



Full wwPDB X-ray Structure Validation Report ⓘ

Feb 1, 2016 – 09:11 AM GMT

PDB ID : 3HHP
Title : Malate dehydrogenase open conformation
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Deposited on : 2009-05-15
Resolution : 1.45 Å(reported)

This is a Full wwPDB X-ray Structure Validation Report for a publicly released PDB entry.
We welcome your comments at validation@mail.wwpdb.org
A user guide is available at
<http://wwpdb.org/validation/2016/XrayValidationReportHelp>
with specific help available everywhere you see the ⓘ symbol.

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

MolProbity : 4.02b-467
Mogul : 1.7 (RC4), CSD as536be (2015)
Xtriage (Phenix) : 1.9-1692
EDS : rb-20026688
Percentile statistics : 20151230.v01 (using entries in the PDB archive December 30th 2015)
Refmac : 5.8.0135
CCP4 : 6.5.0
Ideal geometry (proteins) : Engh & Huber (2001)
Ideal geometry (DNA, RNA) : Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP) : trunk26865

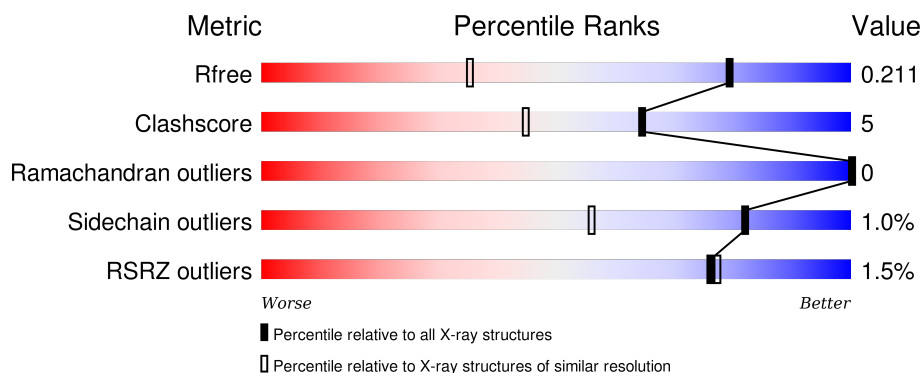
1 Overall quality at a glance ⓘ

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 1.45 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}	91344	1278 (1.48-1.44)
Clashscore	102246	1336 (1.48-1.44)
Ramachandran outliers	100387	1320 (1.48-1.44)
Sidechain outliers	100360	1320 (1.48-1.44)
RSRZ outliers	91569	1279 (1.48-1.44)

The table below summarises the geometric issues observed across the polymeric chains and their fit to the electron density. The red, orange, yellow and green segments on the lower bar indicate the fraction of residues that contain outliers for ≥ 3 , 2, 1 and 0 types of geometric quality criteria. A grey segment represents the fraction of residues that are not modelled. The numeric value for each fraction is indicated below the corresponding segment, with a dot representing fractions $\leq 5\%$. The upper red bar (where present) indicates the fraction of residues that have poor fit to the electron density. The numeric value is given above the bar.

Mol	Chain	Length	Quality of chain
1	A	312	<div> <div>%</div> <div> <div></div> <div>87%</div> <div>12%</div> <div>.</div> </div> </div>
1	B	312	<div> <div>2%</div> <div> <div></div> <div>90%</div> <div>7%</div> <div>.</div> </div> </div>
1	C	312	<div> <div>2%</div> <div> <div></div> <div>90%</div> <div>9%</div> <div>.</div> </div> </div>
1	D	312	<div> <div>%</div> <div> <div></div> <div>91%</div> <div>7%</div> <div>.</div> </div> </div>

2 Entry composition

There are 2 unique types of molecules in this entry. The entry contains 9989 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 dehydrogenase.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	312	Total	C	N	O	S	0	26	0
			2438	1550	407	473	8			
1	B	304	Total	C	N	O	S	0	20	0
			2331	1482	388	455	6			
1	C	312	Total	C	N	O	S	0	19	0
			2385	1514	399	465	7			
1	D	306	Total	C	N	O	S	0	14	0
			2310	1463	384	456	7			

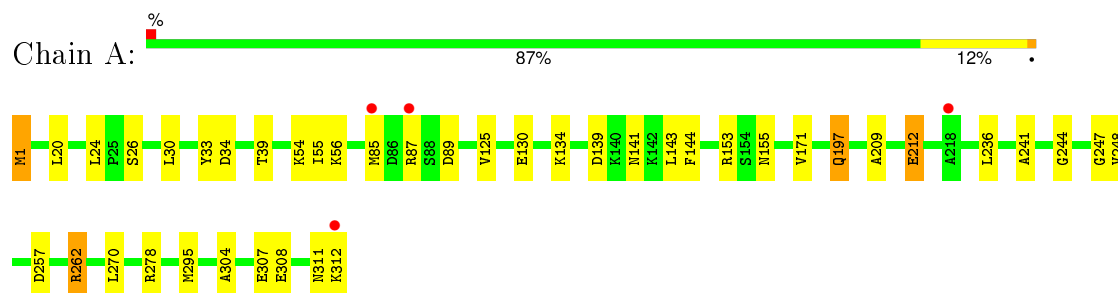
- Molecule 2 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
2	A	119	Total	O	0	0
			119	119		
2	B	131	Total	O	0	0
			131	131		
2	C	143	Total	O	0	0
			143	143		
2	D	132	Total	O	0	0
			132	132		

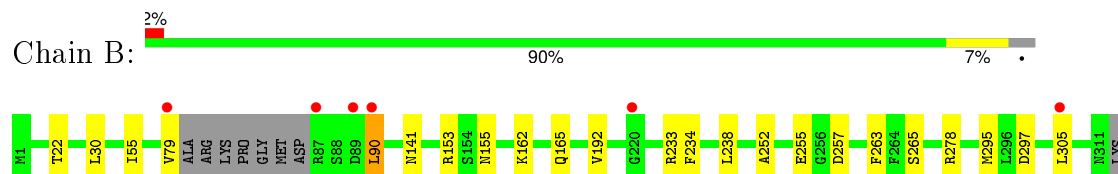
3 Residue-property plots

These plots are drawn for all protein, RNA and DNA chains in the entry. The first graphic for a chain summarises the proportions of errors 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.

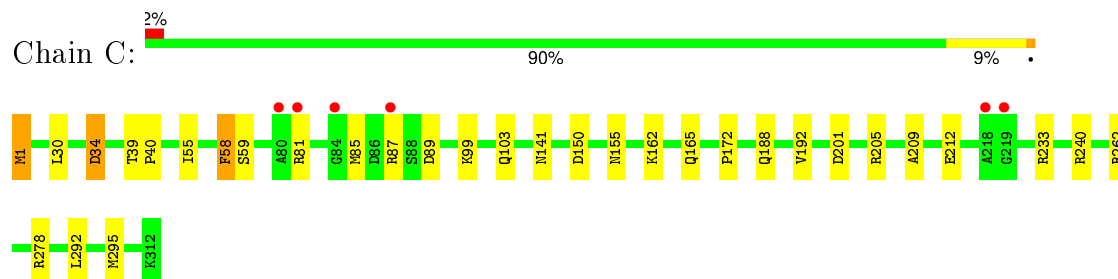
- Molecule 1: Malate dehydrogenase



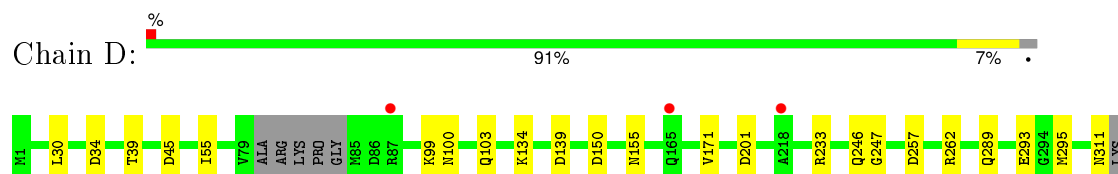
- Molecule 1: Malate dehydrogenase



- Molecule 1: Malate dehydrogenase



- Molecule 1: Malate dehydrogenase



4 Data and refinement statistics

Property	Value	Source
Space group	C 1 2 1	Depositor
Cell constants a, b, c, α , β , γ	146.03Å 51.97Å 168.98Å 90.00° 102.23° 90.00°	Depositor
Resolution (Å)	60.97 – 1.45 60.97 – 1.45	Depositor EDS
% Data completeness (in resolution range)	98.2 (60.97-1.45) 98.2 (60.97-1.45)	Depositor EDS
R_{merge}	0.06	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	1.63 (at 1.45Å)	Xtriage
Refinement program	REFMAC 5.5.0072	Depositor
R, R_{free}	0.186 , 0.214 0.183 , 0.211	Depositor DCC
R_{free} test set	21468 reflections (11.04%)	DCC
Wilson B-factor (Å ²)	16.1	Xtriage
Anisotropy	0.061	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.41 , 48.4	EDS
Estimated twinning fraction	No twinning to report.	Xtriage
L-test for twinning ²	$\langle L \rangle = 0.48$, $\langle L^2 \rangle = 0.31$	Xtriage
Outliers	2 of 215852 reflections (0.001%)	Xtriage
F_o, F_c correlation	0.96	EDS
Total number of atoms	9989	wwPDB-VP
Average B, all atoms (Å ²)	17.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 4.55% 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, 0.375 respectively for untwinned datasets, and 0.333, 0.2 for perfectly twinned datasets.

5 Model quality [i](#)

5.1 Standard geometry [i](#)

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	1.13	2/2521 (0.1%)	1.10	9/3409 (0.3%)
1	B	1.08	1/2397 (0.0%)	1.04	3/3248 (0.1%)
1	C	1.15	1/2455 (0.0%)	1.11	10/3324 (0.3%)
1	D	1.10	0/2363	1.07	8/3201 (0.2%)
All	All	1.11	4/9736 (0.0%)	1.08	30/13182 (0.2%)

All (4) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	A	212	GLU	CB-CG	-6.57	1.39	1.52
1	B	234	PHE	CD2-CE2	5.76	1.50	1.39
1	A	244	GLY	N-CA	5.70	1.54	1.46
1	C	205	ARG	CG-CD	-5.57	1.38	1.51

All (30) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	257	ASP	CB-CG-OD1	10.52	127.77	118.30
1	A	153	ARG	NE-CZ-NH2	-9.57	115.51	120.30
1	C	34	ASP	CB-CG-OD1	8.93	126.33	118.30
1	D	262	ARG	NE-CZ-NH2	-8.33	116.14	120.30
1	C	233	ARG	NE-CZ-NH2	-8.24	116.18	120.30
1	C	150	ASP	CB-CG-OD1	7.86	125.37	118.30
1	B	233	ARG	NE-CZ-NH2	-7.75	116.43	120.30
1	B	153	ARG	NE-CZ-NH2	-6.98	116.81	120.30
1	D	139	ASP	CB-CG-OD1	-6.77	112.20	118.30
1	A	1	MET	CG-SD-CE	6.70	110.93	100.20
1	C	262	ARG	NE-CZ-NH2	-6.63	116.98	120.30
1	C	292	LEU	CB-CG-CD2	-6.21	100.44	111.00
1	A	262[A]	ARG	NE-CZ-NH2	-6.14	117.23	120.30
1	A	262[B]	ARG	NE-CZ-NH2	-6.14	117.23	120.30
1	D	257	ASP	CB-CG-OD1	6.06	123.75	118.30
1	A	139	ASP	CB-CG-OD2	5.85	123.56	118.30

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Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	B	257	ASP	CB-CG-OD1	5.82	123.53	118.30
1	A	257	ASP	CB-CG-OD2	-5.79	113.08	118.30
1	D	45	ASP	CB-CG-OD1	5.76	123.48	118.30
1	C	201	ASP	CB-CG-OD2	-5.72	113.15	118.30
1	C	240	ARG	NE-CZ-NH1	5.57	123.09	120.30
1	D	139	ASP	CB-CG-OD2	5.55	123.30	118.30
1	A	139	ASP	CB-CG-OD1	-5.51	113.34	118.30
1	D	150	ASP	CB-CG-OD1	5.49	123.24	118.30
1	C	233	ARG	NE-CZ-NH1	5.46	123.03	120.30
1	A	33	TYR	CB-CG-CD1	-5.45	117.73	121.00
1	D	201	ASP	CB-CG-OD2	-5.17	113.65	118.30
1	C	1	MET	CG-SD-CE	5.13	108.42	100.20
1	D	233	ARG	NE-CZ-NH2	-5.10	117.75	120.30
1	C	58	PHE	CB-CG-CD2	-5.07	117.25	120.80

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	2438	0	2557	46	0
1	B	2331	0	2433	16	0
1	C	2385	0	2501	28	0
1	D	2310	0	2392	13	0
2	A	119	0	0	2	0
2	B	131	0	0	1	0
2	C	143	0	0	0	0
2	D	132	0	0	0	0
All	All	9989	0	9883	98	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 5.

All (98) 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:297[B]:ASP:OD1	2:B:378:HOH:O	1.65	1.12
1:A:130[B]:GLU:OE1	1:A:307[B]:GLU:HA	1.55	1.05
1:A:125:VAL:HG13	1:A:143[B]:LEU:HD21	1.39	1.04
1:A:197[B]:GLN:HE21	1:A:197[B]:GLN:HA	1.40	0.87
1:A:130[B]:GLU:OE2	1:A:307[B]:GLU:HG3	1.74	0.86
1:A:247:GLY:H	1:C:165:GLN:HE22	1.26	0.83
1:C:141:ASN:ND2	1:C:278[A]:ARG:HH12	1.78	0.81
1:A:125:VAL:HG13	1:A:143[B]:LEU:CD2	2.12	0.80
1:A:20:LEU:HD22	1:A:24[B]:LEU:HD11	1.63	0.80
1:A:241:ALA:HB2	1:A:248[B]:VAL:HG11	1.66	0.78
1:D:134:LYS:HE3	1:D:311:ASN:OD1	1.90	0.71
1:C:141:ASN:HD22	1:C:278[A]:ARG:HH12	1.37	0.70
1:C:81:ARG:HH22	1:C:87:ARG:HG2	1.57	0.69
1:B:165:GLN:HE22	1:D:247:GLY:H	1.40	0.69
1:A:134:LYS:NZ	1:A:311:ASN:HD21	1.90	0.69
1:A:248[B]:VAL:HG12	2:A:346:HOH:O	1.91	0.69
1:B:141:ASN:ND2	1:B:278[A]:ARG:HH12	1.91	0.69
1:A:155:ASN:HD21	1:A:171:VAL:H	1.40	0.68
2:A:369:HOH:O	1:B:22[B]:THR:HG21	1.94	0.67
1:C:162:LYS:HG3	1:C:192[A]:VAL:HG21	1.76	0.67
1:D:99:LYS:NZ	1:D:103:GLN:HE22	1.94	0.65
1:A:130[B]:GLU:OE1	1:A:307[B]:GLU:CA	2.37	0.65
1:D:155:ASN:HD21	1:D:171:VAL:H	1.45	0.64
1:A:54:LYS:HE2	1:A:56[A]:LYS:HE3	1.79	0.64
1:A:155:ASN:ND2	1:A:171:VAL:H	1.95	0.63
1:A:241:ALA:HB2	1:A:248[B]:VAL:CG1	2.27	0.63
1:A:197[B]:GLN:NE2	1:A:197[B]:GLN:HA	2.14	0.62
1:C:39[B]:THR:HG21	1:C:58:PHE:O	2.00	0.62
1:A:304:ALA:O	1:A:308[A]:GLU:HG2	1.99	0.62
1:C:81:ARG:NH2	1:C:87:ARG:HG2	2.13	0.62
1:A:197[B]:GLN:HE21	1:A:197[B]:GLN:CA	2.13	0.61
1:B:79:VAL:HG12	1:B:90:LEU:HD21	1.83	0.60
1:A:311:ASN:O	1:A:312:LYS:HG3	2.01	0.60
1:A:247:GLY:H	1:C:165:GLN:NE2	1.99	0.59
1:D:155:ASN:ND2	1:D:171:VAL:H	2.01	0.58
1:B:30:LEU:HD23	1:B:55:ILE:HD12	1.86	0.56
1:A:20:LEU:O	1:A:24[B]:LEU:HD13	2.06	0.56
1:C:39[B]:THR:CG2	1:C:40:PRO:HD3	2.35	0.56
1:B:141:ASN:HD22	1:B:278[A]:ARG:HH12	1.53	0.56
1:C:99[B]:LYS:HE2	1:C:103:GLN:NE2	2.23	0.54
1:C:85:MET:HG2	1:C:89:ASP:HB2	1.90	0.54
1:A:130[A]:GLU:HG3	1:A:307[A]:GLU:HA	1.90	0.53

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:D:30:LEU:HD23	1:D:55:ILE:HD12	1.90	0.53
1:A:143[B]:LEU:HD23	1:A:144:PHE:N	2.24	0.52
1:C:39[B]:THR:HG23	1:C:40:PRO:HD3	1.90	0.52
1:C:99[A]:LYS:NZ	1:C:103:GLN:HE22	2.07	0.52
1:A:24[B]:LEU:HD12	1:A:236:LEU:HD21	1.92	0.51
1:A:30:LEU:HD23	1:A:55:ILE:HD12	1.93	0.50
1:A:85[B]:MET:HG2	1:A:89:ASP:HB3	1.93	0.50
1:A:130[B]:GLU:OE2	1:A:307[B]:GLU:CG	2.54	0.49
1:A:130[B]:GLU:CD	1:A:307[B]:GLU:HG3	2.33	0.49
1:A:134:LYS:NZ	1:A:311:ASN:ND2	2.60	0.48
1:A:248[B]:VAL:HG13	1:A:270:LEU:HB2	1.95	0.48
1:A:26:SER:OG	1:D:246:GLN:HG2	2.15	0.47
1:A:141:ASN:ND2	1:A:278:ARG:HH12	2.12	0.47
1:A:85[B]:MET:HG2	1:A:89:ASP:CB	2.45	0.47
1:A:20:LEU:CD2	1:A:24[B]:LEU:HD11	2.40	0.47
1:D:99:LYS:HZ1	1:D:103:GLN:HE22	1.60	0.47
1:A:30:LEU:O	1:A:55:ILE:HA	2.14	0.47
1:A:209:ALA:O	1:A:212:GLU:HB3	2.15	0.47
1:A:134:LYS:HZ1	1:A:311:ASN:ND2	2.13	0.46
1:C:30:LEU:HD23	1:C:55:ILE:HD12	1.97	0.46
1:C:209:ALA:O	1:C:212:GLU:HB3	2.16	0.45
1:A:134:LYS:HZ3	1:A:311:ASN:HD21	1.64	0.45
1:C:39[B]:THR:CG2	1:C:58:PHE:O	2.65	0.44
1:A:20:LEU:CA	1:A:24[B]:LEU:HD13	2.47	0.44
1:A:26:SER:OG	1:D:246:GLN:CG	2.66	0.44
1:D:34:ASP:HB3	1:D:39:THR:OG1	2.18	0.44
1:A:85[B]:MET:CG	1:A:89:ASP:HB3	2.48	0.44
1:A:34:ASP:HB3	1:A:39:THR:OG1	2.18	0.43
1:D:289:GLN:O	1:D:293:GLU:HG3	2.18	0.43
1:C:99[B]:LYS:HE2	1:C:103:GLN:HE22	1.82	0.43
1:C:39[B]:THR:HG22	1:C:59[B]:SER:HB3	2.00	0.43
1:C:34:ASP:O	1:C:59[B]:SER:HA	2.19	0.43
1:C:99[A]:LYS:NZ	1:C:103:GLN:NE2	2.66	0.43
1:A:134:LYS:HZ1	1:A:311:ASN:HD21	1.64	0.42
1:C:34:ASP:O	1:C:59[A]:SER:HA	2.19	0.42
1:D:30:LEU:O	1:D:55:ILE:HA	2.19	0.42
1:C:34:ASP:HB3	1:C:39[A]:THR:OG1	2.20	0.41
1:C:172:PRO:HG2	1:C:188:GLN:HE21	1.86	0.41
1:B:162:LYS:HG3	1:B:192[A]:VAL:CG2	2.51	0.41
1:B:252:ALA:O	1:B:265:SER:HA	2.19	0.41
1:B:255:GLU:HB2	1:B:263:PHE:CE2	2.57	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	336/312 (108%)	336 (100%)	0	0	100	100
1	B	320/312 (103%)	316 (99%)	4 (1%)	0	100	100
1	C	330/312 (106%)	327 (99%)	3 (1%)	0	100	100
1	D	316/312 (101%)	312 (99%)	4 (1%)	0	100	100
All	All	1302/1248 (104%)	1291 (99%)	11 (1%)	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	267/241 (111%)	261 (98%)	6 (2%)	60	22
1	B	255/241 (106%)	252 (99%)	3 (1%)	78	48
1	C	261/241 (108%)	259 (99%)	2 (1%)	86	66
1	D	251/241 (104%)	250 (100%)	1 (0%)	93	82
All	All	1034/964 (107%)	1022 (99%)	12 (1%)	82	48

All (12) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	1	MET
1	A	197[A]	GLN
1	A	197[B]	GLN
1	A	262[A]	ARG
1	A	262[B]	ARG
1	A	295	MET
1	B	90	LEU
1	B	238	LEU
1	B	295	MET
1	C	1	MET
1	C	295	MET
1	D	295	MET

Some sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (26) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	141	ASN
1	A	155	ASN
1	A	188	GLN
1	A	207	GLN
1	A	266	GLN
1	A	311	ASN
1	B	141	ASN
1	B	155	ASN
1	B	165	GLN
1	B	188	GLN
1	B	207	GLN
1	B	246	GLN
1	B	266	GLN
1	C	103	GLN
1	C	141	ASN
1	C	155	ASN
1	C	165	GLN
1	C	188	GLN
1	C	207	GLN
1	C	266	GLN
1	D	103	GLN
1	D	141	ASN
1	D	155	ASN
1	D	188	GLN
1	D	207	GLN
1	D	266	GLN

5.3.3 RNA [i](#)

There are no RNA molecules in this entry.

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

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

5.5 Carbohydrates [i](#)

There are no carbohydrates in this entry.

5.6 Ligand geometry [i](#)

There are no ligands in this entry.

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	312/312 (100%)	-0.29	4 (1%) 79 80	10, 15, 26, 43	0
1	B	304/312 (97%)	-0.32	6 (1%) 68 69	10, 16, 28, 57	0
1	C	312/312 (100%)	-0.29	6 (1%) 70 71	10, 15, 28, 48	0
1	D	306/312 (98%)	-0.35	3 (0%) 84 85	10, 16, 28, 46	0
All	All	1234/1248 (98%)	-0.31	19 (1%) 76 77	10, 16, 28, 57	0

All (19) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	218	ALA	5.0
1	B	79	VAL	4.9
1	B	87	ARG	4.9
1	D	87	ARG	3.6
1	C	80	ALA	3.5
1	A	312	LYS	3.4
1	B	90	LEU	3.2
1	C	84	GLY	3.0
1	C	218	ALA	3.0
1	A	87[A]	ARG	2.7
1	C	81	ARG	2.6
1	A	85[A]	MET	2.6
1	B	89	ASP	2.6
1	C	87	ARG	2.4
1	D	218	ALA	2.2
1	B	220	GLY	2.2
1	B	305[A]	LEU	2.1
1	C	219	GLY	2.1
1	D	165	GLN	2.0

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 carbohydrates in this entry.

6.4 Ligands [i](#)

There are no ligands in this entry.

6.5 Other polymers [i](#)

There are no such residues in this entry.