



Full wwPDB X-ray Structure Validation Report ⓘ

Mar 6, 2026 – 03:16 PM UTC

PDB ID : 1S3O / pdb_00001s3o
Title : Human mitochondrial single strand DNA binding protein (hmSSB)
Authors : Venclovas, C.; Ginalski, K.; Kang, C.
Deposited on : 2004-01-13
Resolution : 2.47 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
Xtriage (Phenix)	:	2.0
EDS	:	3.0
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

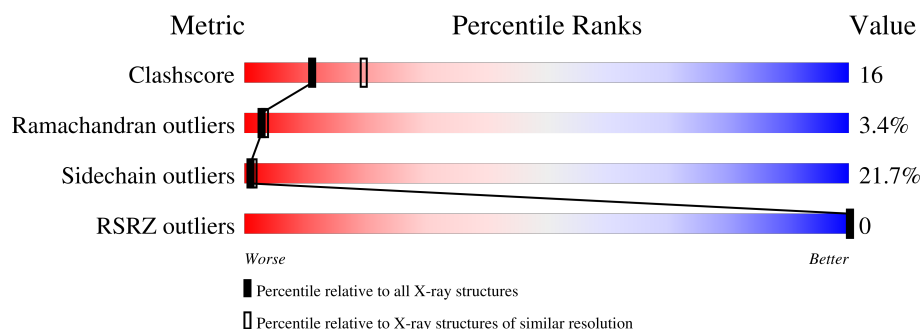
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 2.47 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	8295 (2.50-2.46)
Ramachandran outliers	187476	8164 (2.50-2.46)
Sidechain outliers	187428	8166 (2.50-2.46)
RSRZ outliers	180081	7593 (2.50-2.46)

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	132	
1	B	132	

2 Entry composition

There are 2 unique types of molecules in this entry. The entry contains 1753 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 Single-stranded DNA-binding protein, mitochondrial.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	107	Total	C	N	O	S	0	0	0
			877	554	163	158	2			
1	B	104	Total	C	N	O	S	0	0	0
			855	541	159	153	2			

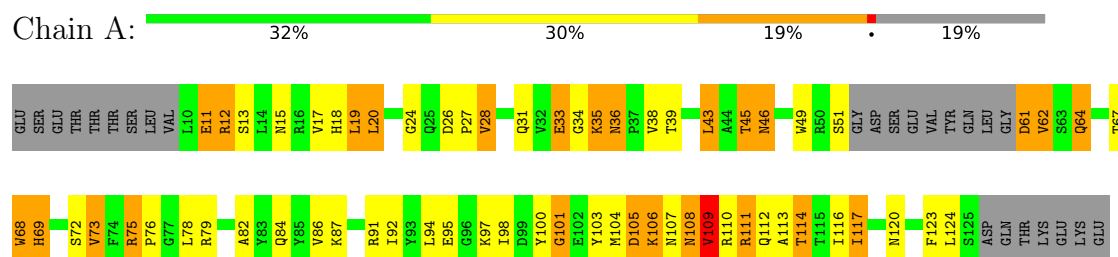
- Molecule 2 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
2	A	11	Total	O	0	0
			11	11		
2	B	10	Total	O	0	0
			10	10		

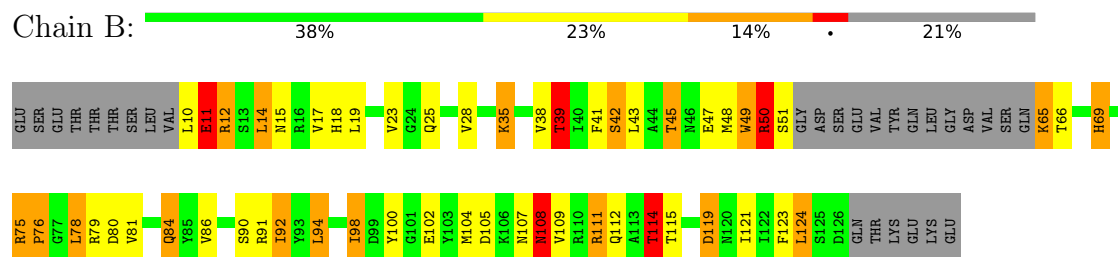
3 Residue-property plots

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: Single-stranded DNA-binding protein, mitochondrial



- Molecule 1: Single-stranded DNA-binding protein, mitochondrial



4 Data and refinement statistics

Property	Value	Source
Space group	P 41 21 2	Depositor
Cell constants a, b, c, α , β , γ	51.83Å 51.83Å 184.24Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	10.00 – 2.47 10.00 – 2.47	Depositor EDS
% Data completeness (in resolution range)	92.1 (10.00-2.47) 90.5 (10.00-2.47)	Depositor EDS
R_{merge}	(Not available)	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	2.60 (at 2.48Å)	Xtriage
Refinement program	X-PLOR 3.851	Depositor
R, R_{free}	0.191 , 0.230 0.192 , (Not available)	Depositor DCC
R_{free} test set	No test flags present.	wwPDB-VP
Wilson B-factor (Å ²)	39.3	Xtriage
Anisotropy	0.155	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.11 , 56.7	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	0.95	EDS
Total number of atoms	1753	wwPDB-VP
Average B, all atoms (Å ²)	39.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 7.54% 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](#)

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	1.10	4/892 (0.4%)	2.00	35/1202 (2.9%)
1	B	1.14	3/870 (0.3%)	2.05	37/1172 (3.2%)
All	All	1.12	7/1762 (0.4%)	2.02	72/2374 (3.0%)

All (7) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	B	69	HIS	CD2-NE2	-6.72	1.30	1.37
1	B	18	HIS	CD2-NE2	-6.27	1.30	1.37
1	A	69	HIS	CD2-NE2	-5.80	1.31	1.37
1	A	18	HIS	CD2-NE2	-5.55	1.31	1.37
1	B	18	HIS	CG-ND1	-5.34	1.32	1.38
1	A	117	ILE	CA-CB	5.17	1.60	1.53
1	A	18	HIS	CG-ND1	-5.03	1.32	1.38

All (72) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	B	66	THR	N-CA-C	10.01	124.97	109.96
1	B	12	ARG	N-CA-C	8.86	124.40	110.32
1	B	108	ASN	CA-CB-CG	8.23	120.83	112.60
1	B	35	LYS	N-CA-C	7.91	123.05	112.30
1	B	119	ASP	CA-CB-CG	7.69	120.29	112.60
1	A	61	ASP	CA-CB-CG	7.64	120.24	112.60
1	B	105	ASP	CA-CB-CG	7.49	120.09	112.60
1	B	39	THR	CA-C-O	7.31	128.59	120.70
1	A	107	ASN	CA-CB-CG	7.20	119.80	112.60
1	B	49	TRP	N-CA-C	6.94	121.16	110.20
1	B	75	ARG	CA-C-N	6.92	126.60	119.82
1	B	75	ARG	C-N-CA	6.92	126.60	119.82
1	A	120	ASN	CA-CB-CG	6.84	119.44	112.60
1	B	80	ASP	N-CA-C	-6.79	103.81	111.14
1	A	101	GLY	O-C-N	6.77	128.68	122.18

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Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	107	ASN	CA-C-N	6.66	134.26	121.54
1	A	107	ASN	C-N-CA	6.66	134.26	121.54
1	A	11	GLU	N-CA-C	-6.63	99.78	110.32
1	A	107	ASN	CA-C-O	6.58	127.94	120.90
1	A	105	ASP	N-CA-C	6.40	117.94	110.97
1	A	108	ASN	N-CA-C	-6.32	97.33	110.80
1	B	75	ARG	N-CA-C	6.25	118.49	109.48
1	B	119	ASP	CB-CA-C	-6.14	98.50	109.24
1	A	69	HIS	CA-CB-CG	6.08	119.88	113.80
1	B	90	SER	CA-CB-OG	6.05	123.19	111.10
1	B	81	VAL	N-CA-C	6.04	116.70	110.36
1	A	79	ARG	N-CA-C	-6.02	104.63	111.07
1	A	107	ASN	O-C-N	6.00	128.33	122.09
1	B	50	ARG	CA-CB-CG	5.98	126.07	114.10
1	A	43	LEU	O-C-N	-5.96	116.34	123.31
1	B	41	PHE	CA-CB-CG	5.91	119.71	113.80
1	B	76	PRO	N-CA-C	5.88	121.56	113.98
1	B	119	ASP	N-CA-CB	5.86	119.03	110.47
1	B	98	ILE	CB-CA-C	-5.86	103.65	110.91
1	A	103	TYR	CA-CB-CG	5.85	124.44	113.90
1	A	72	SER	O-C-N	-5.79	115.86	123.21
1	B	111	ARG	CA-CB-CG	5.78	125.66	114.10
1	A	106	LYS	CA-C-N	5.76	128.31	120.54
1	A	106	LYS	C-N-CA	5.76	128.31	120.54
1	A	28	VAL	N-CA-CB	-5.66	104.12	111.82
1	A	78	LEU	CA-C-N	5.64	127.77	120.44
1	A	78	LEU	C-N-CA	5.64	127.77	120.44
1	B	115	THR	CA-CB-OG1	-5.58	101.23	109.60
1	A	109	VAL	O-C-N	5.57	129.53	122.57
1	A	69	HIS	CB-CG-CD2	-5.49	124.06	131.20
1	A	62	VAL	CA-C-O	5.49	127.64	120.78
1	B	38	VAL	CA-C-N	-5.44	114.78	122.94
1	B	38	VAL	C-N-CA	-5.44	114.78	122.94
1	B	69	HIS	CB-CG-CD2	-5.44	124.13	131.20
1	B	114	THR	CA-C-O	5.36	126.27	120.43
1	B	49	TRP	O-C-N	5.34	129.31	123.01
1	B	65	LYS	CA-C-N	5.33	128.42	120.95
1	B	65	LYS	C-N-CA	5.33	128.42	120.95
1	A	67	THR	CA-CB-OG1	-5.32	101.62	109.60
1	A	46	ASN	N-CA-C	5.32	117.40	108.73
1	A	116	ILE	O-C-N	-5.32	116.46	122.94
1	A	33	GLU	N-CA-CB	-5.31	101.51	110.49

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Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	B	10	LEU	CA-C-N	5.31	131.68	121.54
1	B	10	LEU	C-N-CA	5.31	131.68	121.54
1	B	115	THR	CA-CB-CG2	5.27	119.45	110.50
1	B	38	VAL	CB-CA-C	-5.25	101.72	111.18
1	A	109	VAL	CA-C-O	5.23	127.31	120.78
1	B	11	GLU	N-CA-C	5.23	121.93	110.80
1	A	49	TRP	CE2-CD2-CG	-5.22	100.94	107.20
1	A	18	HIS	N-CA-C	-5.20	100.70	109.07
1	A	36	ASN	CA-C-N	5.14	125.08	119.78
1	A	36	ASN	C-N-CA	5.14	125.08	119.78
1	A	68	TRP	CE2-CD2-CG	-5.08	101.11	107.20
1	A	33	GLU	CA-CB-CG	5.04	124.19	114.10
1	B	81	VAL	N-CA-CB	-5.04	104.92	110.51
1	B	123	PHE	CA-CB-CG	-5.03	108.77	113.80
1	B	49	TRP	CE2-CD2-CG	-5.02	101.17	107.20

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	877	0	889	36	0
1	B	855	0	867	33	0
2	A	11	0	0	2	0
2	B	10	0	0	3	0
All	All	1753	0	1756	57	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 16.

All (57) 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:35:LYS:HE3	2:B:1082:HOH:O	1.50	1.10

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:114:THR:HG21	1:B:114:THR:HG21	1.35	1.03
1:A:12:ARG:HH12	1:B:91:ARG:HH22	1.15	0.88
1:B:49:TRP:HE1	1:B:65:LYS:HD3	1.43	0.84
1:A:12:ARG:NH1	1:B:91:ARG:HH22	1.74	0.84
1:B:108:ASN:HD22	1:B:109:VAL:HG23	1.47	0.78
1:A:51:SER:H	1:A:61:ASP:HB3	1.50	0.77
1:A:111:ARG:HG3	1:A:112:GLN:H	1.56	0.70
1:A:33:GLU:HB3	1:A:35:LYS:HG2	1.78	0.66
1:A:112:GLN:NE2	1:B:114:THR:HG22	2.14	0.62
1:A:24:GLY:HA3	1:A:68:TRP:HZ3	1.64	0.62
1:A:15:ASN:HB2	1:B:45:THR:HG21	1.84	0.60
1:A:27:PRO:HD3	1:A:86:VAL:HG23	1.83	0.60
1:A:114:THR:HG21	1:B:114:THR:CG2	2.23	0.59
1:B:104:MET:HB3	1:B:107:ASN:O	2.02	0.59
1:B:12:ARG:HG3	2:B:1160:HOH:O	2.01	0.58
1:A:45:THR:HG21	1:B:15:ASN:HB2	1.86	0.56
1:B:91:ARG:O	1:B:124:LEU:HB2	2.05	0.55
1:A:39:THR:HB	1:A:73:VAL:HG13	1.89	0.54
1:A:82:ALA:O	1:A:86:VAL:HG22	2.09	0.52
1:A:31:GLN:HA	2:A:1088:HOH:O	2.10	0.52
1:B:78:LEU:HD22	1:B:121:ILE:HD12	1.92	0.51
1:A:35:LYS:HD2	2:A:1088:HOH:O	2.11	0.49
1:B:100:TYR:HA	1:B:114:THR:HB	1.95	0.49
1:B:45:THR:HG22	2:B:1058:HOH:O	2.12	0.49
1:A:46:ASN:ND2	1:A:64:GLN:HE22	2.11	0.49
1:A:17:VAL:O	1:A:95:GLU:HA	2.14	0.47
1:B:50:ARG:HD3	1:B:51:SER:H	1.79	0.47
1:A:19:LEU:HD12	1:B:15:ASN:HA	1.97	0.47
1:A:114:THR:HG23	1:B:112:GLN:NE2	2.30	0.47
1:A:46:ASN:HD22	1:A:64:GLN:HE22	1.63	0.47
1:B:91:ARG:O	1:B:92:ILE:HD12	2.16	0.46
1:A:51:SER:N	1:A:61:ASP:HB3	2.26	0.46
1:B:84:GLN:HE21	1:B:84:GLN:HB3	1.60	0.46
1:A:105:ASP:HB3	1:A:109:VAL:O	2.16	0.45
1:B:25:GLN:HG2	1:B:42:SER:HB3	1.98	0.45
1:B:39:THR:HG23	1:B:79:ARG:HB2	1.98	0.45
1:A:86:VAL:HG12	1:A:123:PHE:CE2	2.52	0.44
1:B:45:THR:HB	1:B:69:HIS:HE1	1.82	0.44
1:A:111:ARG:HB2	1:B:111:ARG:HH11	1.83	0.44
1:A:101:GLY:HA3	1:A:113:ALA:H	1.82	0.44
1:B:75:ARG:HA	1:B:76:PRO:HD3	1.85	0.44

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:98:ILE:HD11	1:B:17:VAL:HG21	1.99	0.44
1:A:105:ASP:H	1:A:110:ARG:HA	1.83	0.43
1:A:91:ARG:HG2	1:A:124:LEU:HD12	2.00	0.43
1:B:23:VAL:HG21	1:B:86:VAL:HG13	1.99	0.43
1:A:45:THR:HB	1:A:69:HIS:HE1	1.83	0.43
1:A:86:VAL:HG12	1:A:123:PHE:HE2	1.84	0.43
1:A:100:TYR:HA	1:A:114:THR:HB	2.00	0.43
1:A:75:ARG:HA	1:A:76:PRO:HD2	1.87	0.42
1:B:19:LEU:HD12	1:B:94:LEU:CD2	2.50	0.42
1:A:117:ILE:HD13	1:A:117:ILE:HG21	1.87	0.41
1:A:45:THR:HB	1:A:69:HIS:CE1	2.54	0.41
1:B:102:GLU:HA	1:B:112:GLN:HA	2.02	0.41
1:B:108:ASN:ND2	1:B:109:VAL:H	2.18	0.40
1:B:75:ARG:O	1:B:79:ARG:HG2	2.20	0.40
1:A:20:LEU:HB3	1:B:14:LEU:HB2	2.03	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	103/132 (78%)	90 (87%)	9 (9%)	4 (4%)		
1	B	100/132 (76%)	91 (91%)	6 (6%)	3 (3%)		
All	All	203/264 (77%)	181 (89%)	15 (7%)	7 (3%)		

All (7) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	108	ASN
1	B	11	GLU
1	A	62	VAL

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Mol	Chain	Res	Type
1	A	109	VAL
1	B	108	ASN
1	B	50	ARG
1	A	34	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	96/119 (81%)	72 (75%)	24 (25%)	0	1
1	B	93/119 (78%)	76 (82%)	17 (18%)	2	3
All	All	189/238 (79%)	148 (78%)	41 (22%)	1	1

All (41) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	11	GLU
1	A	12	ARG
1	A	13	SER
1	A	19	LEU
1	A	20	LEU
1	A	26	ASP
1	A	28	VAL
1	A	35	LYS
1	A	36	ASN
1	A	38	VAL
1	A	43	LEU
1	A	45	THR
1	A	64	GLN
1	A	73	VAL
1	A	75	ARG
1	A	84	GLN
1	A	87	LYS
1	A	92	ILE
1	A	94	LEU

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Mol	Chain	Res	Type
1	A	97	LYS
1	A	104	MET
1	A	106	LYS
1	A	111	ARG
1	A	114	THR
1	B	11	GLU
1	B	14	LEU
1	B	28	VAL
1	B	39	THR
1	B	42	SER
1	B	43	LEU
1	B	45	THR
1	B	47	GLU
1	B	48	MET
1	B	78	LEU
1	B	84	GLN
1	B	92	ILE
1	B	94	LEU
1	B	98	ILE
1	B	114	THR
1	B	119	ASP
1	B	124	LEU

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (10) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	15	ASN
1	A	46	ASN
1	A	64	GLN
1	A	69	HIS
1	B	25	GLN
1	B	46	ASN
1	B	69	HIS
1	B	84	GLN
1	B	108	ASN
1	B	112	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](#)

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 [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	107/132 (81%)	-0.55	0 100 100	11, 30, 94, 100	0
1	B	104/132 (78%)	-0.66	0 100 100	10, 28, 74, 90	0
All	All	211/264 (79%)	-0.60	0 100 100	10, 29, 90, 100	0

There are no RSRZ outliers to report.

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](#)

There are no ligands in this entry.

6.5 Other polymers [i](#)

There are no such residues in this entry.