	All	314/318 (99%)	293 (93%)	21 (7%)	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 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	136/136 (100%)	121 (89%)	15 (11%)	6	13
1	B	136/136 (100%)	120 (88%)	16 (12%)	5	10
All	All	272/272 (100%)	241 (89%)	31 (11%)	5	11

All (31) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	1	MET
1	A	2	ILE
1	A	13	VAL
1	A	16	MET
1	A	24	LEU
1	A	36	LEU
1	A	44	ARG
1	A	52	ARG

Continued on next page...

Continued from previous page...

Mol	Chain	Res	Type
1	A	65	GLN
1	A	87	ASP
1	A	94	ILE
1	A	118	GLU
1	A	119	VAL
1	A	139	GLU
1	A	152	CYS
1	B	1	MET
1	B	5	ILE
1	B	10	VAL
1	B	16	MET
1	B	17	GLU
1	B	23	ASN
1	B	30	TRP
1	B	59	ASN
1	B	68	THR
1	B	70	ASP
1	B	73	THR
1	B	98	ARG
1	B	118	GLU
1	B	119	VAL
1	B	132	ASP
1	B	149	HIS

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (7) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	18	ASN
1	A	65	GLN
1	A	114	HIS
1	B	18	ASN
1	B	45	HIS
1	B	102	GLN
1	B	124	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 ⓘ

2 ligands 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	$\# Z > 2$
2	FOL	B	361	-	34,34,34	1.86	12 (35%)	43,47,47	2.48	18 (41%)
2	FOL	A	161	-	34,34,34	1.74	10 (29%)	43,47,47	2.27	18 (41%)

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	FOL	B	361	-	-	5/22/22/22	0/3/3/3
2	FOL	A	161	-	-	4/22/22/22	0/3/3/3

All (22) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
2	B	361	FOL	C2-N3	4.03	1.42	1.33
2	B	361	FOL	C2-N1	-3.07	1.30	1.37
2	B	361	FOL	C4A-C8A	-3.05	1.33	1.42
2	B	361	FOL	C15-C14	-3.04	1.34	1.39
2	A	161	FOL	C2-NA2	-3.03	1.27	1.34
2	A	161	FOL	CA-N	3.01	1.52	1.45

Continued on next page...

Continued from previous page...

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
2	A	161	FOL	CB-CG	2.92	1.61	1.52
2	A	161	FOL	C2-N3	2.78	1.39	1.33
2	A	161	FOL	C4A-C8A	-2.77	1.34	1.42
2	A	161	FOL	C7-N8	-2.62	1.29	1.34
2	B	361	FOL	C7-N8	-2.59	1.29	1.34
2	A	161	FOL	C16-C15	2.53	1.42	1.38
2	B	361	FOL	C2-NA2	-2.50	1.28	1.34
2	A	161	FOL	C13-C14	2.48	1.43	1.39
2	A	161	FOL	C2-N1	-2.42	1.31	1.37
2	B	361	FOL	O1-CT	2.38	1.29	1.22
2	B	361	FOL	CA-N	2.28	1.50	1.45
2	B	361	FOL	C9-N10	2.24	1.52	1.45
2	A	161	FOL	C11-C	-2.23	1.45	1.50
2	B	361	FOL	C4-N3	-2.20	1.34	1.38
2	B	361	FOL	C13-C14	2.14	1.42	1.39
2	B	361	FOL	C8A-N1	-2.06	1.35	1.38

All (36) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
2	B	361	FOL	CG-CB-CA	-6.06	101.98	113.16
2	B	361	FOL	OE1-CD-CG	-4.70	108.18	123.09
2	B	361	FOL	C15-C16-C11	4.48	125.58	120.80
2	A	161	FOL	C8A-C4A-C4	-4.44	116.68	119.56
2	B	361	FOL	N1-C8A-N8	-4.38	109.83	116.38
2	A	161	FOL	C6-C7-N8	4.37	127.33	123.14
2	A	161	FOL	C16-C15-C14	-4.19	115.47	120.30
2	A	161	FOL	OE1-CD-CG	-4.17	109.86	123.09
2	A	161	FOL	C7-C6-N5	-4.15	118.17	120.87
2	A	161	FOL	N1-C8A-N8	-3.84	110.64	116.38
2	B	361	FOL	CT-CA-N	3.72	119.21	110.57
2	B	361	FOL	C16-C15-C14	-3.66	116.09	120.30
2	B	361	FOL	O4-C4-C4A	3.60	126.75	120.42
2	A	161	FOL	C4A-C8A-N1	3.59	124.51	120.13
2	B	361	FOL	C7-C6-N5	-3.42	118.65	120.87
2	A	161	FOL	NA2-C2-N1	3.39	123.90	116.77
2	B	361	FOL	C13-C14-N10	-3.32	113.46	120.96
2	B	361	FOL	C4A-C8A-N1	3.23	124.07	120.13
2	B	361	FOL	O-C-N	-3.12	116.53	122.47
2	A	161	FOL	C13-C14-N10	-3.11	113.94	120.96
2	B	361	FOL	OE2-CD-CG	2.97	123.40	114.00
2	B	361	FOL	C6-C7-N8	2.91	125.93	123.14

Continued on next page...

Continued from previous page...

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
2	A	161	FOL	C15-C16-C11	2.72	123.71	120.80
2	A	161	FOL	CG-CB-CA	-2.70	108.18	113.16
2	A	161	FOL	O4-C4-C4A	2.63	125.04	120.42
2	B	361	FOL	C8A-C4A-C4	-2.61	117.87	119.56
2	A	161	FOL	N1-C2-N3	-2.58	118.60	123.32
2	B	361	FOL	O-C-C11	2.52	125.90	120.90
2	A	161	FOL	C9-C6-N5	2.51	121.29	116.56
2	B	361	FOL	C16-C11-C12	-2.44	115.47	118.57
2	A	161	FOL	C15-C14-C13	2.43	122.27	119.04
2	A	161	FOL	OE2-CD-CG	2.35	121.43	114.00
2	A	161	FOL	C11-C-N	2.24	121.19	117.04
2	B	361	FOL	NA2-C2-N1	2.12	121.24	116.77
2	B	361	FOL	N1-C2-N3	-2.11	119.47	123.32
2	A	161	FOL	OE2-CD-OE1	2.09	128.71	123.33

There are no chirality outliers.

All (9) torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
2	A	161	FOL	N-CA-CB-CG
2	B	361	FOL	N-CA-CB-CG
2	A	161	FOL	CT-CA-CB-CG
2	B	361	FOL	CT-CA-CB-CG
2	B	361	FOL	C6-C9-N10-C14
2	B	361	FOL	OE1-CD-CG-CB
2	A	161	FOL	OE1-CD-CG-CB
2	A	161	FOL	OE2-CD-CG-CB
2	B	361	FOL	OE2-CD-CG-CB

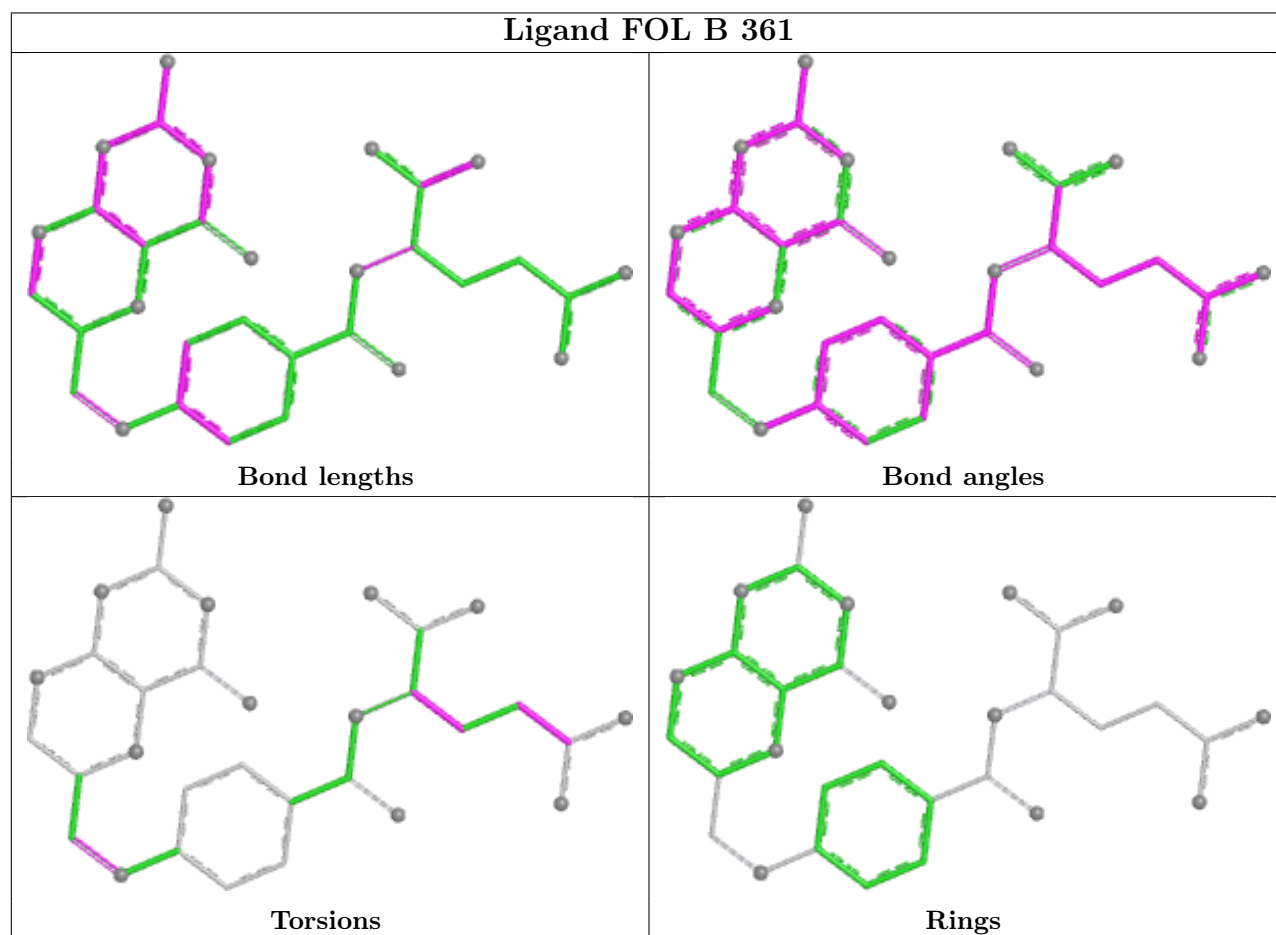
There are no ring outliers.

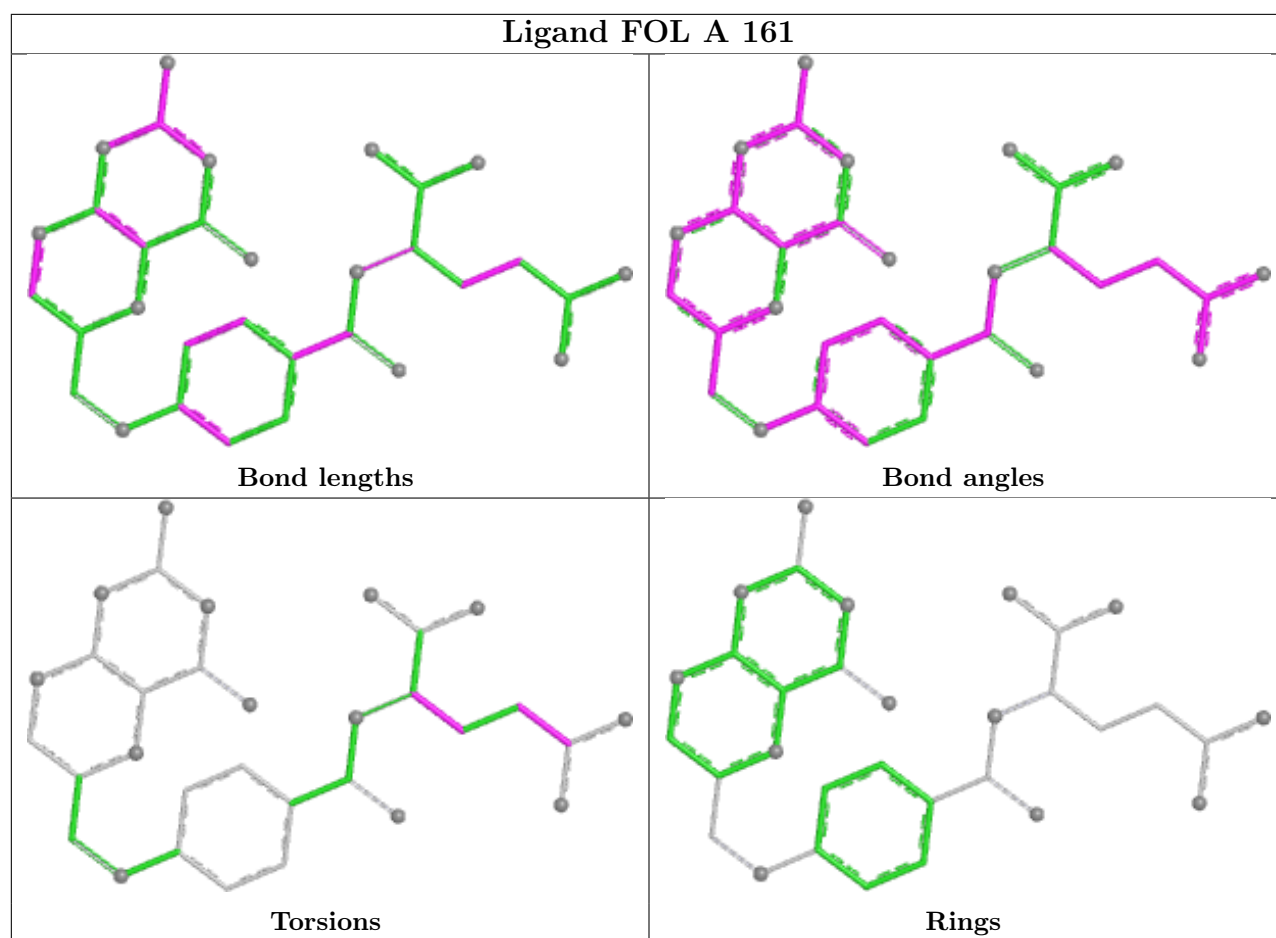
2 monomers are involved in 8 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
2	B	361	FOL	5	0
2	A	161	FOL	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 [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 [i](#)

6.1 Protein, DNA and RNA chains [i](#)

In the following table, the column labelled ‘#RSRZ> 2’ contains the number (and percentage) of RSRZ outliers, followed by percent RSRZ outliers for the chain as percentile scores relative to all X-ray entries and entries of similar resolution. The OWAB column contains the minimum, median, 95th percentile and maximum values of the occupancy-weighted average B-factor per residue. The column labelled ‘Q< 0.9’ lists the number of (and percentage) of residues with an average occupancy less than 0.9.

Mol	Chain	Analysed	<RSRZ>	#RSRZ>2	OWAB(Å ²)	Q<0.9
1	A	159/159 (100%)	-0.67	0 100 100	3, 19, 48, 65	2 (1%)
1	B	159/159 (100%)	-0.65	1 (0%) 85 83	4, 17, 47, 71	2 (1%)
All	All	318/318 (100%)	-0.66	1 (0%) 90 88	3, 18, 48, 71	4 (1%)

All (1) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	B	65	GLN	2.2

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

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

6.3 Carbohydrates [i](#)

There are no oligosaccharides in this entry.

6.4 Ligands [i](#)

In the following table, the Atoms column lists the number of modelled atoms in the group and the number defined in the chemical component dictionary. The B-factors column lists the minimum, median, 95th percentile and maximum values of B factors of atoms in the group. The column labelled ‘Q< 0.9’ lists the number of atoms with occupancy less than 0.9.

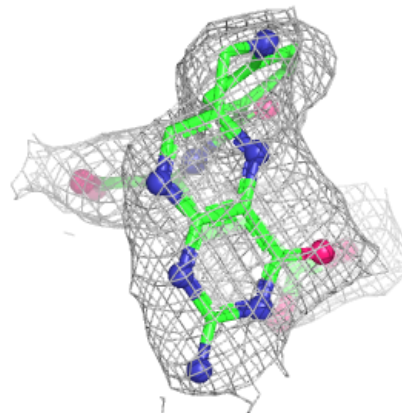
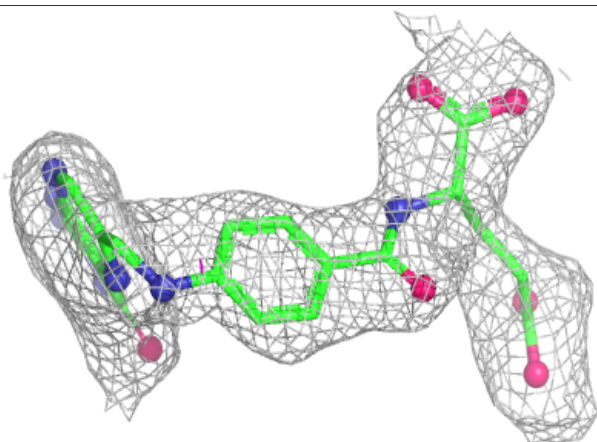
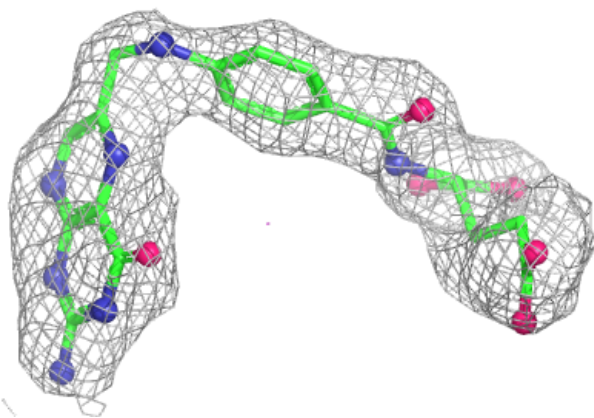
Mol	Type	Chain	Res	Atoms	RSCC	RSR	B-factors(Å ²)	Q<0.9
2	FOL	A	161	32/32	0.94	0.07	11,25,66,73	0
2	FOL	B	361	32/32	0.94	0.08	8,20,56,62	0

The following is a graphical depiction of the model fit to experimental electron density of all

instances of the Ligand of Interest. In addition, ligands with molecular weight > 250 and outliers as shown on the geometry validation Tables will also be included. Each fit is shown from different orientation to approximate a three-dimensional view.

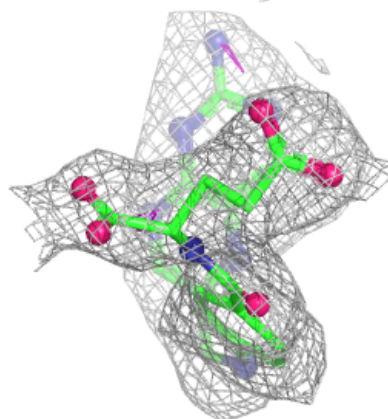
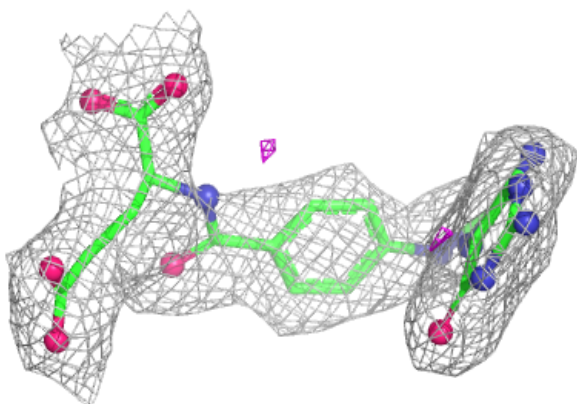
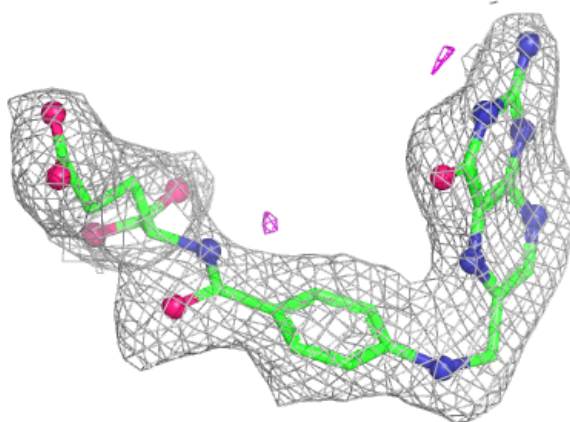
Electron density around FOL A 161:

$2mF_o-DF_c$ (at 0.7 rmsd) in gray
 mF_o-DF_c (at 3 rmsd) in purple (negative)
and green (positive)



Electron density around FOL B 361:

$2mF_o-DF_c$ (at 0.7 rmsd) in gray
 mF_o-DF_c (at 3 rmsd) in purple (negative)
and green (positive)



6.5 Other polymers [i](#)

There are no such residues in this entry.