



Full wwPDB X-ray Structure Validation Report ⓘ

Mar 4, 2026 – 11:16 PM UTC

PDB ID : 1AA6 / pdb_00001aa6
Title : REDUCED FORM OF FORMATE DEHYDROGENASE H FROM E. COLI
Authors : Sun, P.D.; Boyington, J.C.
Deposited on : 1997-01-23
Resolution : 2.30 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

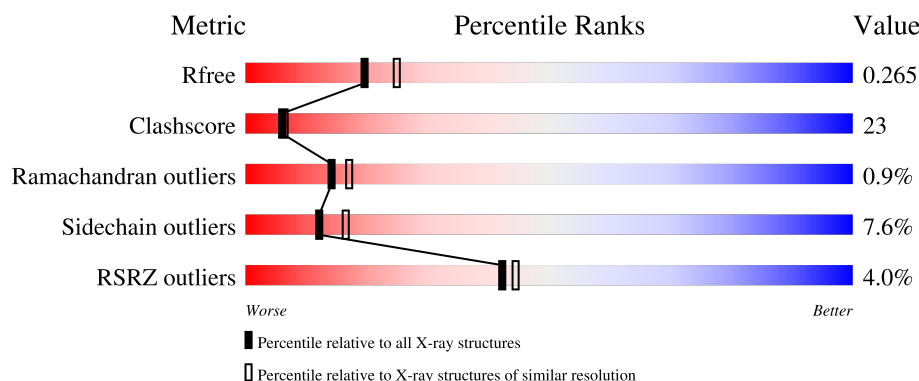
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 2.30 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))
R_{free}	180053	6319 (2.30-2.30)
Clashscore	190562	6919 (2.30-2.30)
Ramachandran outliers	187476	6854 (2.30-2.30)
Sidechain outliers	187428	6854 (2.30-2.30)
RSRZ outliers	180081	6325 (2.30-2.30)

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	715	

2 Entry composition [i](#)

There are 5 unique types of molecules in this entry. The entry contains 5646 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 FORMATE DEHYDROGENASE H.

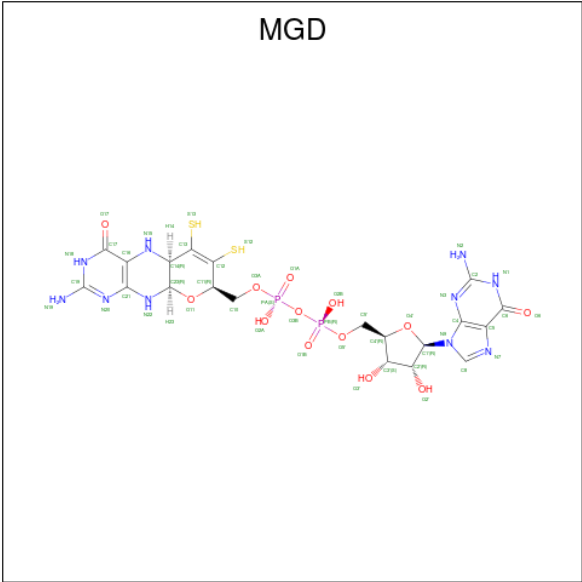
Mol	Chain	Residues	Atoms						ZeroOcc	AltConf	Trace
			Total	C	N	O	S	Se			
1	A	697	5460	3436	957	1034	32	1	0	2	0

- Molecule 2 is IRON/SULFUR CLUSTER (CCD ID: SF4) (formula: Fe_4S_4).



Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
			Total	Fe	S		
2	A	1	8	4	4	0	0

- Molecule 3 is 2-AMINO-5,6-DIMERCAPTO-7-METHYL-3,7,8A,9-TETRAHYDRO-8-OXA-1,3,9,10-TETRAAZA-ANTHRACEN-4-ONE GUANOSINE DINUCLEOTIDE (CCD ID: MGD) (formula: $\text{C}_{20}\text{H}_{26}\text{N}_{10}\text{O}_{13}\text{P}_2\text{S}_2$).



Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	
3	A	1	Total	C	N	O	P	S	0	0
			47	20	10	13	2	2		
3	A	1	Total	C	N	O	P	S	0	0
			47	20	10	13	2	2		

- Molecule 4 is MOLYBDENUM(IV) ION (CCD ID: 4MO) (formula: Mo).

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
4	A	1	Total	Mo	0	0
			1	1		

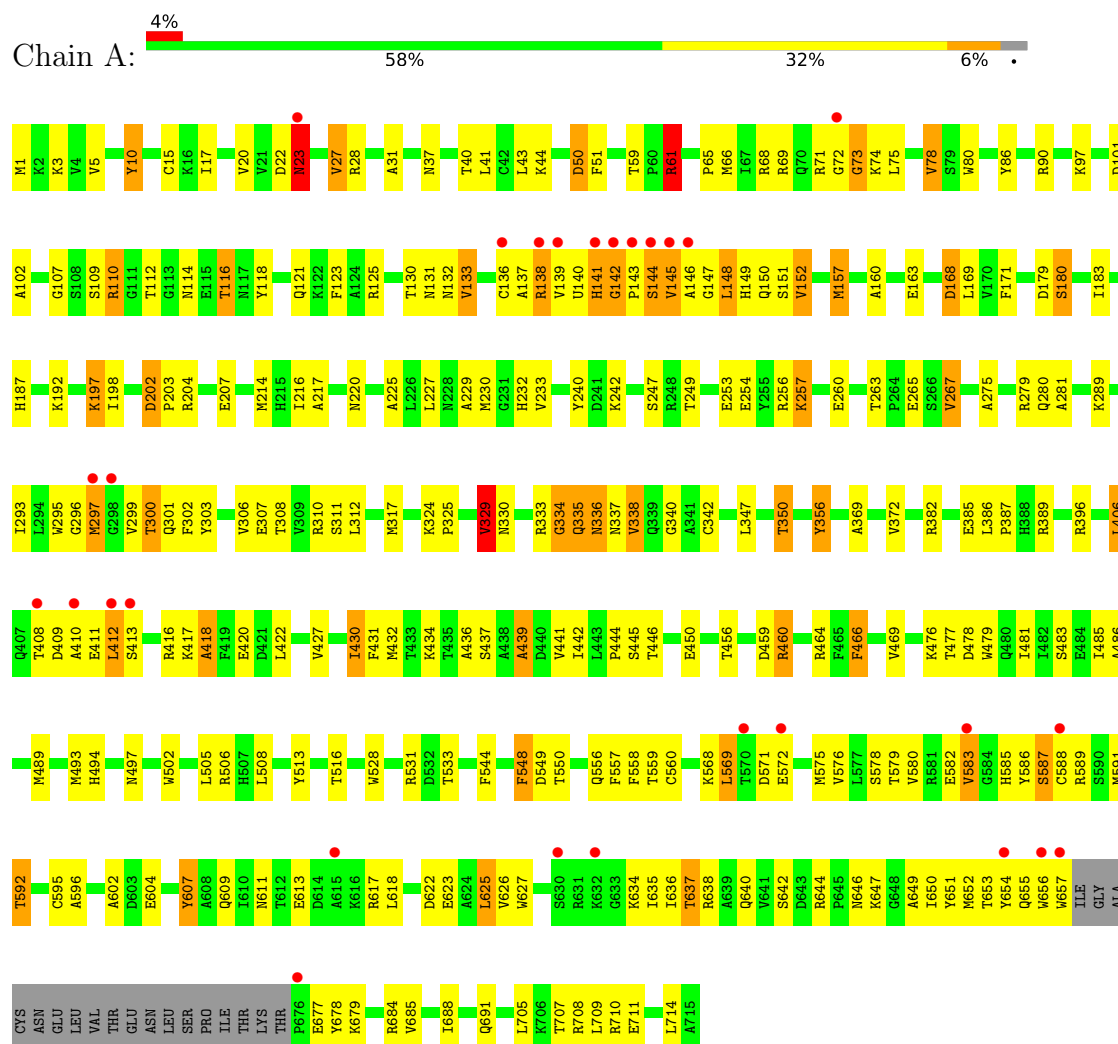
- Molecule 5 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
5	A	83	Total	O	0	0
			83	83		

3 Residue-property plots

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: FORMATE DEHYDROGENASE H



4 Data and refinement statistics

Property	Value	Source
Space group	P 41 21 2	Depositor
Cell constants a, b, c, α , β , γ	146.40Å 146.40Å 82.70Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	6.00 – 2.30 6.00 – 2.30	Depositor EDS
% Data completeness (in resolution range)	87.9 (6.00-2.30) 82.5 (6.00-2.30)	Depositor EDS
R_{merge}	0.09	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	8.69 (at 2.29Å)	Xtriage
Refinement program	X-PLOR 3.1	Depositor
R, R_{free}	0.217 , 0.287 0.209 , 0.265	Depositor DCC
R_{free} test set	1649 reflections (4.58%)	wwPDB-VP
Wilson B-factor (Å ²)	27.4	Xtriage
Anisotropy	0.270	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.56 , 92.7	EDS
L-test for twinning ²	$\langle L \rangle = 0.48$, $\langle L^2 \rangle = 0.31$	Xtriage
Estimated twinning fraction	No twinning to report.	Xtriage
F_o, F_c correlation	0.93	EDS
Total number of atoms	5646	wwPDB-VP
Average B, all atoms (Å ²)	28.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 3.08% 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

5.1 Standard geometry

Bond lengths and bond angles in the following residue types are not validated in this section: SF4, SEC, MGD, 4MO

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	0.73	0/5573	1.16	46/7555 (0.6%)

Chiral center outliers are detected by calculating the chiral volume of a chiral center and verifying if the center is modelled as a planar moiety or with the opposite hand. A planarity outlier is detected by checking planarity of atoms in a peptide group, atoms in a mainchain group or atoms of a sidechain that are expected to be planar.

Mol	Chain	#Chirality outliers	#Planarity outliers
1	A	0	3

There are no bond length outliers.

All (46) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	145	VAL	N-CA-C	11.00	121.67	110.23
1	A	73	GLY	N-CA-C	10.59	131.13	111.12
1	A	300	THR	N-CA-C	10.03	122.29	111.36
1	A	548	PHE	N-CA-C	8.17	123.46	113.17
1	A	107	GLY	N-CA-C	-7.93	100.51	112.41
1	A	72	GLY	N-CA-C	-7.90	94.47	113.18
1	A	202	ASP	CA-C-N	7.45	126.72	118.97
1	A	202	ASP	C-N-CA	7.45	126.72	118.97
1	A	334	GLY	N-CA-C	7.09	129.98	113.18
1	A	550	THR	N-CA-C	-7.02	100.95	110.36
1	A	408	THR	N-CA-C	6.94	122.03	113.50
1	A	197	LYS	N-CA-C	-6.86	101.29	110.55
1	A	74	LYS	N-CA-C	-6.76	94.31	107.62
1	A	607	TYR	N-CA-C	6.75	120.52	110.52
1	A	133	VAL	CB-CA-C	-6.47	100.86	110.82
1	A	544	PHE	N-CA-C	6.46	121.11	113.23

Continued on next page...

Continued from previous page...

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	335	GLN	N-CA-C	6.44	119.11	110.35
1	A	531	ARG	N-CA-C	6.41	121.30	112.90
1	A	75	LEU	N-CA-C	-6.33	100.03	109.15
1	A	97	LYS	N-CA-C	6.25	118.17	111.36
1	A	136	CYS	N-CA-C	-6.22	103.81	111.40
1	A	180	SER	N-CA-C	6.13	119.23	111.69
1	A	72	GLY	CA-C-N	-6.04	116.74	122.66
1	A	72	GLY	C-N-CA	-6.04	116.74	122.66
1	A	329	VAL	N-CA-C	-6.03	98.85	107.77
1	A	569	LEU	N-CA-C	-6.00	101.40	110.28
1	A	145	VAL	CB-CA-C	-5.72	104.38	111.70
1	A	418	ALA	N-CA-C	-5.72	104.95	111.07
1	A	338	VAL	N-CA-C	-5.63	103.90	111.44
1	A	168	ASP	N-CA-C	-5.59	106.30	113.23
1	A	50	ASP	N-CA-C	5.57	118.07	111.33
1	A	604	GLU	N-CA-C	-5.55	102.66	110.31
1	A	586	TYR	N-CA-C	5.50	117.37	108.34
1	A	571	ASP	N-CA-C	-5.46	105.87	112.54
1	A	653	THR	N-CA-C	-5.46	101.83	109.69
1	A	625	LEU	N-CA-C	-5.41	103.35	110.43
1	A	596	ALA	N-CA-C	5.31	117.75	111.33
1	A	125	ARG	N-CA-C	5.30	118.08	111.24
1	A	439	ALA	N-CA-C	5.29	116.92	110.41
1	A	142	GLY	CA-C-N	5.28	125.09	119.28
1	A	142	GLY	C-N-CA	5.28	125.09	119.28
1	A	247	SER	N-CA-C	5.25	119.40	112.89
1	A	297	MET	N-CA-C	5.24	117.89	111.82
1	A	466	PHE	N-CA-C	5.15	118.12	110.14
1	A	61	ARG	N-CA-C	-5.03	103.41	110.50
1	A	329	VAL	CB-CA-C	5.01	117.18	110.42

There are no chirality outliers.

All (3) planarity outliers are listed below:

Mol	Chain	Res	Type	Group
1	A	10	TYR	Sidechain
1	A	303	TYR	Sidechain
1	A	356	TYR	Sidechain

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	5460	0	5335	246	0
2	A	8	0	0	1	0
3	A	94	0	44	8	0
4	A	1	0	0	0	0
5	A	83	0	0	4	0
All	All	5646	0	5379	247	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 23.

All (247) 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:130:THR:HG22	1:A:132:ASN:H	1.20	1.05
1:A:141:HIS:HB3	1:A:144:SER:HB2	1.51	0.91
1:A:588:CYS:HB3	5:A:854:HOH:O	1.70	0.91
1:A:144:SER:HB3	1:A:333:ARG:HH21	1.35	0.90
1:A:607:TYR:HD2	1:A:640:GLN:HB2	1.38	0.88
1:A:602:ALA:HB1	1:A:656:TRP:HH2	1.40	0.86
1:A:214:MET:HE1	1:A:280:GLN:HB3	1.59	0.85
1:A:140:SEC:HA	3:A:801:MGD:S13	2.19	0.82
1:A:311:SER:OG	1:A:559:THR:HG22	1.79	0.82
1:A:138[B]:ARG:HH21	1:A:145:VAL:HG22	1.45	0.81
1:A:151:SER:OG	1:A:310:ARG:HD2	1.80	0.81
1:A:157:MET:HG2	1:A:330:ASN:HB3	1.63	0.81
1:A:143:PRO:HB2	1:A:300:THR:HG22	1.61	0.80
1:A:147:GLY:O	1:A:310:ARG:HD3	1.83	0.79
1:A:485:ILE:HG22	1:A:489:MET:HE2	1.64	0.77
1:A:116:THR:HG22	1:A:479:TRP:HD1	1.47	0.77
1:A:141:HIS:CD2	1:A:333:ARG:HG2	2.19	0.77
1:A:589:ARG:HH11	1:A:657:TRP:H	1.32	0.76
1:A:138[B]:ARG:NH1	1:A:342:CYS:SG	2.58	0.76
1:A:141:HIS:HE1	1:A:295:TRP:HD1	1.32	0.74
1:A:225:ALA:HB1	1:A:267:VAL:HG21	1.70	0.74
1:A:130:THR:HG22	1:A:132:ASN:N	2.00	0.72

Continued on next page...

Continued from previous page...

Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:141:HIS:HB2	1:A:333:ARG:CD	2.20	0.72
1:A:204:ARG:NH2	1:A:580:VAL:HG21	2.05	0.71
1:A:483:SER:HA	1:A:493:MET:HE3	1.72	0.71
1:A:141:HIS:CB	1:A:333:ARG:HE	2.03	0.71
1:A:86:TYR:O	1:A:90:ARG:HG2	1.91	0.71
1:A:169:LEU:HD12	1:A:197:LYS:HB2	1.71	0.71
1:A:220:ASN:HD21	1:A:646:ASN:HD21	1.38	0.71
1:A:112:THR:HG22	1:A:116:THR:HG21	1.72	0.71
1:A:141:HIS:HE1	1:A:295:TRP:CD1	2.08	0.70
1:A:112:THR:HG22	1:A:116:THR:CG2	2.21	0.70
1:A:302:PHE:HA	1:A:677:GLU:HG3	1.72	0.69
1:A:141:HIS:CE1	1:A:295:TRP:CD1	2.80	0.69
1:A:613:GLU:HG2	1:A:647:LYS:NZ	2.07	0.69
1:A:295:TRP:HZ3	1:A:329:VAL:HG22	1.58	0.69
1:A:144:SER:HB3	1:A:333:ARG:NH2	2.08	0.69
1:A:68:ARG:CG	1:A:73:GLY:HA3	2.22	0.68
1:A:141:HIS:HB2	1:A:333:ARG:NE	2.08	0.68
1:A:225:ALA:HB1	1:A:267:VAL:CG2	2.24	0.68
1:A:589:ARG:NH1	1:A:657:TRP:H	1.92	0.67
1:A:637:THR:HG21	1:A:652:MET:HE3	1.77	0.67
1:A:613:GLU:HG2	1:A:647:LYS:HZ3	1.57	0.67
1:A:143:PRO:HB3	1:A:306:VAL:HG22	1.75	0.67
1:A:141:HIS:HD2	1:A:333:ARG:HG2	1.59	0.67
1:A:220:ASN:ND2	1:A:646:ASN:HD21	1.93	0.66
1:A:66:MET:HE1	1:A:432:MET:HE1	1.77	0.66
1:A:688:ILE:HB	1:A:691:GLN:NE2	2.10	0.66
1:A:602:ALA:HB1	1:A:656:TRP:CH2	2.27	0.64
1:A:68:ARG:HD3	1:A:73:GLY:HA3	1.80	0.64
1:A:204:ARG:HH11	1:A:609:GLN:HE22	1.44	0.64
1:A:141:HIS:NE2	1:A:296:GLY:HA2	2.13	0.64
1:A:51:PHE:CZ	1:A:591:MET:HE3	2.33	0.64
1:A:587:SER:HA	1:A:655:GLN:HG2	1.79	0.63
1:A:295:TRP:CZ3	1:A:329:VAL:HG22	2.32	0.63
1:A:144:SER:CB	1:A:333:ARG:HH21	2.09	0.63
1:A:146:ALA:HA	1:A:149:HIS:HB3	1.81	0.62
1:A:66:MET:HE1	1:A:432:MET:CE	2.30	0.62
1:A:68:ARG:HG3	1:A:73:GLY:HA3	1.81	0.62
1:A:585:HIS:HA	1:A:592:THR:HG21	1.81	0.62
1:A:71:ARG:NH2	1:A:422:LEU:O	2.34	0.61
1:A:130:THR:HG22	1:A:131:ASN:N	2.15	0.61
1:A:110:ARG:HA	1:A:336:ASN:HD21	1.65	0.60

Continued on next page...

Continued from previous page...

Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:31:ALA:HB2	1:A:41:LEU:HG	1.85	0.59
1:A:141:HIS:HB3	1:A:144:SER:CB	2.28	0.59
1:A:138[B]:ARG:NH2	1:A:145:VAL:HG22	2.18	0.59
1:A:430:ILE:HG22	1:A:431:PHE:CD2	2.38	0.59
1:A:141:HIS:HB3	1:A:333:ARG:HE	1.66	0.59
1:A:140:SEC:O	1:A:297:MET:SD	2.62	0.58
1:A:297:MET:HE3	1:A:301:GLN:NE2	2.17	0.58
1:A:66:MET:HE3	1:A:442:ILE:HG13	1.86	0.58
1:A:137[A]:ALA:HB1	1:A:335:GLN:OE1	2.04	0.58
1:A:144:SER:O	1:A:148:LEU:HB2	2.04	0.57
1:A:204:ARG:CZ	1:A:580:VAL:HG21	2.35	0.57
1:A:141:HIS:HB2	1:A:333:ARG:HE	1.64	0.57
1:A:460:ARG:HB2	1:A:528:TRP:NE1	2.19	0.57
1:A:138[A]:ARG:NH1	1:A:347:LEU:HD22	2.20	0.57
1:A:17:ILE:HG12	1:A:41:LEU:HD21	1.87	0.56
1:A:141:HIS:CE1	1:A:295:TRP:HD1	2.16	0.56
1:A:112:THR:HG23	1:A:478:ASP:OD2	2.04	0.56
1:A:171:PHE:CE2	1:A:230:MET:HE1	2.41	0.56
1:A:207:GLU:HG2	1:A:644:ARG:NH2	2.21	0.56
1:A:207:GLU:HG2	1:A:644:ARG:HH22	1.71	0.56
1:A:141:HIS:CB	1:A:333:ARG:NE	2.68	0.56
1:A:112:THR:CG2	1:A:116:THR:HG21	2.34	0.56
1:A:171:PHE:HE2	1:A:230:MET:HE1	1.72	0.55
1:A:350:THR:HG23	1:A:356:TYR:CD1	2.40	0.55
1:A:459:ASP:O	1:A:460:ARG:HG2	2.06	0.55
1:A:575:MET:HE3	1:A:650:ILE:HG23	1.88	0.55
1:A:68:ARG:CD	1:A:73:GLY:HA3	2.36	0.54
1:A:139:VAL:HG12	1:A:139:VAL:O	2.08	0.54
1:A:301:GLN:OE1	1:A:679:LYS:HE2	2.08	0.54
1:A:37:ASN:HB2	1:A:40:THR:O	2.07	0.54
1:A:50:ASP:HB3	1:A:595:CYS:HA	1.90	0.54
1:A:109:SER:HB3	1:A:338:VAL:HA	1.89	0.54
1:A:141:HIS:CG	1:A:144:SER:HG	2.26	0.54
3:A:801:MGD:S12	3:A:802:MGD:S13	3.05	0.54
1:A:572:GLU:O	1:A:684:ARG:HD2	2.07	0.54
1:A:622:ASP:O	1:A:623:GLU:HB2	2.08	0.53
1:A:627:TRP:CE3	1:A:634:LYS:HG2	2.44	0.53
1:A:229:ALA:O	1:A:232:HIS:HB3	2.08	0.53
1:A:256:ARG:HH22	1:A:257:LYS:HE2	1.72	0.53
1:A:61:ARG:HH11	1:A:61:ARG:CG	2.22	0.53
1:A:297:MET:C	1:A:299:VAL:H	2.16	0.53

Continued on next page...

Continued from previous page...

Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:86:TYR:CE2	1:A:90:ARG:NH2	2.76	0.53
1:A:707:THR:O	1:A:711:GLU:HG3	2.09	0.53
1:A:69:ARG:NH1	1:A:86:TYR:HE2	2.07	0.53
1:A:216:ILE:HD11	1:A:281:ALA:CB	2.38	0.53
1:A:123:PHE:CZ	1:A:489:MET:HE1	2.44	0.52
1:A:27:VAL:HG12	1:A:28:ARG:HG2	1.92	0.52
1:A:65:PRO:HG2	1:A:78:VAL:O	2.09	0.52
1:A:141:HIS:ND1	1:A:144:SER:OG	2.39	0.52
1:A:477:THR:O	1:A:481:ILE:HG13	2.10	0.52
1:A:293:ILE:HG21	1:A:312:LEU:HD22	1.90	0.52
1:A:607:TYR:CD2	1:A:640:GLN:HB2	2.30	0.52
1:A:141:HIS:O	1:A:144:SER:HB2	2.08	0.52
1:A:148:LEU:HD21	1:A:329:VAL:HG11	1.92	0.52
1:A:350:THR:HG23	1:A:356:TYR:CE1	2.45	0.52
1:A:15:CYS:SG	1:A:37:ASN:HB3	2.51	0.51
1:A:123:PHE:CE1	1:A:489:MET:CE	2.93	0.51
1:A:588:CYS:HA	5:A:825:HOH:O	2.10	0.51
1:A:585:HIS:HB2	1:A:592:THR:HG21	1.92	0.51
1:A:61:ARG:HH11	1:A:61:ARG:HG2	1.76	0.51
1:A:15:CYS:SG	1:A:183:ILE:HG12	2.51	0.51
1:A:22:ASP:O	1:A:23:ASN:HB2	2.11	0.51
1:A:61:ARG:HG2	1:A:61:ARG:NH1	2.24	0.51
1:A:412:LEU:O	1:A:416:ARG:HG3	2.10	0.51
1:A:138[A]:ARG:HH11	1:A:347:LEU:CD2	2.24	0.50
1:A:130:THR:HG21	1:A:132:ASN:CG	2.36	0.50
1:A:138[A]:ARG:C	1:A:140:SEC:H	2.18	0.50
1:A:202:ASP:O	1:A:217:ALA:HA	2.12	0.50
1:A:141:HIS:CE1	1:A:296:GLY:O	2.64	0.50
1:A:369:ALA:HB2	1:A:508:LEU:HD21	1.93	0.50
1:A:253:GLU:O	1:A:257:LYS:HE3	2.11	0.49
1:A:385:GLU:O	1:A:389:ARG:HG2	2.12	0.49
1:A:297:MET:C	1:A:299:VAL:N	2.68	0.49
1:A:456:THR:CG2	1:A:460:ARG:HA	2.43	0.49
1:A:585:HIS:CA	1:A:592:THR:HG21	2.42	0.49
1:A:137[B]:ALA:HB1	1:A:335:GLN:OE1	2.13	0.49
1:A:625:LEU:HD21	1:A:638:ARG:NH1	2.27	0.49
1:A:139:VAL:O	1:A:297:MET:HE1	2.13	0.49
1:A:253:GLU:OE1	1:A:256:ARG:NH1	2.46	0.49
1:A:506:ARG:HD2	1:A:513:TYR:O	2.11	0.49
1:A:109:SER:OG	1:A:137[A]:ALA:HB3	2.12	0.48
1:A:275:ALA:O	1:A:279:ARG:HG3	2.13	0.48

Continued on next page...

Continued from previous page...

Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:143:PRO:HB2	1:A:300:THR:CG2	2.37	0.48
1:A:145:VAL:O	1:A:149:HIS:CB	2.61	0.48
1:A:568:LYS:HG2	1:A:569:LEU:O	2.13	0.48
1:A:160:ALA:HB3	1:A:163:GLU:HG3	1.94	0.48
1:A:138[A]:ARG:NH1	1:A:347:LEU:CD2	2.76	0.48
1:A:336:ASN:HD22	1:A:336:ASN:H	1.62	0.48
1:A:583:VAL:HA	3:A:802:MGD:N19	2.29	0.48
1:A:307:GLU:HG2	1:A:560:CYS:SG	2.54	0.48
1:A:617:ARG:NH2	1:A:618:LEU:HD21	2.29	0.48
1:A:324:LYS:HB2	1:A:325:PRO:HD2	1.96	0.47
1:A:254:GLU:OE1	1:A:254:GLU:HA	2.14	0.47
1:A:118:TYR:O	1:A:121:GLN:HG3	2.14	0.47
1:A:427:VAL:CG2	1:A:439:ALA:HB2	2.44	0.47
1:A:434:LYS:HE2	1:A:705:LEU:HD21	1.97	0.47
1:A:369:ALA:CB	1:A:508:LEU:HD21	2.45	0.47
1:A:109:SER:OG	1:A:137[B]:ALA:HB3	2.14	0.47
1:A:578:SER:O	1:A:651:TYR:HA	2.15	0.47
1:A:80:TRP:CD2	1:A:476:LYS:HE2	2.50	0.47
1:A:411:GLU:O	1:A:411:GLU:HG2	2.14	0.47
1:A:548:PHE:O	1:A:549:ASP:HB2	2.13	0.47
1:A:102:ALA:HB1	1:A:396:ARG:HG2	1.97	0.47
1:A:145:VAL:O	1:A:149:HIS:HB3	2.14	0.47
1:A:623:GLU:O	1:A:638:ARG:NE	2.46	0.46
1:A:657:TRP:N	1:A:657:TRP:CD1	2.83	0.46
1:A:417:LYS:O	1:A:420:GLU:HB3	2.16	0.46
1:A:22:ASP:HB3	1:A:27:VAL:HG21	1.98	0.46
1:A:265:GLU:OE1	1:A:279:ARG:NH2	2.49	0.46
1:A:516:THR:CG2	1:A:533:THR:HG23	2.46	0.45
1:A:5:VAL:O	1:A:466:PHE:HD1	1.99	0.45
1:A:61:ARG:NH2	1:A:450:GLU:OE1	2.49	0.45
1:A:387:PRO:HA	1:A:418:ALA:HB2	1.98	0.45
1:A:232:HIS:CE1	1:A:263:THR:HG22	2.51	0.45
1:A:576:VAL:O	1:A:649:ALA:HA	2.17	0.45
1:A:486:ALA:CB	1:A:493:MET:HE2	2.47	0.45
1:A:110:ARG:HD3	1:A:335:GLN:HG2	1.99	0.45
1:A:123:PHE:HE1	1:A:489:MET:CE	2.30	0.45
1:A:301:GLN:HG2	1:A:678:TYR:HD2	1.82	0.45
1:A:3:LYS:HG2	1:A:20:VAL:HG22	1.99	0.44
1:A:110:ARG:HB2	5:A:840:HOH:O	2.16	0.44
1:A:192:LYS:HB2	1:A:198:ILE:HD11	1.99	0.44
1:A:59:THR:CG2	1:A:709:LEU:HD13	2.48	0.44

Continued on next page...

Continued from previous page...

Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:114:ASN:OD1	1:A:340:GLY:HA3	2.17	0.44
1:A:183:ILE:O	1:A:187:HIS:HD2	2.00	0.44
1:A:430:ILE:HD11	1:A:446:THR:O	2.17	0.44
1:A:130:THR:CG2	1:A:131:ASN:N	2.79	0.44
1:A:585:HIS:CB	1:A:592:THR:HG21	2.47	0.44
1:A:589:ARG:HB3	1:A:657:TRP:NE1	2.33	0.44
1:A:141:HIS:HB2	1:A:333:ARG:CG	2.48	0.44
1:A:558:PHE:C	1:A:558:PHE:CD1	2.95	0.44
1:A:141:HIS:HB2	1:A:333:ARG:HG2	1.99	0.44
1:A:589:ARG:HD3	1:A:657:TRP:CD1	2.53	0.44
1:A:138[B]:ARG:HE	1:A:145:VAL:CG2	2.31	0.44
1:A:430:ILE:CD1	1:A:445:SER:OG	2.66	0.44
1:A:69:ARG:NH1	1:A:86:TYR:CE2	2.86	0.43
1:A:337:ASN:OD1	1:A:340:GLY:HA3	2.17	0.43
1:A:502:TRP:O	1:A:505:LEU:HG	2.18	0.43
1:A:139:VAL:C	1:A:141:HIS:N	2.71	0.43
1:A:333:ARG:HD2	5:A:827:HOH:O	2.18	0.43
1:A:588:CYS:HB2	3:A:801:MGD:O1B	2.18	0.43
1:A:650:ILE:HG21	1:A:685:VAL:HG21	2.00	0.43
1:A:142:GLY:N	1:A:143:PRO:CD	2.82	0.43
1:A:583:VAL:HA	3:A:802:MGD:H191	1.84	0.43
1:A:611:ASN:HA	1:A:642:SER:O	2.18	0.43
1:A:580:VAL:HG23	3:A:802:MGD:H3'	2.01	0.43
1:A:216:ILE:HD11	1:A:281:ALA:HB1	2.01	0.42
1:A:256:ARG:NH2	1:A:257:LYS:HE2	2.34	0.42
1:A:679:LYS:NZ	3:A:802:MGD:O2B	2.51	0.42
1:A:65:PRO:HA	1:A:444:PRO:HD3	2.00	0.42
1:A:123:PHE:CZ	1:A:489:MET:CE	3.02	0.42
1:A:151:SER:HB3	1:A:317:MET:HE1	2.02	0.42
1:A:411:GLU:O	1:A:413:SER:N	2.53	0.42
1:A:61:ARG:CG	1:A:61:ARG:NH1	2.82	0.42
1:A:386:LEU:HB3	1:A:387:PRO:HD3	2.02	0.42
1:A:297:MET:CE	1:A:301:GLN:NE2	2.83	0.42
1:A:485:ILE:O	1:A:489:MET:HG3	2.20	0.42
1:A:436:ALA:O	1:A:442:ILE:HD11	2.20	0.41
1:A:116:THR:HG22	1:A:479:TRP:CD1	2.39	0.41
1:A:168:ASP:OD2	1:A:289:LYS:HB2	2.20	0.41
1:A:410:ALA:HB2	1:A:678:TYR:HE1	1.84	0.41
1:A:216:ILE:HD11	1:A:281:ALA:HB2	2.02	0.41
1:A:10:TYR:HB2	2:A:800:SF4:S3	2.60	0.41
1:A:558:PHE:CD1	1:A:559:THR:N	2.89	0.41

Continued on next page...

Continued from previous page...

Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:101:ASP:OD1	1:A:130:THR:HG23	2.21	0.41
1:A:240:TYR:CE2	1:A:242:LYS:HG2	2.55	0.41
1:A:249:THR:OG1	1:A:557:PHE:HE2	2.04	0.41
1:A:44:LYS:HE3	1:A:44:LYS:HB2	1.77	0.41
1:A:386:LEU:O	1:A:387:PRO:C	2.62	0.41
1:A:179:ASP:OD2	1:A:582:GLU:HA	2.20	0.41
1:A:169:LEU:HD12	1:A:197:LYS:CB	2.47	0.41
1:A:207:GLU:OE2	1:A:644:ARG:NH2	2.54	0.41
1:A:152:VAL:O	1:A:548:PHE:O	2.39	0.40
1:A:456:THR:HG22	1:A:460:ARG:HA	2.03	0.40
1:A:710:ARG:HG2	1:A:714:LEU:HG	2.02	0.40
1:A:112:THR:HG22	1:A:116:THR:HG23	2.01	0.40
1:A:257:LYS:HE3	1:A:257:LYS:HB2	1.84	0.40
1:A:406:LEU:HD13	1:A:416:ARG:HG2	2.02	0.40
1:A:138[A]:ARG:HH22	1:A:382:ARG:HH11	1.70	0.40
1:A:466:PHE:CD1	1:A:466:PHE:N	2.90	0.40
1:A:137[B]:ALA:HA	3:A:801:MGD:H11	2.03	0.40
1:A:227:LEU:CD1	1:A:308:THR:HG23	2.52	0.40
1:A:229:ALA:O	1:A:233:VAL:HG23	2.22	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 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	694/715 (97%)	649 (94%)	39 (6%)	6 (1%)	14 17

All (6) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	141	HIS
1	A	412	LEU

Continued on next page...

Continued from previous page...

Mol	Chain	Res	Type
1	A	583	VAL
1	A	587	SER
1	A	23	ASN
1	A	334	GLY

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	569/584 (97%)	525 (92%)	44 (8%)	12	16

All (44) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	1	MET
1	A	23	ASN
1	A	27	VAL
1	A	43	LEU
1	A	61	ARG
1	A	78	VAL
1	A	110	ARG
1	A	116	THR
1	A	133	VAL
1	A	138[A]	ARG
1	A	138[B]	ARG
1	A	144	SER
1	A	148	LEU
1	A	150	GLN
1	A	152	VAL
1	A	157	MET
1	A	180	SER
1	A	203	PRO
1	A	257	LYS
1	A	260	GLU
1	A	267	VAL
1	A	329	VAL

Continued on next page...

Continued from previous page...

Mol	Chain	Res	Type
1	A	336	ASN
1	A	350	THR
1	A	372	VAL
1	A	406	LEU
1	A	409	ASP
1	A	430	ILE
1	A	437	SER
1	A	441	VAL
1	A	460	ARG
1	A	464	ARG
1	A	469	VAL
1	A	494	HIS
1	A	497	ASN
1	A	556	GLN
1	A	579	THR
1	A	592	THR
1	A	626	VAL
1	A	635	ILE
1	A	636	ILE
1	A	637	THR
1	A	654	TYR
1	A	708	ARG

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (11) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	190	ASN
1	A	220	ASN
1	A	280	GLN
1	A	336	ASN
1	A	339	GLN
1	A	538	GLN
1	A	585	HIS
1	A	609	GLN
1	A	629	HIS
1	A	655	GLN
1	A	696	GLN

5.3.3 RNA ⓘ

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 oligosaccharides in this entry.

5.6 Ligand geometry [i](#)

Of 4 ligands modelled in this entry, 1 is monoatomic - leaving 3 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	SF4	A	800	1	0,12,12	-	-	-		
3	MGD	A	802	4	47,52,52	1.19	3 (6%)	58,81,81	1.54	6 (10%)
3	MGD	A	801	4	47,52,52	1.20	6 (12%)	58,81,81	2.14	12 (20%)

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	MGD	A	802	4	-	2/22/66/66	0/6/6/6
2	SF4	A	800	1	-	-	0/6/5/5
3	MGD	A	801	4	-	4/22/66/66	0/6/6/6

All (9) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
3	A	802	MGD	C23-C14	-4.86	1.49	1.53
3	A	801	MGD	PB-O3B	-3.44	1.55	1.59
3	A	801	MGD	C23-C14	-2.90	1.51	1.53
3	A	802	MGD	PB-O3B	2.70	1.62	1.59

Continued on next page...

Continued from previous page...

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
3	A	801	MGD	PA-O3B	-2.43	1.56	1.59
3	A	801	MGD	C21-N22	2.28	1.37	1.35
3	A	802	MGD	O11-C23	-2.09	1.40	1.43
3	A	801	MGD	O11-C23	2.02	1.46	1.43
3	A	801	MGD	C10-C11	2.00	1.54	1.51

All (18) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
3	A	801	MGD	C23-C14-N15	8.65	116.36	107.87
3	A	801	MGD	O11-C23-C14	8.19	114.42	108.96
3	A	802	MGD	O11-C23-C14	5.15	112.40	108.96
3	A	802	MGD	C23-C14-N15	4.99	112.77	107.87
3	A	801	MGD	C19-N20-C21	4.65	121.57	113.36
3	A	802	MGD	C19-N20-C21	4.53	121.35	113.36
3	A	801	MGD	O11-C23-N22	3.54	111.82	108.61
3	A	801	MGD	O3A-C10-C11	3.29	116.71	108.58
3	A	801	MGD	O2B-PB-O1B	2.65	124.75	112.44
3	A	801	MGD	O2A-PA-O1A	2.57	124.40	112.44
3	A	801	MGD	C19-N18-C17	-2.54	120.51	125.11
3	A	801	MGD	C16-C17-N18	2.28	118.38	112.13
3	A	802	MGD	O17-C17-C16	-2.27	121.79	127.26
3	A	801	MGD	O3B-PB-O1B	-2.24	103.95	110.70
3	A	801	MGD	O3B-PA-O1A	-2.20	104.08	110.70
3	A	801	MGD	O6-C6-C5	-2.19	120.76	126.53
3	A	802	MGD	C2-N3-C4	2.10	115.91	112.30
3	A	802	MGD	C19-N18-C17	-2.02	121.46	125.11

There are no chirality outliers.

All (6) torsion outliers are listed below:

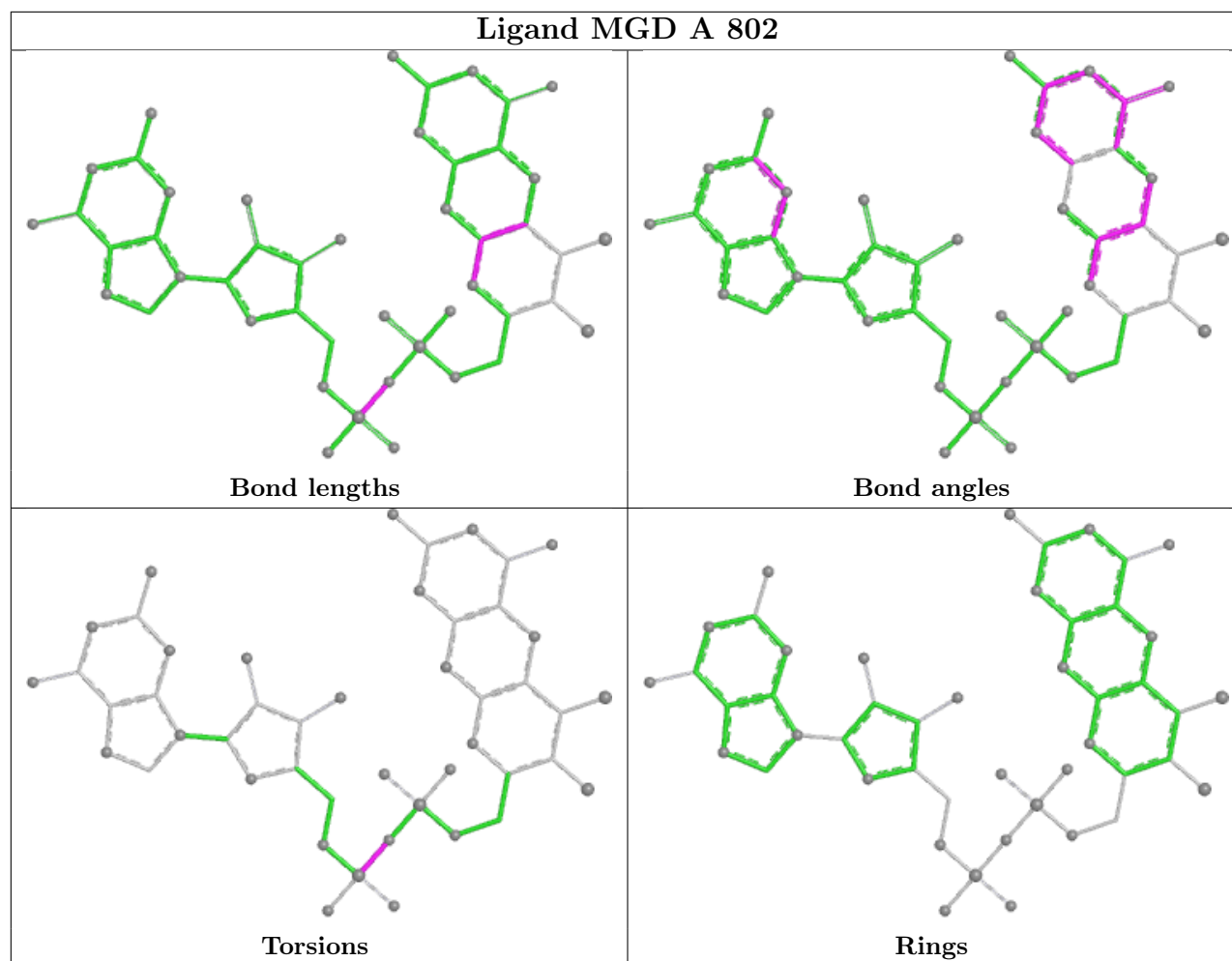
Mol	Chain	Res	Type	Atoms
3	A	801	MGD	C5'-O5'-PB-O2B
3	A	801	MGD	PB-O3B-PA-O1A
3	A	801	MGD	PB-O3B-PA-O2A
3	A	802	MGD	PA-O3B-PB-O1B
3	A	801	MGD	C11-C10-O3A-PA
3	A	802	MGD	PA-O3B-PB-O2B

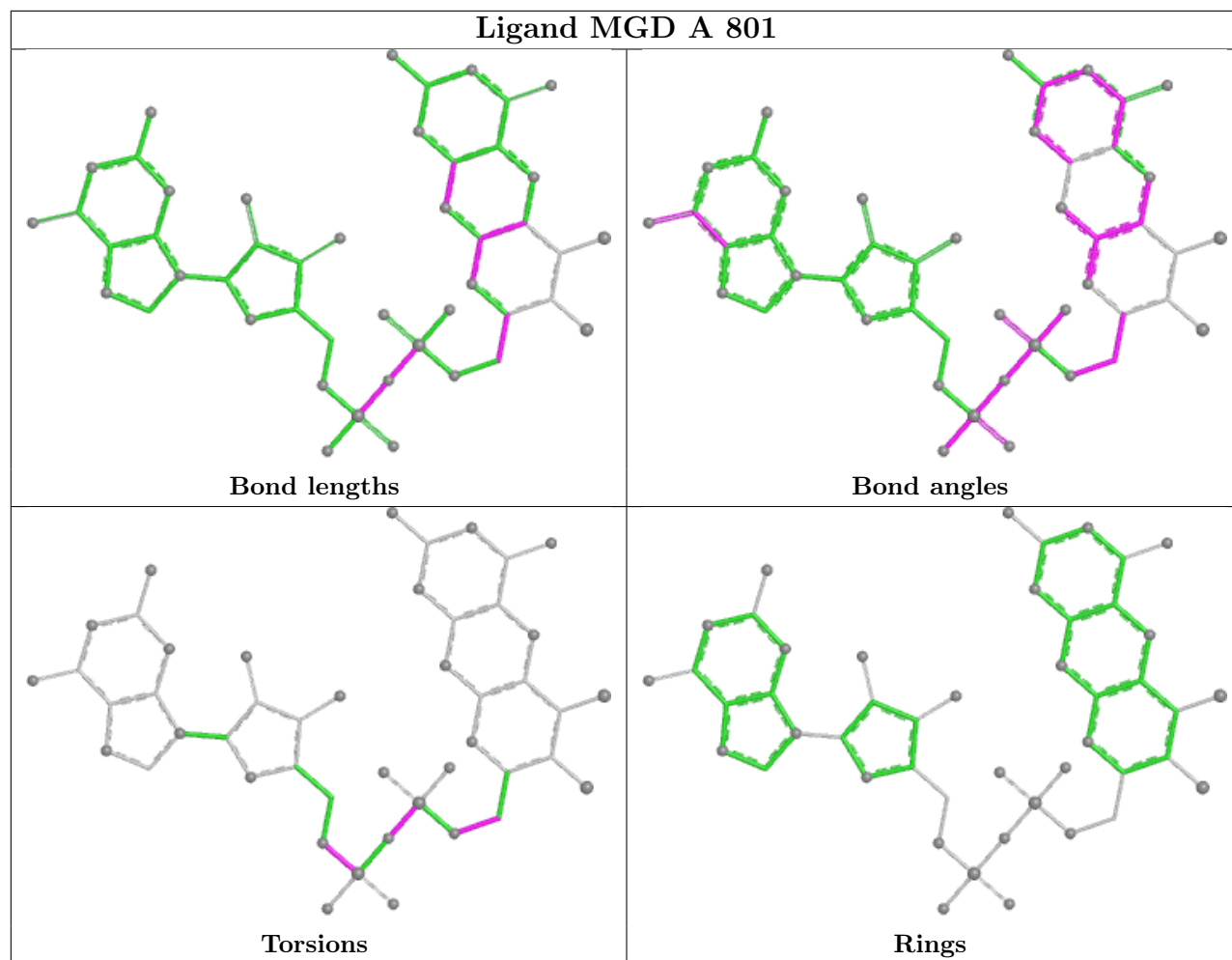
There are no ring outliers.

3 monomers are involved in 9 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
2	A	800	SF4	1	0
3	A	802	MGD	5	0
3	A	801	MGD	4	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

6.1 Protein, DNA and RNA chains

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	696/715 (97%)	-0.31	28 (4%)	42 44	8, 24, 53, 73	2 (0%)

All (28) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	141	HIS	5.2
1	A	676	PRO	4.5
1	A	144	SER	4.5
1	A	588	CYS	4.3
1	A	142	GLY	4.2
1	A	139	VAL	4.2
1	A	410	ALA	4.1
1	A	146	ALA	4.1
1	A	654	TYR	3.9
1	A	408	THR	3.6
1	A	572	GLU	3.3
1	A	145	VAL	3.2
1	A	657	TRP	3.1
1	A	632	LYS	2.9
1	A	298	GLY	2.9
1	A	72	GLY	2.7
1	A	615	ALA	2.7
1	A	656	TRP	2.6
1	A	412	LEU	2.5
1	A	136	CYS	2.5
1	A	297	MET	2.5
1	A	143	PRO	2.3
1	A	630	SER	2.3
1	A	413	SER	2.3
1	A	570	THR	2.2
1	A	23	ASN	2.2
1	A	138[A]	ARG	2.1

Continued on next page...

Continued from previous page...

Mol	Chain	Res	Type	RSRZ
1	A	583	VAL	2.1

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](#)

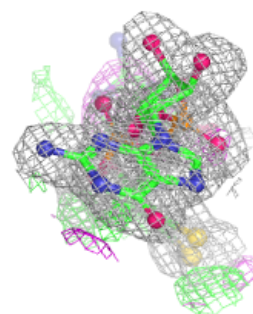
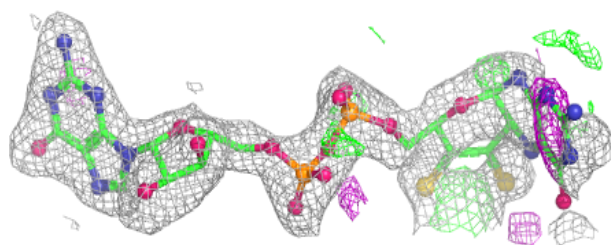
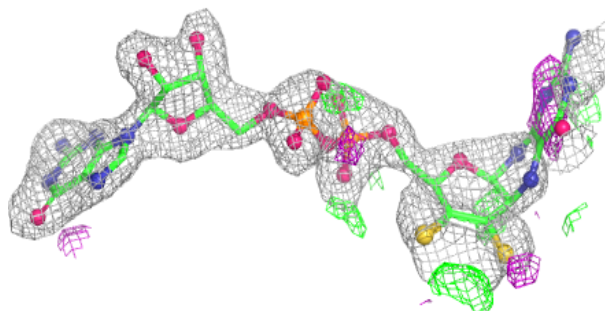
In the following table, the Atoms column lists the number of modelled atoms in the group and the number defined in the chemical component dictionary. The B-factors column lists the minimum, median, 95th percentile and maximum values of B factors of atoms in the group. The column labelled 'Q< 0.9' lists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

Mol	Type	Chain	Res	Atoms	RSCC	RSR	B-factors(Å ²)	Q<0.9
4	4MO	A	803	1/1	0.82	0.08	28,28,28,28	0
3	MGD	A	801	47/47	0.92	0.09	14,32,53,55	0
3	MGD	A	802	47/47	0.95	0.06	14,20,30,32	0
2	SF4	A	800	8/8	0.98	0.04	15,17,19,19	0

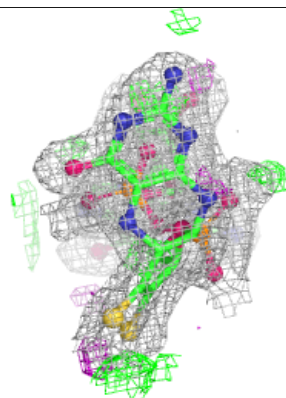
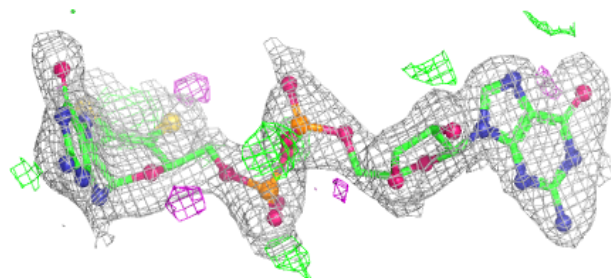
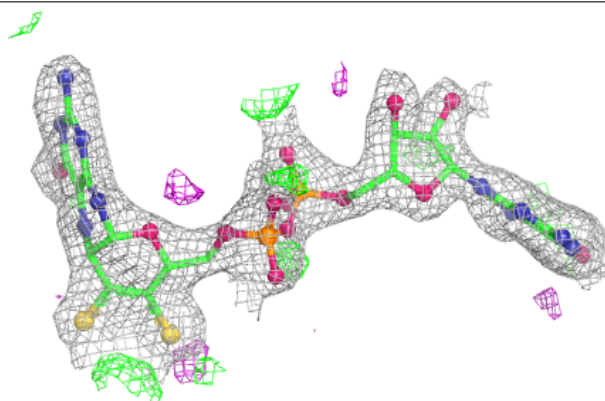
The following is a graphical depiction of the model fit to experimental electron density of all instances of the Ligand of Interest. In addition, ligands with molecular weight > 250 and outliers as shown on the geometry validation Tables will also be included. Each fit is shown from different orientation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

Electron density around MGD A 801:

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

**Electron density around MGD A 802:**

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



6.5 Other polymers ⓘ

There are no such residues in this entry.