



# Full wwPDB X-ray Structure Validation Report ⓘ

May 22, 2020 – 10:33 pm BST

PDB ID : 4NZZ  
Title : Crystal structure of epoxide hydrolase from bacillus megaterium  
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Deposited on : 2013-12-13  
Resolution : 1.75 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](mailto: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.

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

MolProbity	:	4.02b-467
Xtriage (Phenix)	:	1.13
EDS	:	2.11
Percentile statistics	:	20191225.v01 (using entries in the PDB archive December 25th 2019)
Refmac	:	5.8.0158
CCP4	:	7.0.044 (Gargrove)
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, RNA)	:	Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP)	:	2.11

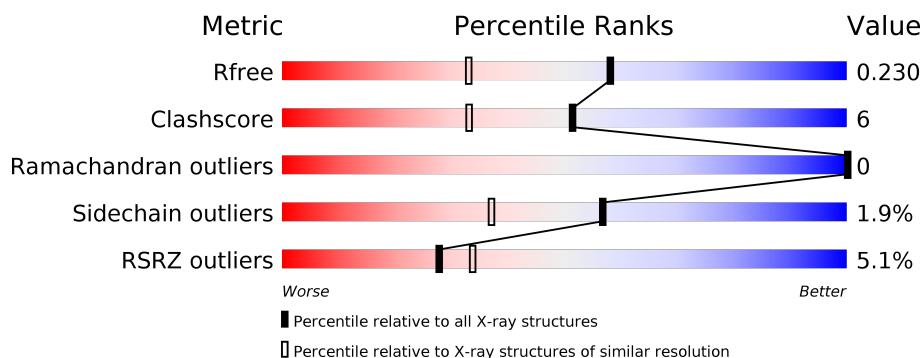
# 1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

## *X-RAY DIFFRACTION*

The reported resolution of this entry is 1.75 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))
$R_{free}$	130704	2340 (1.76-1.76)
Clashscore	141614	2466 (1.76-1.76)
Ramachandran outliers	138981	2437 (1.76-1.76)
Sidechain outliers	138945	2437 (1.76-1.76)
RSRZ outliers	127900	2298 (1.76-1.76)

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  $\geq 3$ , 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	320	<div> <div>5%</div> <div> <div></div> <div>76%</div> <div>13%</div> <div>• 10%</div> </div> </div>
1	B	320	<div> <div>4%</div> <div> <div></div> <div>79%</div> <div>10%</div> <div>• 10%</div> </div> </div>

## 2 Entry composition

There are 2 unique types of molecules in this entry. The entry contains 5264 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 Soluble epoxide hydrolase.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	287	Total	C	N	O	S	0	7	0
			2432	1555	408	458	11			
1	B	287	Total	C	N	O	S	0	5	0
			2418	1545	409	454	10			

There are 66 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	-32	MET	-	EXPRESSION TAG	UNP G9BEX6
A	-31	GLY	-	EXPRESSION TAG	UNP G9BEX6
A	-30	SER	-	EXPRESSION TAG	UNP G9BEX6
A	-29	SER	-	EXPRESSION TAG	UNP G9BEX6
A	-28	HIS	-	EXPRESSION TAG	UNP G9BEX6
A	-27	HIS	-	EXPRESSION TAG	UNP G9BEX6
A	-26	HIS	-	EXPRESSION TAG	UNP G9BEX6
A	-25	HIS	-	EXPRESSION TAG	UNP G9BEX6
A	-24	HIS	-	EXPRESSION TAG	UNP G9BEX6
A	-23	HIS	-	EXPRESSION TAG	UNP G9BEX6
A	-22	SER	-	EXPRESSION TAG	UNP G9BEX6
A	-21	SER	-	EXPRESSION TAG	UNP G9BEX6
A	-20	GLY	-	EXPRESSION TAG	UNP G9BEX6
A	-19	LEU	-	EXPRESSION TAG	UNP G9BEX6
A	-18	VAL	-	EXPRESSION TAG	UNP G9BEX6
A	-17	PRO	-	EXPRESSION TAG	UNP G9BEX6
A	-16	ARG	-	EXPRESSION TAG	UNP G9BEX6
A	-15	GLY	-	EXPRESSION TAG	UNP G9BEX6
A	-14	SER	-	EXPRESSION TAG	UNP G9BEX6
A	-13	HIS	-	EXPRESSION TAG	UNP G9BEX6
A	-12	MET	-	EXPRESSION TAG	UNP G9BEX6
A	-11	ALA	-	EXPRESSION TAG	UNP G9BEX6
A	-10	SER	-	EXPRESSION TAG	UNP G9BEX6
A	-9	MET	-	EXPRESSION TAG	UNP G9BEX6
A	-8	THR	-	EXPRESSION TAG	UNP G9BEX6

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Chain	Residue	Modelled	Actual	Comment	Reference
A	-7	GLY	-	EXPRESSION TAG	UNP G9BEX6
A	-6	GLY	-	EXPRESSION TAG	UNP G9BEX6
A	-5	GLN	-	EXPRESSION TAG	UNP G9BEX6
A	-4	GLN	-	EXPRESSION TAG	UNP G9BEX6
A	-3	MET	-	EXPRESSION TAG	UNP G9BEX6
A	-2	GLY	-	EXPRESSION TAG	UNP G9BEX6
A	-1	ARG	-	EXPRESSION TAG	UNP G9BEX6
A	0	GLY	-	EXPRESSION TAG	UNP G9BEX6
B	-32	MET	-	EXPRESSION TAG	UNP G9BEX6
B	-31	GLY	-	EXPRESSION TAG	UNP G9BEX6
B	-30	SER	-	EXPRESSION TAG	UNP G9BEX6
B	-29	SER	-	EXPRESSION TAG	UNP G9BEX6
B	-28	HIS	-	EXPRESSION TAG	UNP G9BEX6
B	-27	HIS	-	EXPRESSION TAG	UNP G9BEX6
B	-26	HIS	-	EXPRESSION TAG	UNP G9BEX6
B	-25	HIS	-	EXPRESSION TAG	UNP G9BEX6
B	-24	HIS	-	EXPRESSION TAG	UNP G9BEX6
B	-23	HIS	-	EXPRESSION TAG	UNP G9BEX6
B	-22	SER	-	EXPRESSION TAG	UNP G9BEX6
B	-21	SER	-	EXPRESSION TAG	UNP G9BEX6
B	-20	GLY	-	EXPRESSION TAG	UNP G9BEX6
B	-19	LEU	-	EXPRESSION TAG	UNP G9BEX6
B	-18	VAL	-	EXPRESSION TAG	UNP G9BEX6
B	-17	PRO	-	EXPRESSION TAG	UNP G9BEX6
B	-16	ARG	-	EXPRESSION TAG	UNP G9BEX6
B	-15	GLY	-	EXPRESSION TAG	UNP G9BEX6
B	-14	SER	-	EXPRESSION TAG	UNP G9BEX6
B	-13	HIS	-	EXPRESSION TAG	UNP G9BEX6
B	-12	MET	-	EXPRESSION TAG	UNP G9BEX6
B	-11	ALA	-	EXPRESSION TAG	UNP G9BEX6
B	-10	SER	-	EXPRESSION TAG	UNP G9BEX6
B	-9	MET	-	EXPRESSION TAG	UNP G9BEX6
B	-8	THR	-	EXPRESSION TAG	UNP G9BEX6
B	-7	GLY	-	EXPRESSION TAG	UNP G9BEX6
B	-6	GLY	-	EXPRESSION TAG	UNP G9BEX6
B	-5	GLN	-	EXPRESSION TAG	UNP G9BEX6
B	-4	GLN	-	EXPRESSION TAG	UNP G9BEX6
B	-3	MET	-	EXPRESSION TAG	UNP G9BEX6
B	-2	GLY	-	EXPRESSION TAG	UNP G9BEX6
B	-1	ARG	-	EXPRESSION TAG	UNP G9BEX6
B	0	GLY	-	EXPRESSION TAG	UNP G9BEX6

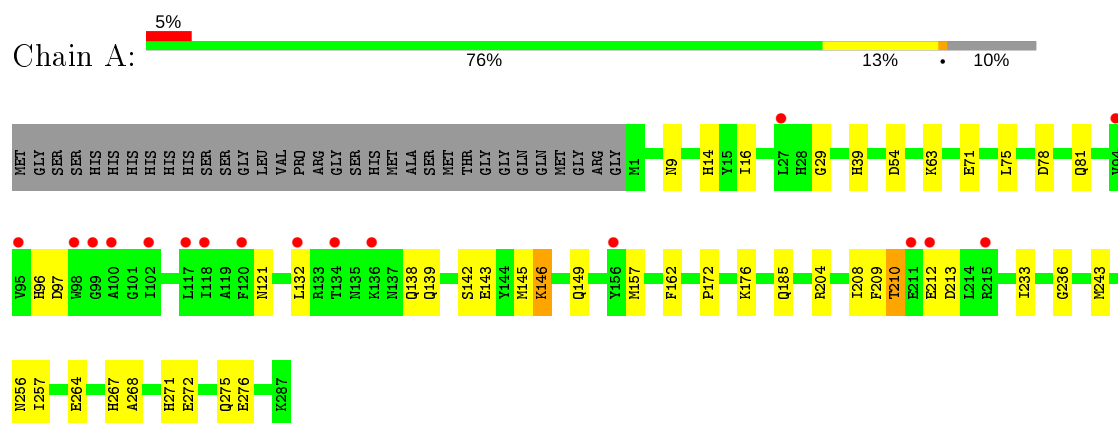
- Molecule 2 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
2	A	234	Total 234	O 234	0	0
2	B	180	Total 180	O 180	0	0

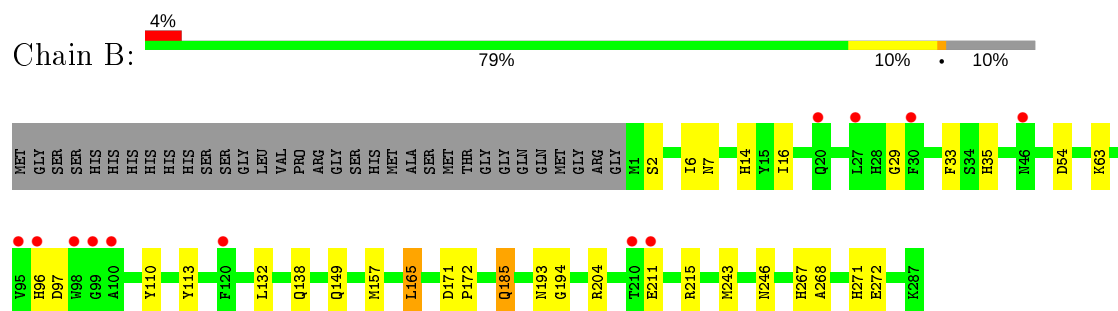
### 3 Residue-property plots [i](#)

These plots are drawn for all protein, RNA and DNA 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: Soluble epoxide hydrolase



- Molecule 1: Soluble epoxide hydrolase



## 4 Data and refinement statistics

Property	Value	Source
Space group	P 21 21 21	Depositor
Cell constants a, b, c, $\alpha$ , $\beta$ , $\gamma$	64.23Å 76.01Å 120.81Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	35.58 – 1.75 35.58 – 1.75	Depositor EDS
% Data completeness (in resolution range)	95.8 (35.58-1.75) 98.6 (35.58-1.75)	Depositor EDS
$R_{merge}$	(Not available)	Depositor
$R_{sym}$	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ <sup>1</sup>	2.76 (at 1.75Å)	Xtriage
Refinement program	PHENIX (PHENIX.REFINE: 1.7_637)	Depositor
R, $R_{free}$	0.186 , 0.233 0.186 , 0.230	Depositor DCC
$R_{free}$ test set	3025 reflections (5.06%)	wwPDB-VP
Wilson B-factor (Å <sup>2</sup> )	26.2	Xtriage
Anisotropy	0.479	Xtriage
Bulk solvent $k_{sol}$ (e/Å <sup>3</sup> ), $B_{sol}$ (Å <sup>2</sup> )	0.34 , 43.5	EDS
L-test for twinning <sup>2</sup>	$\langle  L  \rangle = 0.47$ , $\langle L^2 \rangle = 0.30$	Xtriage
Estimated twinning fraction	No twinning to report.	Xtriage
$F_o, F_c$ correlation	0.96	EDS
Total number of atoms	5264	wwPDB-VP
Average B, all atoms (Å <sup>2</sup> )	30.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 4.24% of the height of the origin peak. No significant pseudotranslation is detected.*

<sup>1</sup>Intensities estimated from amplitudes.

<sup>2</sup>Theoretical 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

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	0.38	0/2498	0.50	0/3383
1	B	0.34	0/2484	0.50	0/3365
All	All	0.36	0/4982	0.50	0/6748

There are no bond length outliers.

There are no bond angle outliers.

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	2432	0	2322	32	0
1	B	2418	0	2307	21	0
2	A	234	0	0	7	0
2	B	180	0	0	3	0
All	All	5264	0	4629	53	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 (53) 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:210:THR:HG22	1:A:213:ASP:H	1.30	0.95

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:121:ASN:HD21	1:A:236:GLY:H	1.16	0.88
1:B:138:GLN:HE22	1:B:243:MET:H	1.32	0.78
1:A:71[B]:GLU:HG2	2:A:445:HOH:O	1.87	0.73
1:A:210:THR:HG22	1:A:213:ASP:N	2.09	0.66
1:A:138:GLN:HE22	1:A:243:MET:H	1.43	0.66
1:B:63:LYS:HE2	1:B:193:ASN:O	1.96	0.66
1:B:16:ILE:HD11	2:B:468:HOH:O	1.97	0.65
1:A:96:HIS:HE1	1:A:267:HIS:O	1.81	0.64
1:B:138:GLN:NE2	1:B:243:MET:H	1.96	0.64
1:A:268:ALA:O	1:A:272[B]:GLU:HG3	1.99	0.62
1:B:63:LYS:HE3	1:B:194:GLY:HA2	1.81	0.61
1:A:16[B]:ILE:HD11	2:A:327:HOH:O	2.01	0.61
1:A:138:GLN:NE2	1:A:243:MET:H	1.99	0.60
1:B:96:HIS:HD2	2:B:467:HOH:O	1.84	0.60
1:B:96:HIS:HE1	1:B:267:HIS:O	1.87	0.57
1:A:81:GLN:NE2	2:A:491:HOH:O	2.37	0.57
1:A:142:SER:HB3	1:A:145:MET:HE2	1.86	0.56
1:A:233:ILE:HG12	1:A:257:ILE:HD11	1.88	0.56
1:A:29:GLY:HA3	1:A:97:ASP:HB3	1.88	0.55
1:A:121:ASN:HD22	1:A:121:ASN:H	1.52	0.55
1:A:157:MET:O	1:A:162:PHE:HA	2.07	0.54
1:A:96:HIS:HD2	2:A:453:HOH:O	1.90	0.54
1:B:138:GLN:NE2	1:B:246:ASN:HD21	2.07	0.53
1:B:149:GLN:HE22	1:B:204:ARG:HA	1.75	0.52
1:B:157:MET:HB3	1:B:165:LEU:HD13	1.93	0.51
1:B:185[B]:GLN:NE2	2:B:427:HOH:O	2.42	0.51
1:B:29:GLY:HA3	1:B:97:ASP:HB3	1.95	0.48
1:B:14:HIS:HD2	1:B:54:ASP:OD2	1.94	0.48
1:B:268:ALA:O	1:B:272[A]:GLU:HG3	2.14	0.48
1:A:146:LYS:HD3	1:A:146:LYS:O	2.14	0.48
1:A:275[A]:GLN:HG2	1:A:276:GLU:N	2.28	0.48
1:A:14:HIS:HD2	1:A:54:ASP:OD2	1.98	0.47
1:B:211:GLU:HG2	1:B:215:ARG:HH22	1.79	0.47
1:A:233:ILE:CG1	1:A:257:ILE:HD11	2.46	0.46
1:B:211:GLU:CG	1:B:215:ARG:HH12	2.28	0.46
1:A:9:ASN:H	1:A:81:GLN:NE2	2.14	0.45
1:A:9:ASN:H	1:A:81:GLN:HE22	1.65	0.45
1:A:145:MET:HE1	1:A:208:ILE:CD1	2.49	0.43
1:B:132:LEU:HD23	1:B:132:LEU:HA	1.87	0.43
1:A:172:PRO:O	1:A:176:LYS:HG3	2.19	0.43
1:B:6:ILE:HG12	1:B:7:ASN:N	2.34	0.43

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:185:GLN:HG2	2:A:533:HOH:O	2.19	0.42
1:A:264:GLU:HB2	2:A:448:HOH:O	2.19	0.42
1:A:75:LEU:O	1:A:78:ASP:HB2	2.19	0.42
1:B:171:ASP:HB2	1:B:172:PRO:HD3	2.01	0.42
1:A:139:GLN:O	1:A:143:GLU:HG3	2.20	0.42
1:A:149:GLN:HE22	1:A:204:ARG:HA	1.86	0.41
1:B:33:PHE:CE2	1:B:35:HIS:HB2	2.55	0.41
1:A:132:LEU:HD23	1:A:132:LEU:HA	1.91	0.41
1:B:110:TYR:HB3	1:B:113:TYR:HD1	1.86	0.41
1:A:146:LYS:HG2	1:A:209:PHE:CD1	2.56	0.41
1:A:39:HIS:HE1	2:A:304:HOH:O	2.03	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	291/320 (91%)	280 (96%)	11 (4%)	0	100	100
1	B	290/320 (91%)	281 (97%)	9 (3%)	0	100	100
All	All	581/640 (91%)	561 (97%)	20 (3%)	0	100	100

There are no Ramachandran outliers to report.

### 5.3.2 Protein sidechains [i](#)

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	266/284 (94%)	260 (98%)	6 (2%)	50	28
1	B	264/284 (93%)	259 (98%)	5 (2%)	57	37
All	All	530/568 (93%)	519 (98%)	11 (2%)	57	31

All (11) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	63	LYS
1	A	146	LYS
1	A	210	THR
1	A	212	GLU
1	A	256	ASN
1	A	271	HIS
1	B	2	SER
1	B	165	LEU
1	B	185[A]	GLN
1	B	185[B]	GLN
1	B	271	HIS

Some sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (20) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	14	HIS
1	A	39	HIS
1	A	81	GLN
1	A	96	HIS
1	A	121	ASN
1	A	138	GLN
1	A	149	GLN
1	A	154	GLN
1	A	205	ASN
1	A	237	ASN
1	A	246	ASN
1	A	256	ASN
1	B	14	HIS
1	B	81	GLN
1	B	96	HIS
1	B	138	GLN
1	B	149	GLN
1	B	154	GLN
1	B	228	ASN

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Mol	Chain	Res	Type
1	B	237	ASN

### 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, 95<sup>th</sup> 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 <sup>2</sup> )	Q<0.9
1	A	287/320 (89%)	0.24	17 (5%) 22 27	15, 26, 47, 70	0
1	B	287/320 (89%)	0.24	12 (4%) 36 42	17, 31, 48, 69	0
All	All	574/640 (89%)	0.24	29 (5%) 28 34	15, 29, 48, 70	0

All (29) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	211	GLU	3.9
1	A	27	LEU	3.4
1	A	102	ILE	3.1
1	A	95	VAL	3.0
1	A	94	VAL	3.0
1	B	46	ASN	2.9
1	B	100	ALA	2.9
1	B	95	VAL	2.9
1	A	215	ARG	2.9
1	B	20	GLN	2.9
1	A	136	LYS	2.8
1	A	98	TRP	2.7
1	B	211	GLU	2.7
1	B	99	GLY	2.6
1	B	96	HIS	2.6
1	B	98	TRP	2.5
1	A	134	THR	2.4
1	A	117	LEU	2.4
1	A	100	ALA	2.3
1	A	156	TYR	2.3
1	A	120	PHE	2.3
1	B	120	PHE	2.3
1	A	132	LEU	2.2
1	A	212	GLU	2.2

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Mol	Chain	Res	Type	RSRZ
1	B	30	PHE	2.2
1	B	27	LEU	2.1
1	A	118	ILE	2.1
1	B	210	THR	2.1
1	A	99	GLY	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.