



Full wwPDB X-ray Structure Validation Report ⓘ

Apr 25, 2026 – 06:47 AM EDT

PDB ID : 2G8Y / pdb_00002g8y
Title : The structure of a putative malate/lactate dehydrogenase from E. coli.
Authors : Cuff, M.E.; Skarina, T.; Edwards, A.; Savchenko, A.; Cymborowski, M.; Minor, W.; Joachimiak, A.; Midwest Center for Structural Genomics (MCSG)
Deposited on : 2006-03-03
Resolution : 2.15 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

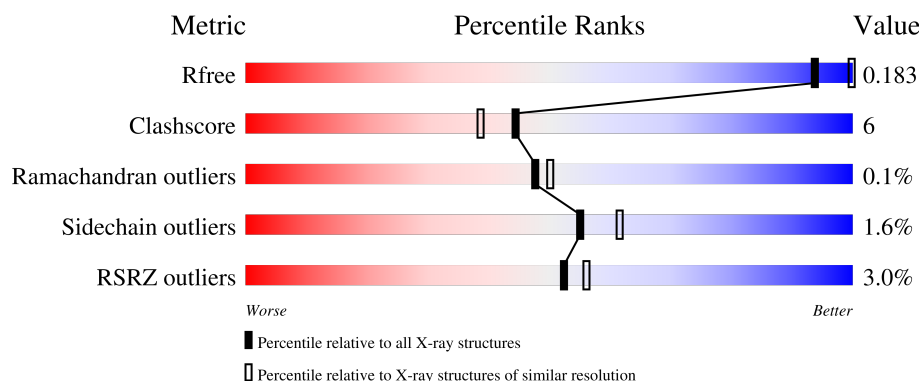
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 2.15 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	2057 (2.16-2.16)
Clashscore	190562	2159 (2.16-2.16)
Ramachandran outliers	187476	2134 (2.16-2.16)
Sidechain outliers	187428	2133 (2.16-2.16)
RSRZ outliers	180081	2059 (2.16-2.16)

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	385	
1	B	385	

The following table lists non-polymeric compounds, carbohydrate monomers and non-standard residues in protein, DNA, RNA chains that are outliers for geometric or electron-density-fit criteria:

Mol	Type	Chain	Res	Chirality	Geometry	Clashes	Electron density
4	EDO	B	1014	-	-	X	-

2 Entry composition

There are 6 unique types of molecules in this entry. The entry contains 6576 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 Malate/L-lactate dehydrogenases.

Mol	Chain	Residues	Atoms						ZeroOcc	AltConf	Trace
1	A	359	Total	C	N	O	S	Se	0	4	0
			2761	1740	497	508	8	8			
1	B	358	Total	C	N	O	S	Se	0	4	0
			2754	1738	496	504	8	8			

There are 66 discrepancies between the modelled and reference sequences:

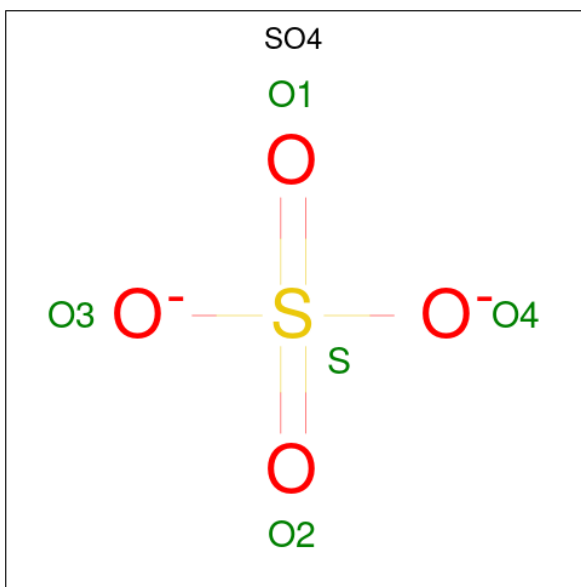
Chain	Residue	Modelled	Actual	Comment	Reference
A	-21	MSE	-	SEE REMARK 999	UNP P30178
A	-20	GLY	-	cloning artifact	UNP P30178
A	-19	SER	-	cloning artifact	UNP P30178
A	-18	SER	-	cloning artifact	UNP P30178
A	-17	HIS	-	expression tag	UNP P30178
A	-16	HIS	-	expression tag	UNP P30178
A	-15	HIS	-	expression tag	UNP P30178
A	-14	HIS	-	expression tag	UNP P30178
A	-13	HIS	-	expression tag	UNP P30178
A	-12	HIS	-	expression tag	UNP P30178
A	-11	SER	-	cloning artifact	UNP P30178
A	-10	SER	-	cloning artifact	UNP P30178
A	-9	GLY	-	cloning artifact	UNP P30178
A	-8	ARG	-	cloning artifact	UNP P30178
A	-7	GLU	-	cloning artifact	UNP P30178
A	-6	ASN	-	cloning artifact	UNP P30178
A	-5	LEU	-	cloning artifact	UNP P30178
A	-4	TYR	-	cloning artifact	UNP P30178
A	-3	PHE	-	cloning artifact	UNP P30178
A	-2	GLN	-	cloning artifact	UNP P30178
A	-1	GLY	-	cloning artifact	UNP P30178
A	0	HIS	-	cloning artifact	UNP P30178
A	1	MSE	MET	modified residue	UNP P30178
A	23	MSE	MET	modified residue	UNP P30178
A	52	MSE	MET	modified residue	UNP P30178

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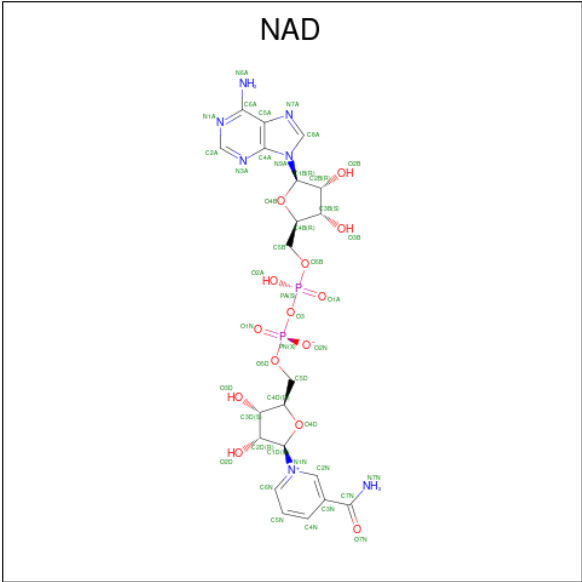
Chain	Residue	Modelled	Actual	Comment	Reference
A	98	MSE	MET	modified residue	UNP P30178
A	149	MSE	MET	modified residue	UNP P30178
A	220	MSE	MET	modified residue	UNP P30178
A	242	MSE	MET	modified residue	UNP P30178
A	272	MSE	MET	modified residue	UNP P30178
A	347	MSE	MET	modified residue	UNP P30178
A	362	GLY	-	cloning artifact	UNP P30178
A	363	SER	-	cloning artifact	UNP P30178
B	-21	MSE	-	SEE REMARK 999	UNP P30178
B	-20	GLY	-	cloning artifact	UNP P30178
B	-19	SER	-	cloning artifact	UNP P30178
B	-18	SER	-	cloning artifact	UNP P30178
B	-17	HIS	-	expression tag	UNP P30178
B	-16	HIS	-	expression tag	UNP P30178
B	-15	HIS	-	expression tag	UNP P30178
B	-14	HIS	-	expression tag	UNP P30178
B	-13	HIS	-	expression tag	UNP P30178
B	-12	HIS	-	expression tag	UNP P30178
B	-11	SER	-	cloning artifact	UNP P30178
B	-10	SER	-	cloning artifact	UNP P30178
B	-9	GLY	-	cloning artifact	UNP P30178
B	-8	ARG	-	cloning artifact	UNP P30178
B	-7	GLU	-	cloning artifact	UNP P30178
B	-6	ASN	-	cloning artifact	UNP P30178
B	-5	LEU	-	cloning artifact	UNP P30178
B	-4	TYR	-	cloning artifact	UNP P30178
B	-3	PHE	-	cloning artifact	UNP P30178
B	-2	GLN	-	cloning artifact	UNP P30178
B	-1	GLY	-	cloning artifact	UNP P30178
B	0	HIS	-	cloning artifact	UNP P30178
B	1	MSE	MET	modified residue	UNP P30178
B	23	MSE	MET	modified residue	UNP P30178
B	52	MSE	MET	modified residue	UNP P30178
B	98	MSE	MET	modified residue	UNP P30178
B	149	MSE	MET	modified residue	UNP P30178
B	220	MSE	MET	modified residue	UNP P30178
B	242	MSE	MET	modified residue	UNP P30178
B	272	MSE	MET	modified residue	UNP P30178
B	347	MSE	MET	modified residue	UNP P30178
B	362	GLY	-	cloning artifact	UNP P30178
B	363	SER	-	cloning artifact	UNP P30178

- Molecule 2 is SULFATE ION (CCD ID: SO4) (formula: O₄S).



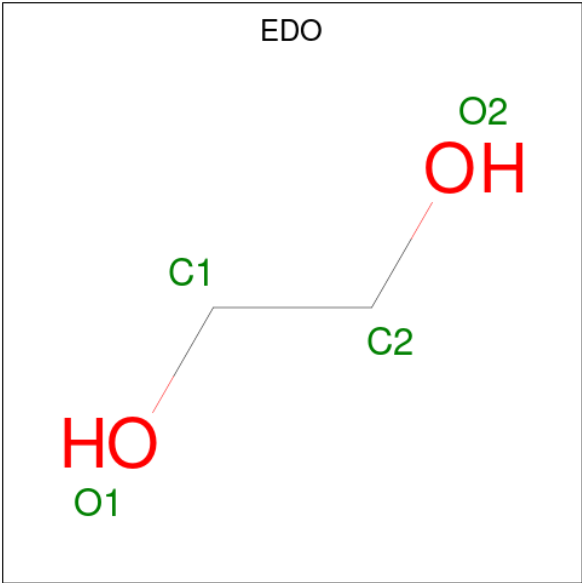
Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
2	A	1	Total	O	S	0	0
			5	4	1		
2	A	1	Total	O	S	0	0
			5	4	1		
2	A	1	Total	O	S	0	0
			5	4	1		
2	B	1	Total	O	S	0	0
			5	4	1		
2	B	1	Total	O	S	0	0
			5	4	1		
2	B	1	Total	O	S	0	0
			5	4	1		
2	B	1	Total	O	S	0	0
			5	4	1		

- Molecule 3 is NICOTINAMIDE-ADENINE-DINUCLEOTIDE (CCD ID: NAD) (formula: $C_{21}H_{27}N_7O_{14}P_2$).



Mol	Chain	Residues	Atoms					ZeroOcc	AltConf
3	A	1	Total 44	C 21	N 7	O 14	P 2	0	0
3	B	1	Total 44	C 21	N 7	O 14	P 2	0	0

- Molecule 4 is 1,2-ETHANEDIOL (CCD ID: EDO) (formula: C₂H₆O₂).



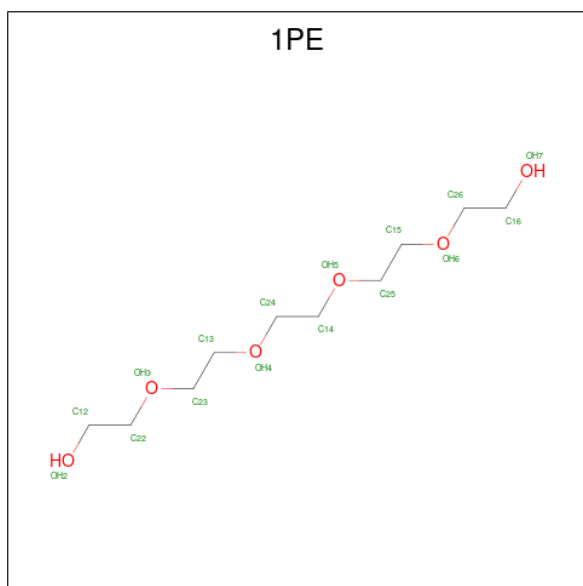
Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
4	A	1	Total	C	O	0	0
			4	2	2		
4	A	1	Total	C	O	0	0
			4	2	2		

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Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
4	A	1	Total	C	O	0	0
			4	2	2		
4	A	1	Total	C	O	0	0
			4	2	2		
4	A	1	Total	C	O	0	0
			4	2	2		
4	B	1	Total	C	O	0	0
			4	2	2		
4	B	1	Total	C	O	0	0
			4	2	2		
4	B	1	Total	C	O	0	0
			4	2	2		
4	B	1	Total	C	O	0	0
			4	2	2		

- Molecule 5 is PENTAETHYLENE GLYCOL (CCD ID: 1PE) (formula: $C_{10}H_{22}O_6$).



Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
5	A	1	Total	C	O	0	0
			16	10	6		

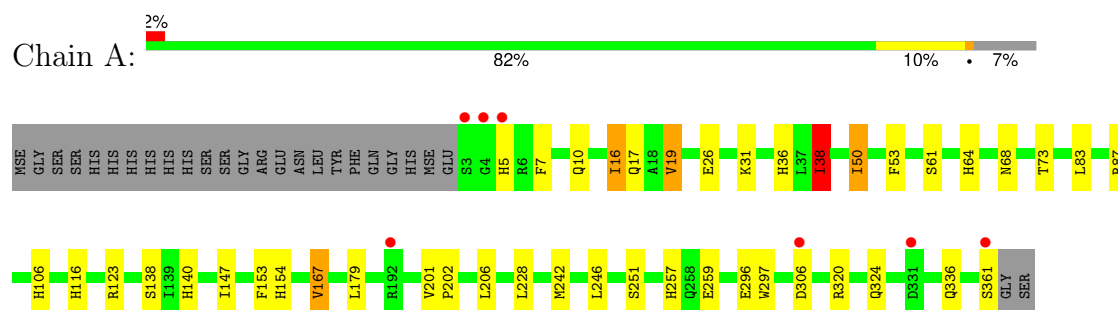
- Molecule 6 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
6	A	448	Total 448	O 448	0	0
6	B	429	Total 429	O 429	0	0

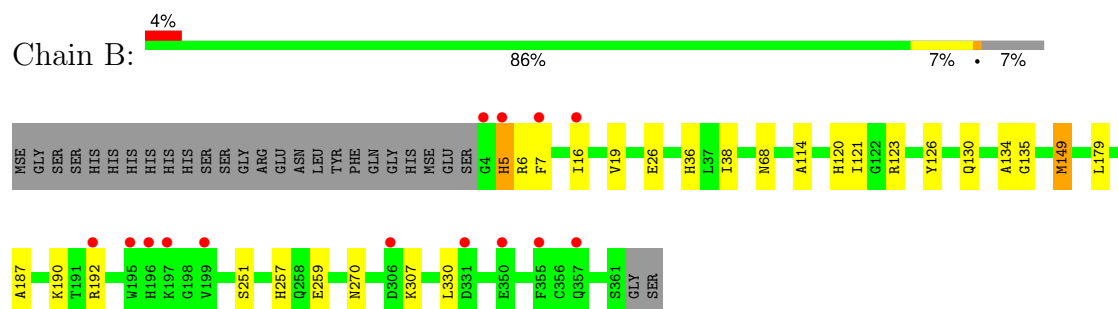
3 Residue-property plots [i](#)

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: Malate/L-lactate dehydrogenases



- Molecule 1: Malate/L-lactate dehydrogenases



4 Data and refinement statistics

Property	Value	Source
Space group	P 32 2 1	Depositor
Cell constants a, b, c, α , β , γ	139.09Å 139.09Å 151.65Å 90.00° 90.00° 120.00°	Depositor
Resolution (Å)	35.50 – 2.15 35.50 – 2.15	Depositor EDS
% Data completeness (in resolution range)	96.1 (35.50-2.15) 96.0 (35.50-2.15)	Depositor EDS
R_{merge}	(Not available)	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	2.51 (at 2.16Å)	Xtriage
Refinement program	REFMAC 5.2.0019	Depositor
R, R_{free}	0.158 , 0.186 0.155 , 0.183	Depositor DCC
R_{free} test set	4456 reflections (4.40%)	wwPDB-VP
Wilson B-factor (Å ²)	29.1	Xtriage
Anisotropy	0.621	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.34 , 37.3	EDS
L-test for twinning ²	$\langle L \rangle = 0.50$, $\langle L^2 \rangle = 0.33$	Xtriage
Estimated twinning fraction	0.018 for -h,-k,l	Xtriage
F_o, F_c correlation	0.96	EDS
Total number of atoms	6576	wwPDB-VP
Average B, all atoms (Å ²)	38.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 3.25% 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: 1PE, SO4, EDO, NAD

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	0.80	0/2826	0.86	3/3829 (0.1%)
1	B	0.77	0/2819	0.86	0/3820
All	All	0.79	0/5645	0.86	3/7649 (0.0%)

There are no bond length outliers.

All (3) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	38	ILE	CG1-CB-CG2	-6.73	90.51	110.70
1	A	167	VAL	CB-CA-C	-5.46	101.27	110.71
1	A	16	ILE	CB-CA-C	-5.05	105.33	112.14

There are no chirality outliers.

There are no planarity outliers.

5.2 Too-close contacts [i](#)

In the following table, the Non-H and H(model) columns list the number of non-hydrogen atoms and hydrogen atoms in the chain respectively. The H(added) column lists the number of hydrogen atoms added and optimized by MolProbity. The Clashes column lists the number of clashes within the asymmetric unit, whereas Symm-Clashes lists symmetry-related clashes.

Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
1	A	2761	0	2666	38	0
1	B	2754	0	2666	27	0
2	A	15	0	0	0	0
2	B	25	0	0	0	0
3	A	44	0	26	1	0
3	B	44	0	26	0	0

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Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
4	A	20	0	30	2	0
4	B	20	0	30	9	0
5	A	16	0	22	1	0
6	A	448	0	0	11	0
6	B	429	0	0	8	0
All	All	6576	0	5466	67	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 (67) 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:16:ILE:HD12	1:A:38:ILE:HD13	1.34	1.09
1:B:149:MSE:HE3	6:B:1374:HOH:O	1.57	1.04
1:A:61:SER:HA	5:A:1021:1PE:H232	1.43	1.00
1:A:16:ILE:HD12	1:A:38:ILE:CD1	1.98	0.94
1:A:26:GLU:H	1:A:68:ASN:HD21	1.18	0.88
1:B:26:GLU:H	1:B:68:ASN:HD21	1.18	0.86
1:B:121:ILE:H	1:B:270:ASN:HD22	1.21	0.86
1:A:5[A]:HIS:CE1	6:A:1434:HOH:O	2.29	0.84
1:A:296:GLU:HB2	6:A:1438:HOH:O	1.79	0.81
1:A:242:MSE:HE3	6:A:1456:HOH:O	1.82	0.78
1:A:16:ILE:CD1	1:A:38:ILE:CD1	2.66	0.73
1:A:116:HIS:HD2	1:A:251:SER:O	1.73	0.71
1:A:246:LEU:HG	6:A:1456:HOH:O	1.90	0.70
1:B:257:HIS:HD2	1:B:259:GLU:OE1	1.78	0.66
1:B:187:ALA:HA	6:B:1422:HOH:O	1.96	0.66
1:B:5[A]:HIS:HB2	1:B:7:PHE:CE2	2.33	0.63
1:B:192:ARG:HD2	4:B:1020:EDO:H22	1.81	0.62
1:A:17:GLN:HE21	1:A:31:LYS:HA	1.63	0.61
4:B:1014:EDO:H21	6:B:1331:HOH:O	2.00	0.61
1:B:121:ILE:H	1:B:270:ASN:ND2	1.97	0.61
1:B:149:MSE:CE	6:B:1374:HOH:O	2.28	0.61
1:B:6:ARG:HH12	4:B:1014:EDO:C1	2.14	0.60
1:B:130:GLN:NE2	6:B:1192:HOH:O	2.35	0.59
1:A:306:ASP:HB3	6:A:1344:HOH:O	2.03	0.59
1:B:5[B]:HIS:HA	6:B:1330:HOH:O	2.01	0.58
1:A:257:HIS:HD2	1:A:259[B]:GLU:OE1	1.91	0.54
1:A:16:ILE:CD1	1:A:38:ILE:HD12	2.37	0.54
1:A:116:HIS:CD2	1:A:251:SER:O	2.59	0.53

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:B:135:GLY:HA3	4:B:1012:EDO:H11	1.90	0.52
1:B:6:ARG:HH12	4:B:1014:EDO:H12	1.75	0.51
1:A:106:HIS:HB3	6:A:1036:HOH:O	2.11	0.51
1:B:179:LEU:C	1:B:179:LEU:HD23	2.37	0.50
1:A:116:HIS:HE1	6:A:1251:HOH:O	1.95	0.49
1:B:16:ILE:HD12	1:B:38:ILE:HG12	1.95	0.48
1:A:73:THR:HA	1:A:83:LEU:HD23	1.93	0.48
1:A:179:LEU:C	1:A:179:LEU:HD23	2.40	0.47
1:A:5[B]:HIS:HB2	1:A:7:PHE:CE2	2.49	0.47
1:B:192:ARG:CD	4:B:1020:EDO:H22	2.44	0.47
1:A:36:HIS:HE1	1:A:123:ARG:H	1.61	0.46
1:A:10[B]:GLN:NE2	6:A:1062:HOH:O	2.48	0.46
1:A:5[A]:HIS:HE1	6:A:1434:HOH:O	1.85	0.45
1:A:138:SER:OG	1:A:140:HIS:HE1	1.98	0.45
4:B:1014:EDO:C2	6:B:1331:HOH:O	2.61	0.45
1:A:206:LEU:CD2	1:A:228:LEU:HD23	2.46	0.45
1:A:10[B]:GLN:NE2	6:A:1396:HOH:O	2.47	0.45
1:A:19:VAL:HG13	1:A:53:PHE:CZ	2.52	0.44
4:A:1017:EDO:H12	1:B:307:LYS:NZ	2.33	0.44
1:B:6:ARG:HH12	4:B:1014:EDO:H11	1.83	0.44
1:A:123:ARG:HG3	3:A:1001:NAD:O3D	2.18	0.44
1:B:134:ALA:O	4:B:1012:EDO:H22	2.18	0.43
1:A:153:PHE:O	1:A:154:HIS:HB2	2.20	0.42
1:B:36:HIS:HE1	1:B:123:ARG:H	1.67	0.42
1:A:147:ILE:O	1:A:147:ILE:HG22	2.20	0.42
1:A:320:ARG:O	1:A:324:GLN:HG2	2.20	0.41
1:B:187:ALA:HB3	1:B:190:LYS:HG2	2.02	0.41
1:A:50:ILE:HG21	1:A:50:ILE:HD13	1.76	0.41
1:B:36:HIS:HD2	1:B:126:TYR:CD2	2.38	0.41
1:A:16:ILE:HD11	1:A:50:ILE:HB	2.03	0.41
1:A:297:TRP:CD2	1:B:257:HIS:HA	2.55	0.41
1:B:114:ALA:HB1	1:B:251:SER:HA	2.02	0.41
1:A:36:HIS:CE1	1:A:123:ARG:H	2.37	0.41
4:A:1016:EDO:H22	6:A:1433:HOH:O	2.21	0.41
1:B:7:PHE:HE2	1:B:330:LEU:HB2	1.86	0.41
1:A:201:VAL:HB	1:A:202:PRO:HD2	2.03	0.41
1:A:16:ILE:HD11	1:A:38:ILE:HD12	2.03	0.40
1:A:64:HIS:O	1:A:87:ARG:HD2	2.20	0.40
1:B:5[B]:HIS:HD2	6:B:1447:HOH:O	2.04	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	361/385 (94%)	352 (98%)	9 (2%)	0	100	100
1	B	360/385 (94%)	352 (98%)	7 (2%)	1 (0%)	36	34
All	All	721/770 (94%)	704 (98%)	16 (2%)	1 (0%)	48	50

All (1) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	B	120	HIS

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	284/292 (97%)	278 (98%)	6 (2%)	47	52
1	B	283/292 (97%)	279 (99%)	4 (1%)	59	66
All	All	567/584 (97%)	557 (98%)	10 (2%)	55	58

All (10) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	19	VAL
1	A	38	ILE
1	A	50	ILE
1	A	167	VAL
1	A	336	GLN

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Mol	Chain	Res	Type
1	A	361	SER
1	B	5[A]	HIS
1	B	5[B]	HIS
1	B	19	VAL
1	B	149	MSE

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (21) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	17	GLN
1	A	36	HIS
1	A	62	GLN
1	A	66	GLN
1	A	68	ASN
1	A	108	HIS
1	A	116	HIS
1	A	140	HIS
1	A	154	HIS
1	A	196	HIS
1	A	257	HIS
1	A	258	GLN
1	A	344	GLN
1	A	353	GLN
1	B	17	GLN
1	B	36	HIS
1	B	68	ASN
1	B	130	GLN
1	B	257	HIS
1	B	270	ASN
1	B	358	GLN

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 [i](#)

There are no oligosaccharides in this entry.

5.6 Ligand geometry [i](#)

21 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
4	EDO	A	1016	-	3,3,3	0.34	0	2,2,2	0.42	0
2	SO4	A	1003	-	4,4,4	0.29	0	6,6,6	0.69	0
4	EDO	B	1015	-	3,3,3	0.34	0	2,2,2	0.78	0
2	SO4	A	1007	-	4,4,4	0.56	0	6,6,6	0.58	0
4	EDO	A	1019	-	3,3,3	0.50	0	2,2,2	0.50	0
2	SO4	B	1006	-	4,4,4	0.34	0	6,6,6	0.37	0
3	NAD	A	1001	-	46,48,48	1.82	7 (15%)	64,73,73	1.52	11 (17%)
2	SO4	B	1010	-	4,4,4	0.60	0	6,6,6	0.10	0
4	EDO	B	1020	-	3,3,3	0.48	0	2,2,2	0.17	0
2	SO4	B	1005	-	4,4,4	0.39	0	6,6,6	0.43	0
2	SO4	B	1008	-	4,4,4	0.26	0	6,6,6	0.46	0
3	NAD	B	1002	-	46,48,48	1.87	7 (15%)	64,73,73	1.42	9 (14%)
2	SO4	A	1004	-	4,4,4	0.30	0	6,6,6	0.45	0
4	EDO	B	1014	-	3,3,3	0.12	0	2,2,2	1.12	0
4	EDO	B	1012	-	3,3,3	0.30	0	2,2,2	0.76	0
5	1PE	A	1021	-	15,15,15	0.42	0	14,14,14	0.45	0
4	EDO	A	1011	-	3,3,3	0.46	0	2,2,2	0.29	0
2	SO4	B	1009	-	4,4,4	0.29	0	6,6,6	0.12	0
4	EDO	A	1018	-	3,3,3	0.57	0	2,2,2	0.32	0
4	EDO	A	1017	-	3,3,3	0.76	0	2,2,2	0.76	0
4	EDO	B	1013	-	3,3,3	0.50	0	2,2,2	0.28	0

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	EDO	A	1016	-	-	1/1/1/1	-
4	EDO	B	1020	-	-	1/1/1/1	-
5	1PE	A	1021	-	-	9/13/13/13	-
4	EDO	A	1011	-	-	1/1/1/1	-
4	EDO	A	1018	-	-	1/1/1/1	-
3	NAD	B	1002	-	-	0/30/62/62	0/5/5/5
4	EDO	A	1019	-	-	0/1/1/1	-
4	EDO	A	1017	-	-	1/1/1/1	-
3	NAD	A	1001	-	-	0/30/62/62	0/5/5/5
4	EDO	B	1014	-	-	0/1/1/1	-
4	EDO	B	1015	-	-	1/1/1/1	-
4	EDO	B	1012	-	-	0/1/1/1	-
4	EDO	B	1013	-	-	0/1/1/1	-

All (14) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
3	B	1002	NAD	O7N-C7N	8.62	1.40	1.24
3	A	1001	NAD	O7N-C7N	8.28	1.39	1.24
3	A	1001	NAD	C2N-N1N	3.86	1.39	1.35
3	B	1002	NAD	PA-O3	3.60	1.63	1.59
3	B	1002	NAD	PN-O3	3.46	1.63	1.59
3	A	1001	NAD	PN-O3	3.43	1.63	1.59
3	B	1002	NAD	C2A-N1A	3.21	1.39	1.33
3	B	1002	NAD	C2N-N1N	3.20	1.38	1.35
3	A	1001	NAD	C2A-N1A	3.20	1.39	1.33
3	A	1001	NAD	PA-O3	2.61	1.62	1.59
3	B	1002	NAD	C2A-N3A	2.49	1.38	1.33
3	A	1001	NAD	C8A-N7A	2.40	1.36	1.31
3	A	1001	NAD	C2A-N3A	2.37	1.38	1.33
3	B	1002	NAD	C8A-N7A	2.00	1.35	1.31

All (20) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
3	A	1001	NAD	N3A-C2A-N1A	-5.55	120.17	128.58
3	B	1002	NAD	N3A-C2A-N1A	-4.88	121.20	128.58
3	B	1002	NAD	N9A-C8A-N7A	-4.40	107.69	113.94
3	A	1001	NAD	N9A-C8A-N7A	-4.05	108.19	113.94
3	B	1002	NAD	C5A-N7A-C8A	3.60	109.11	103.45
3	A	1001	NAD	C5A-N7A-C8A	3.20	108.48	103.45
3	B	1002	NAD	C4A-N9A-C8A	2.89	108.77	105.74
3	A	1001	NAD	C5A-C4A-N3A	-2.87	122.76	126.72

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Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
3	A	1001	NAD	C2A-N3A-C4A	2.84	118.77	111.83
3	B	1002	NAD	C5A-C4A-N3A	-2.81	122.84	126.72
3	A	1001	NAD	C4A-N9A-C8A	2.68	108.55	105.74
3	A	1001	NAD	C3N-C7N-N7N	2.43	120.74	117.74
3	B	1002	NAD	C2A-N3A-C4A	2.35	117.58	111.83
3	A	1001	NAD	C4A-N9A-C1B	-2.34	121.15	126.63
3	A	1001	NAD	O7N-C7N-C3N	-2.20	116.91	119.60
3	B	1002	NAD	C4A-C5A-N7A	-2.18	108.08	110.58
3	A	1001	NAD	C4A-C5A-N7A	-2.18	108.09	110.58
3	B	1002	NAD	N3A-C4A-N9A	2.15	130.82	127.17
3	B	1002	NAD	C4A-N9A-C1B	-2.13	121.64	126.63
3	A	1001	NAD	O4B-C1B-N9A	2.11	112.15	108.09

There are no chirality outliers.

All (15) torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
5	A	1021	1PE	OH6-C15-C25-OH5
5	A	1021	1PE	OH4-C13-C23-OH3
4	A	1016	EDO	O1-C1-C2-O2
4	B	1020	EDO	O1-C1-C2-O2
5	A	1021	1PE	OH7-C16-C26-OH6
5	A	1021	1PE	C23-C13-OH4-C24
5	A	1021	1PE	C15-C25-OH5-C14
5	A	1021	1PE	C14-C24-OH4-C13
5	A	1021	1PE	OH2-C12-C22-OH3
5	A	1021	1PE	C12-C22-OH3-C23
4	A	1017	EDO	O1-C1-C2-O2
4	B	1015	EDO	O1-C1-C2-O2
4	A	1011	EDO	O1-C1-C2-O2
4	A	1018	EDO	O1-C1-C2-O2
5	A	1021	1PE	OH5-C14-C24-OH4

There are no ring outliers.

7 monomers are involved in 13 short contacts:

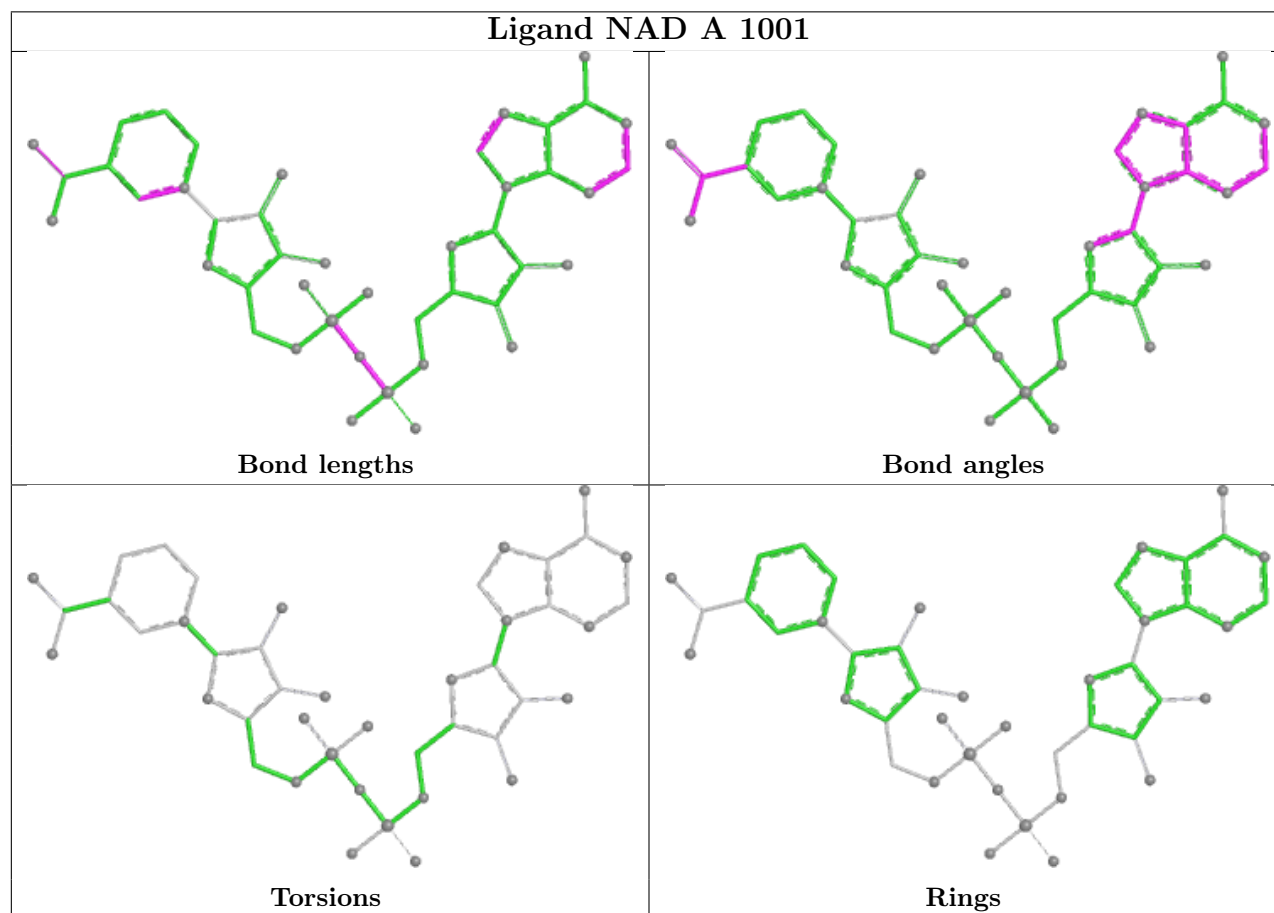
Mol	Chain	Res	Type	Clashes	Symm-Clashes
4	A	1016	EDO	1	0
3	A	1001	NAD	1	0
4	B	1020	EDO	2	0
4	B	1014	EDO	5	0

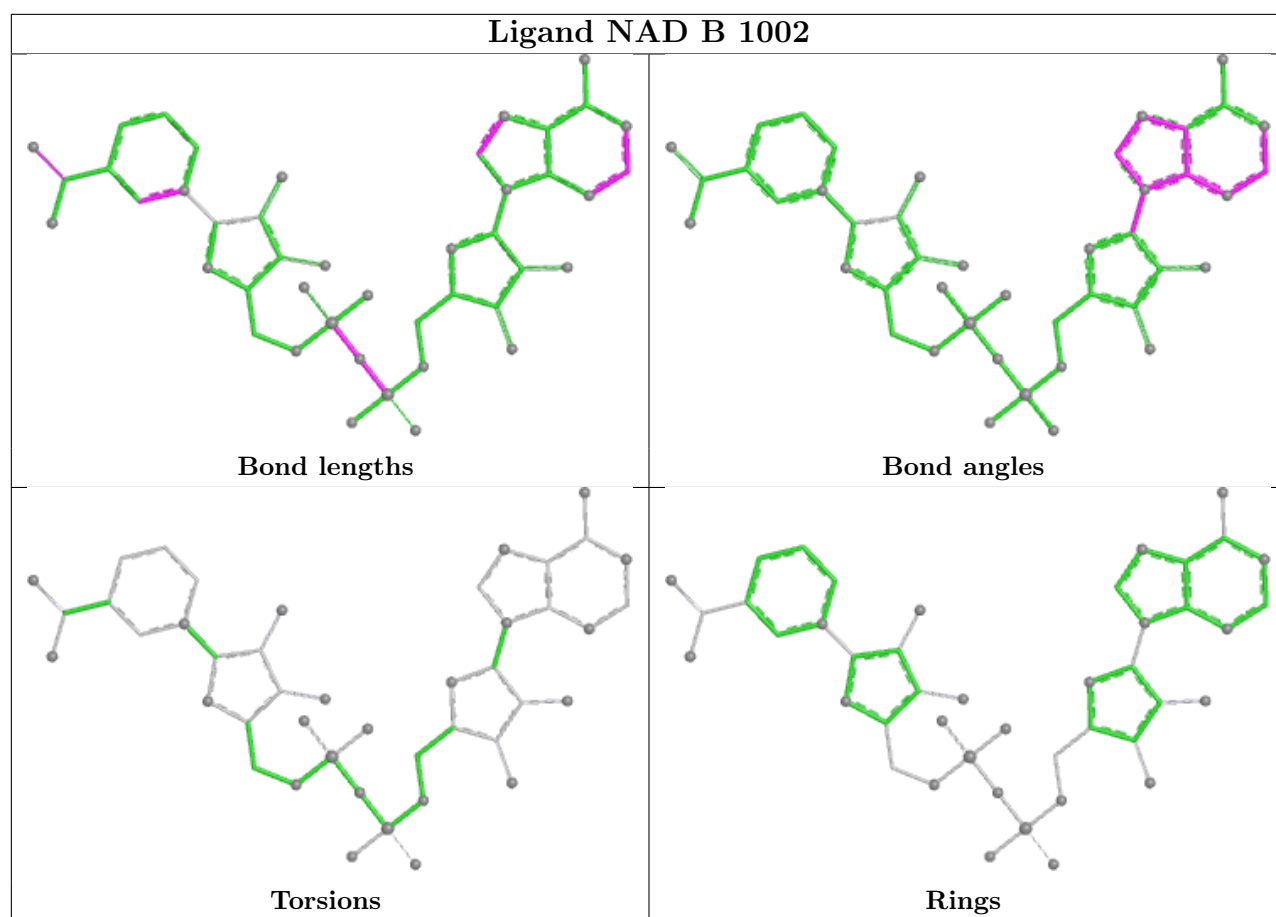
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Mol	Chain	Res	Type	Clashes	Symm-Clashes
4	B	1012	EDO	2	0
5	A	1021	1PE	1	0
4	A	1017	EDO	1	0

The following is a two-dimensional graphical depiction of Mogul quality analysis of bond lengths, bond angles, torsion angles, and ring geometry for all instances of the Ligand of Interest. In addition, ligands with molecular weight > 250 and outliers as shown on the validation Tables will also be included. For torsion angles, if less than 5% of the Mogul distribution of torsion angles is within 10 degrees of the torsion angle in question, then that torsion angle is considered an outlier. Any bond that is central to one or more torsion angles identified as an outlier by Mogul will be highlighted in the graph. For rings, the root-mean-square deviation (RMSD) between the ring in question and similar rings identified by Mogul is calculated over all ring torsion angles. If the average RMSD is greater than 60 degrees and the minimal RMSD between the ring in question and any Mogul-identified rings is also greater than 60 degrees, then that ring is considered an outlier. The outliers are highlighted in purple. The color gray indicates Mogul did not find sufficient equivalents in the CSD to analyse the geometry.





5.7 Other polymers [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	351/385 (91%)	-0.15	7 (1%) 65 69	17, 33, 46, 66	4 (1%)
1	B	350/385 (90%)	0.31	14 (4%) 42 47	17, 35, 57, 75	4 (1%)
All	All	701/770 (91%)	0.08	21 (2%) 52 56	17, 34, 51, 75	8 (1%)

All (21) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	5[A]	HIS	8.1
1	B	5[A]	HIS	7.2
1	B	4	GLY	5.6
1	A	4	GLY	5.3
1	B	192	ARG	4.7
1	A	361	SER	4.7
1	B	196	HIS	4.0
1	B	357	GLN	3.2
1	B	197	LYS	3.1
1	A	3	SER	3.0
1	B	306	ASP	3.0
1	B	195	TRP	2.9
1	A	192[A]	ARG	2.8
1	A	306	ASP	2.7
1	A	331	ASP	2.5
1	B	331	ASP	2.3
1	B	16	ILE	2.3
1	B	199	VAL	2.2
1	B	7	PHE	2.1
1	B	350	GLU	2.1
1	B	355	PHE	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](#)

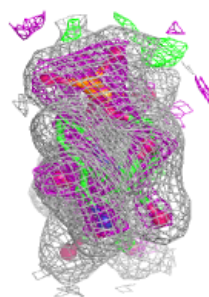
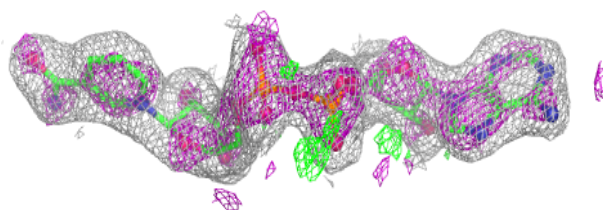
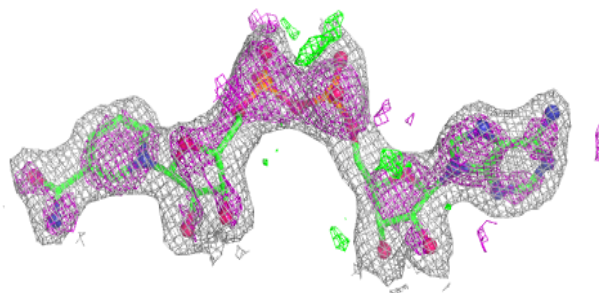
In the following table, the Atoms column lists the number of modelled atoms in the group and the number defined in the chemical component dictionary. The B-factors column lists the minimum, median, 95th percentile and maximum values of B factors of atoms in the group. The column labelled 'Q< 0.9' lists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

Mol	Type	Chain	Res	Atoms	RSCC	RSR	B-factors($\text{\AA}^2$)	Q<0.9
2	SO4	B	1010	5/5	0.64	0.17	133,133,133,133	0
4	EDO	A	1017	4/4	0.76	0.37	85,86,86,87	0
2	SO4	B	1008	5/5	0.79	0.25	101,102,102,102	0
2	SO4	B	1009	5/5	0.79	0.12	99,99,100,100	0
4	EDO	B	1020	4/4	0.83	0.32	84,85,85,85	0
2	SO4	B	1006	5/5	0.84	0.16	80,81,81,81	0
4	EDO	B	1012	4/4	0.86	0.16	55,57,57,58	0
4	EDO	B	1015	4/4	0.86	0.19	47,52,54,56	0
4	EDO	A	1018	4/4	0.86	0.23	56,57,59,61	0
2	SO4	A	1004	5/5	0.87	0.15	80,82,83,84	0
2	SO4	A	1003	5/5	0.87	0.20	68,69,69,71	0
4	EDO	A	1019	4/4	0.88	0.23	48,49,51,54	0
2	SO4	A	1007	5/5	0.88	0.32	61,61,62,63	0
4	EDO	A	1011	4/4	0.91	0.21	56,57,58,60	0
4	EDO	B	1014	4/4	0.91	0.11	42,42,46,47	0
2	SO4	B	1005	5/5	0.92	0.21	62,63,64,65	0
4	EDO	B	1013	4/4	0.93	0.19	44,46,49,52	0
4	EDO	A	1016	4/4	0.94	0.11	47,48,50,50	0
3	NAD	A	1001	44/44	0.96	0.10	26,32,34,35	0
3	NAD	B	1002	44/44	0.96	0.09	23,29,34,34	0
5	1PE	A	1021	16/16	0.96	0.10	23,28,43,44	16

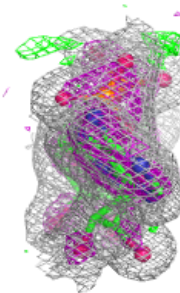
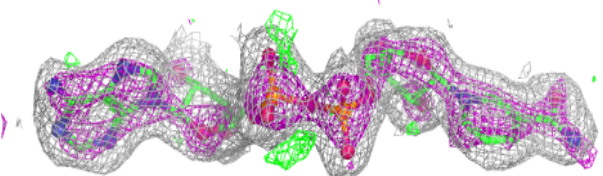
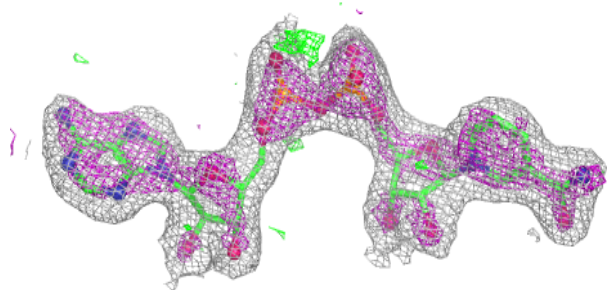
The following is a graphical depiction of the model fit to experimental electron density of all instances of the Ligand of Interest. In addition, ligands with molecular weight > 250 and outliers as shown on the geometry validation Tables will also be included. Each fit is shown from different orientation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

Electron density around NAD A 1001:

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

**Electron density around NAD B 1002:**

$2mF_o-DF_c$ (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.