



# Full wwPDB X-ray Structure Validation Report ⓘ

Sep 12, 2023 – 05:55 AM EDT

PDB ID : 4MV7  
Title : Crystal Structure of Biotin Carboxylase form Haemophilus influenzae in Complex with Phosphonoformate  
Authors : Broussard, T.C.; Pakhomova, S.; Neau, D.B.; Champion, T.S.; Bonnot, R.J.; Waldrop, G.L.  
Deposited on : 2013-09-23  
Resolution : 1.73 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.

The types of validation reports are described at

<http://www.wwpdb.org/validation/2017/FAQs#types>.

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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  
Mogul : 1.8.5 (274361), CSD as541be (2020)  
Xtriage (Phenix) : 1.13  
EDS : 2.35.1  
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) : 2.35.1

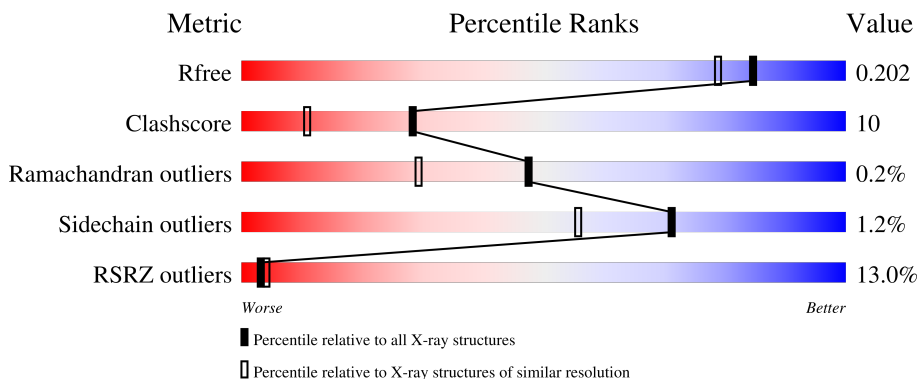
# 1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

*X-RAY DIFFRACTION*

The reported resolution of this entry is 1.73 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	3764 (1.76-1.72)
Clashscore	141614	3923 (1.76-1.72)
Ramachandran outliers	138981	3878 (1.76-1.72)
Sidechain outliers	138945	3878 (1.76-1.72)
RSRZ outliers	127900	3705 (1.76-1.72)

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  $\geq 3$ , 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	468	

## 2 Entry composition

There are 4 unique types of molecules in this entry. The entry contains 6633 atoms, of which 3223 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.

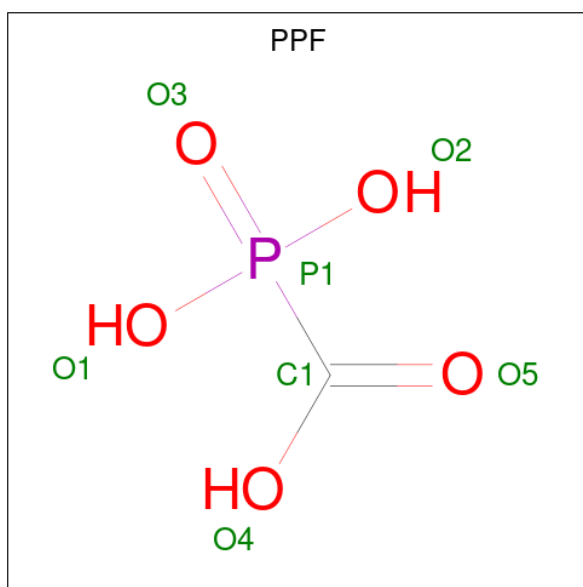
- Molecule 1 is a protein called Biotin carboxylase.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace	
			Total	C	H	N	O				S
1	A	414	6409	2013	3211	564	604	17	0	3	0

There are 20 discrepancies between the modelled and reference sequences:

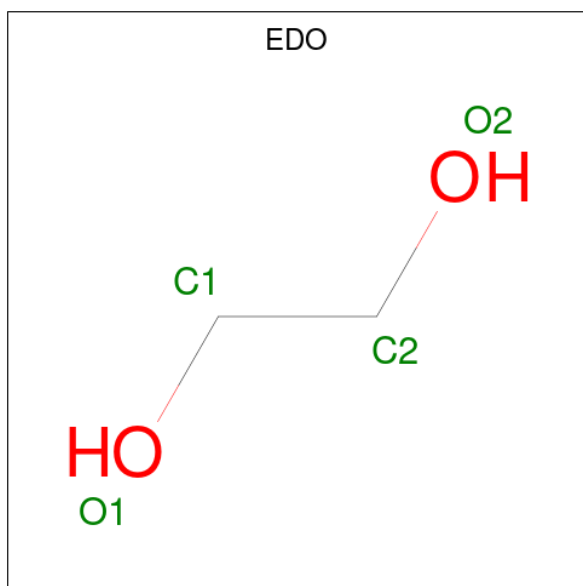
Chain	Residue	Modelled	Actual	Comment	Reference
A	-19	MET	-	expression tag	UNP P43873
A	-18	GLY	-	expression tag	UNP P43873
A	-17	SER	-	expression tag	UNP P43873
A	-16	SER	-	expression tag	UNP P43873
A	-15	HIS	-	expression tag	UNP P43873
A	-14	HIS	-	expression tag	UNP P43873
A	-13	HIS	-	expression tag	UNP P43873
A	-12	HIS	-	expression tag	UNP P43873
A	-11	HIS	-	expression tag	UNP P43873
A	-10	HIS	-	expression tag	UNP P43873
A	-9	SER	-	expression tag	UNP P43873
A	-8	SER	-	expression tag	UNP P43873
A	-7	GLY	-	expression tag	UNP P43873
A	-6	LEU	-	expression tag	UNP P43873
A	-5	VAL	-	expression tag	UNP P43873
A	-4	PRO	-	expression tag	UNP P43873
A	-3	ARG	-	expression tag	UNP P43873
A	-2	GLY	-	expression tag	UNP P43873
A	-1	SER	-	expression tag	UNP P43873
A	0	HIS	-	expression tag	UNP P43873

- Molecule 2 is PHOSPHONOFORMIC ACID (three-letter code: PPF) (formula: CH<sub>3</sub>O<sub>5</sub>P).



Mol	Chain	Residues	Atoms			ZeroOcc	AltConf	
			Total	C	O			P
2	A	1	7	1	5	1	0	0

- Molecule 3 is 1,2-ETHANEDIOL (three-letter code: EDO) (formula:  $C_2H_6O_2$ ).



Mol	Chain	Residues	Atoms			ZeroOcc	AltConf	
			Total	C	H			O
3	A	1	10	2	6	2	0	0
3	A	1	10	2	6	2	0	0

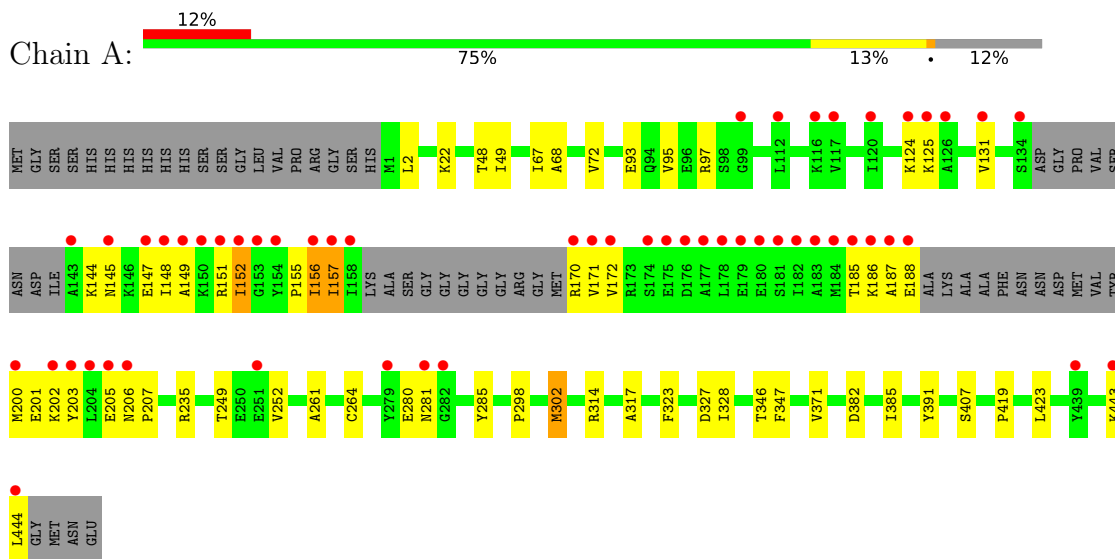
- Molecule 4 is water.

<b>Mol</b>	<b>Chain</b>	<b>Residues</b>	<b>Atoms</b>		<b>ZeroOcc</b>	<b>AltConf</b>
4	A	197	Total 197	O 197	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: Biotin carboxylase



## 4 Data and refinement statistics

Property	Value	Source
Space group	P 64	Depositor
Cell constants a, b, c, $\alpha$ , $\beta$ , $\gamma$	86.01Å 86.01Å 103.14Å 90.00° 90.00° 120.00°	Depositor
Resolution (Å)	43.00 – 1.73 42.40 – 1.73	Depositor EDS
% Data completeness (in resolution range)	97.9 (43.00-1.73) 98.1 (42.40-1.73)	Depositor EDS
$R_{merge}$	(Not available)	Depositor
$R_{sym}$	0.03	Depositor
$\langle I/\sigma(I) \rangle$ <sup>1</sup>	2.02 (at 1.73Å)	Xtrriage
Refinement program	PHENIX (phenix.refine: 1.8.1_1168)	Depositor
R, $R_{free}$	0.175 , 0.203 0.176 , 0.202	Depositor DCC
$R_{free}$ test set	2163 reflections (4.88%)	wwPDB-VP
Wilson B-factor (Å <sup>2</sup> )	30.1	Xtrriage
Anisotropy	0.080	Xtrriage
Bulk solvent $k_{sol}$ (e/Å <sup>3</sup> ), $B_{sol}$ (Å <sup>2</sup> )	0.36 , 48.2	EDS
L-test for twinning <sup>2</sup>	$\langle  L  \rangle = 0.49$ , $\langle L^2 \rangle = 0.32$	Xtrriage
Estimated twinning fraction	0.049 for h,-h-k,-l	Xtrriage
$F_o, F_c$ correlation	0.97	EDS
Total number of atoms	6633	wwPDB-VP
Average B, all atoms (Å <sup>2</sup> )	47.0	wwPDB-VP

Xtrriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 3.93% 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 [i](#)

### 5.1 Standard geometry [i](#)

Bond lengths and bond angles in the following residue types are not validated in this section: EDO, PPF

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	0.43	0/3258	0.62	1/4405 (0.0%)

There are no bond length outliers.

All (1) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	302	MET	CG-SD-CE	-5.58	91.28	100.20

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	3198	3211	3181	63	4
2	A	7	0	0	0	0
3	A	8	12	12	0	0
4	A	197	0	0	6	3
All	All	3410	3223	3193	63	4

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 10.

All (63) 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:148:ILE:HD12	1:A:149:ALA:N	1.80	0.96
1:A:144:LYS:O	1:A:147:GLU:HG2	1.66	0.95
1:A:407:SER:OG	4:A:759:HOH:O	1.91	0.87
1:A:148:ILE:CD1	1:A:200:MET:HE3	2.08	0.84
1:A:148:ILE:HD11	1:A:200:MET:CE	2.09	0.82
1:A:314[B]:ARG:NH2	4:A:676:HOH:O	2.13	0.82
1:A:148:ILE:HD11	1:A:200:MET:HE3	1.65	0.79
1:A:419:PRO:O	1:A:423:LEU:HD13	1.84	0.77
1:A:156:ILE:HG23	1:A:157:ILE:N	2.04	0.72
1:A:144:LYS:O	1:A:147:GLU:CG	2.38	0.71
1:A:148:ILE:CD1	1:A:149:ALA:N	2.53	0.71
1:A:382:ASP:OD2	4:A:619:HOH:O	2.11	0.68
1:A:148:ILE:CD1	1:A:200:MET:CE	2.67	0.68
1:A:156:ILE:CG2	1:A:157:ILE:N	2.57	0.67
1:A:148:ILE:HD12	1:A:148:ILE:C	2.15	0.67
1:A:147:GLU:HG3	1:A:148:ILE:N	2.10	0.66
1:A:131:VAL:HG22	1:A:285:TYR:HB3	1.78	0.66
1:A:148:ILE:HD12	1:A:149:ALA:CA	2.28	0.63
1:A:443:LYS:O	1:A:444:LEU:HB2	1.98	0.62
1:A:144:LYS:O	1:A:148:ILE:HG23	2.01	0.61
1:A:148:ILE:HD13	1:A:200:MET:HE3	1.83	0.60
1:A:148:ILE:HD11	1:A:200:MET:HE1	1.83	0.59
1:A:249:THR:HG21	4:A:745:HOH:O	2.02	0.59
1:A:371:VAL:HG21	1:A:385:ILE:HB	1.87	0.57
1:A:144:LYS:C	1:A:147:GLU:HG2	2.26	0.57
1:A:67:ILE:HD11	1:A:95:VAL:HG22	1.88	0.56
1:A:205:GLU:O	4:A:777:HOH:O	2.17	0.55
1:A:203:TYR:CE2	1:A:205:GLU:HG2	2.41	0.55
1:A:423:LEU:CD1	4:A:790:HOH:O	2.55	0.55
1:A:148:ILE:CG1	1:A:149:ALA:N	2.71	0.54
1:A:155:PRO:HD2	1:A:202:LYS:NZ	2.23	0.54
1:A:298:PRO:O	1:A:302:MET:HG2	2.07	0.54
1:A:186:LYS:O	1:A:188:GLU:N	2.45	0.50
1:A:151:ARG:NH1	1:A:152:ILE:CD1	2.75	0.49
1:A:171:VAL:HG12	1:A:172:VAL:N	2.27	0.49
1:A:391:TYR:CD1	1:A:391:TYR:C	2.86	0.49
1:A:145:ASN:O	1:A:148:ILE:HG13	2.13	0.48
1:A:206:ASN:N	1:A:207:PRO:HD3	2.30	0.47
1:A:157:ILE:HG13	1:A:201:GLU:O	2.15	0.47
1:A:148:ILE:HG13	1:A:149:ALA:H	1.82	0.44
1:A:170:ARG:CB	1:A:185:THR:HG22	2.47	0.44

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:443:LYS:O	1:A:444:LEU:CB	2.65	0.44
1:A:2:LEU:HG	1:A:317:ALA:HB2	1.99	0.44
1:A:68:ALA:O	1:A:72:VAL:HG22	2.18	0.43
1:A:443:LYS:O	1:A:444:LEU:HD23	2.18	0.43
1:A:444:LEU:HD22	1:A:444:LEU:N	2.34	0.43
1:A:346:THR:O	1:A:347:PHE:HB2	2.19	0.43
1:A:93:GLU:O	1:A:97:ARG:HG3	2.19	0.43
1:A:147:GLU:CG	1:A:148:ILE:N	2.79	0.42
1:A:323:PHE:CE1	1:A:328:ILE:HD11	2.55	0.42
1:A:249:THR:HG23	1:A:252:VAL:H	1.83	0.42
1:A:156:ILE:HG23	1:A:157:ILE:H	1.84	0.42
1:A:147:GLU:HG3	1:A:148:ILE:H	1.84	0.42
1:A:201:GLU:O	1:A:202:LYS:C	2.56	0.42
1:A:206:ASN:N	1:A:207:PRO:CD	2.82	0.42
1:A:48:THR:O	1:A:49:ILE:HD13	2.20	0.42
1:A:261:ALA:O	1:A:264:CYS:HB2	2.19	0.41
1:A:280:GLU:O	1:A:281:ASN:C	2.59	0.41
1:A:148:ILE:HD13	1:A:200:MET:CE	2.43	0.41
1:A:323:PHE:CD1	1:A:328:ILE:HD11	2.55	0.41
1:A:155:PRO:HD2	1:A:202:LYS:HZ1	1.85	0.41
1:A:151:ARG:NH1	1:A:152:ILE:HD13	2.36	0.40
1:A:171:VAL:CG1	1:A:172:VAL:N	2.84	0.40

All (4) symmetry-related close contacts are listed below. The label for Atom-2 includes the symmetry operator and encoded unit-cell translations to be applied.

Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:205:GLU:OE1	4:A:787:HOH:O[4_455]	2.00	0.20
1:A:22:LYS:NZ	4:A:759:HOH:O[4_345]	2.13	0.07
1:A:235:ARG:HH22	1:A:327:ASP:OD1[6_564]	1.53	0.07
1:A:125:LYS:O	4:A:785:HOH:O[2_465]	2.14	0.06

## 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	409/468 (87%)	391 (96%)	17 (4%)	1 (0%)	47 29

All (1) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	187	ALA

### 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	336/381 (88%)	332 (99%)	4 (1%)	71 56

All (4) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	124	LYS
1	A	152	ILE
1	A	156	ILE
1	A	157	ILE

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. There are no such sidechains identified.

### 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 monosaccharides in this entry.

## 5.6 Ligand geometry [i](#)

3 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
3	EDO	A	502	-	3,3,3	0.46	0	2,2,2	0.28	0
3	EDO	A	503	-	3,3,3	0.46	0	2,2,2	0.27	0
2	PPF	A	501	-	4,6,6	1.16	0	3,9,9	0.40	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
3	EDO	A	502	-	-	0/1/1/1	-
3	EDO	A	503	-	-	0/1/1/1	-
2	PPF	A	501	-	-	0/0/6/6	-

There are no bond length outliers.

There are no bond angle outliers.

There are no chirality outliers.

There are no torsion outliers.

There are no ring outliers.

No monomer is involved in short contacts.

## 5.7 Other polymers [i](#)

There are no such residues in this entry.

## 5.8 Polymer linkage issues

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	414/468 (88%)	0.70	54 (13%) <b>3</b> <b>4</b>	19, 39, 87, 129	0

All (54) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	183	ALA	9.1
1	A	187	ALA	8.6
1	A	157	ILE	7.8
1	A	200	MET	7.7
1	A	171	VAL	7.2
1	A	148	ILE	6.1
1	A	186	LYS	5.2
1	A	178	LEU	5.1
1	A	152	ILE	4.8
1	A	184	MET	4.8
1	A	143	ALA	4.7
1	A	156	ILE	4.6
1	A	117	VAL	4.4
1	A	180	GLU	4.4
1	A	150	LYS	4.2
1	A	170	ARG	4.1
1	A	206	ASN	4.0
1	A	172	VAL	4.0
1	A	120	ILE	3.8
1	A	281	ASN	3.8
1	A	176	ASP	3.8
1	A	177	ALA	3.6
1	A	182	ILE	3.6
1	A	145	ASN	3.4
1	A	203	TYR	3.4
1	A	149	ALA	3.3
1	A	131	VAL	3.2

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Mol	Chain	Res	Type	RSRZ
1	A	125	LYS	3.2
1	A	153	GLY	3.2
1	A	158	ILE	3.1
1	A	134	SER	3.1
1	A	185	THR	3.1
1	A	99	GLY	3.0
1	A	154	TYR	2.9
1	A	174	SER	2.8
1	A	147	GLU	2.7
1	A	205	GLU	2.7
1	A	439	TYR	2.7
1	A	179	GLU	2.6
1	A	126	ALA	2.4
1	A	116	LYS	2.4
1	A	443	LYS	2.4
1	A	151	ARG	2.4
1	A	251	GLU	2.4
1	A	282	GLY	2.3
1	A	204	LEU	2.3
1	A	175	GLU	2.3
1	A	279	TYR	2.3
1	A	181	SER	2.2
1	A	188	GLU	2.2
1	A	202	LYS	2.1
1	A	112	LEU	2.1
1	A	444	LEU	2.1
1	A	124	LYS	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 monosaccharides 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, 95<sup>th</sup> 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 <sup>2</sup> )	Q<0.9
3	EDO	A	502	4/4	0.73	0.13	62,74,80,82	0
3	EDO	A	503	4/4	0.86	0.27	56,67,67,67	10
2	PPF	A	501	7/7	0.98	0.12	25,26,32,32	0

## 6.5 Other polymers [i](#)

There are no such residues in this entry.