



# Full wwPDB X-ray Structure Validation Report ⓘ

Sep 14, 2023 – 08:45 PM EDT

PDB ID : 1ZCZ  
Title : Crystal structure of Phosphoribosylaminoimidazolecarboxamide formyltransferase / IMP cyclohydrolase (TM1249) from THERMOTOGA MARITIMA at 1.88 Å resolution  
Authors : Joint Center for Structural Genomics (JCSG)  
Deposited on : 2005-04-13  
Resolution : 1.88 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

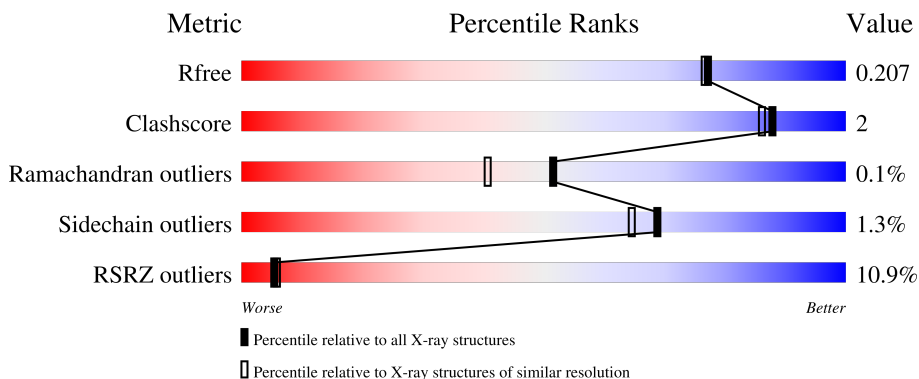
# 1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

*X-RAY DIFFRACTION*

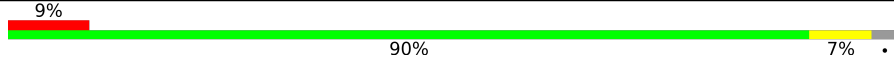
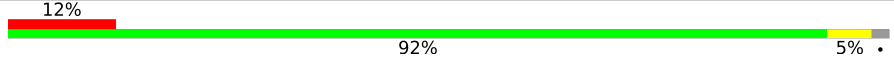
The reported resolution of this entry is 1.88 Å.

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	9470 (1.90-1.86)
Clashscore	141614	10282 (1.90-1.86)
Ramachandran outliers	138981	10152 (1.90-1.86)
Sidechain outliers	138945	10152 (1.90-1.86)
RSRZ outliers	127900	9303 (1.90-1.86)

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	464	
1	B	464	

## 2 Entry composition i

There are 4 unique types of molecules in this entry. The entry contains 7676 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 Bifunctional purine biosynthesis protein purH.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
1	A	452	Total	C	N	O	S	0	6	0
			3503	2259	581	655	8			
1	B	454	Total	C	N	O	S	0	11	0
			3509	2261	582	656	10			

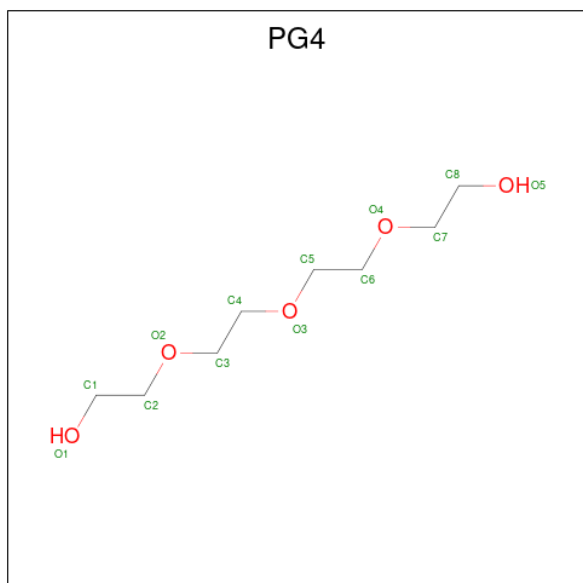
There are 24 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	-11	MET	-	expression tag	UNP Q9X0X6
A	-10	GLY	-	expression tag	UNP Q9X0X6
A	-9	SER	-	expression tag	UNP Q9X0X6
A	-8	ASP	-	expression tag	UNP Q9X0X6
A	-7	LYS	-	expression tag	UNP Q9X0X6
A	-6	ILE	-	expression tag	UNP Q9X0X6
A	-5	HIS	-	expression tag	UNP Q9X0X6
A	-4	HIS	-	expression tag	UNP Q9X0X6
A	-3	HIS	-	expression tag	UNP Q9X0X6
A	-2	HIS	-	expression tag	UNP Q9X0X6
A	-1	HIS	-	expression tag	UNP Q9X0X6
A	0	HIS	-	expression tag	UNP Q9X0X6
B	-11	MET	-	expression tag	UNP Q9X0X6
B	-10	GLY	-	expression tag	UNP Q9X0X6
B	-9	SER	-	expression tag	UNP Q9X0X6
B	-8	ASP	-	expression tag	UNP Q9X0X6
B	-7	LYS	-	expression tag	UNP Q9X0X6
B	-6	ILE	-	expression tag	UNP Q9X0X6
B	-5	HIS	-	expression tag	UNP Q9X0X6
B	-4	HIS	-	expression tag	UNP Q9X0X6
B	-3	HIS	-	expression tag	UNP Q9X0X6
B	-2	HIS	-	expression tag	UNP Q9X0X6
B	-1	HIS	-	expression tag	UNP Q9X0X6
B	0	HIS	-	expression tag	UNP Q9X0X6

- Molecule 2 is POTASSIUM ION (three-letter code: K) (formula: K).

Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
2	A	1	Total K 1 1	0	0
2	B	1	Total K 1 1	0	0

- Molecule 3 is TETRAETHYLENE GLYCOL (three-letter code: PG4) (formula: C<sub>8</sub>H<sub>18</sub>O<sub>5</sub>).



Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
3	A	1	Total C O 13 8 5	0	0
3	B	1	Total C O 13 8 5	0	0

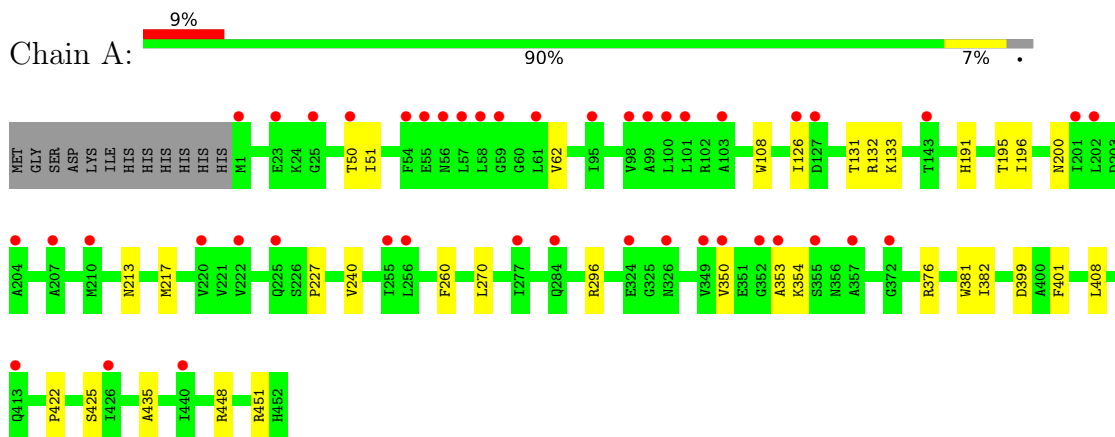
- Molecule 4 is water.

Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
4	A	333	Total O 333 333	0	0
4	B	303	Total O 303 303	0	0

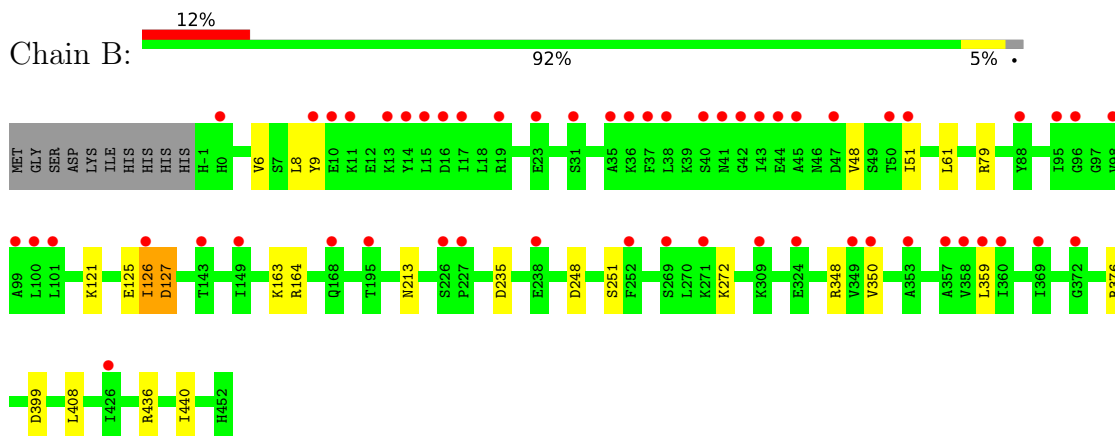
### 3 Residue-property plots [i](#)

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: Bifunctional purine biosynthesis protein purH



- Molecule 1: Bifunctional purine biosynthesis protein purH



## 4 Data and refinement statistics

Property	Value	Source
Space group	P 1	Depositor
Cell constants a, b, c, $\alpha$ , $\beta$ , $\gamma$	62.08Å 58.63Å 72.75Å 99.26° 96.89° 106.13°	Depositor
Resolution (Å)	50.00 – 1.88 29.96 – 1.88	Depositor EDS
% Data completeness (in resolution range)	95.9 (50.00-1.88) 94.6 (29.96-1.88)	Depositor EDS
$R_{merge}$	(Not available)	Depositor
$R_{sym}$	0.06	Depositor
$\langle I/\sigma(I) \rangle$ <sup>1</sup>	2.18 (at 1.88Å)	Xtrriage
Refinement program	REFMAC 5.2.0005	Depositor
R, $R_{free}$	0.156 , 0.197 0.166 , 0.207	Depositor DCC
$R_{free}$ test set	3700 reflections (5.03%)	wwPDB-VP
Wilson B-factor (Å <sup>2</sup> )	31.0	Xtrriage
Anisotropy	0.255	Xtrriage
Bulk solvent $k_{sol}$ (e/Å <sup>3</sup> ), $B_{sol}$ (Å <sup>2</sup> )	0.33 , 49.3	EDS
L-test for twinning <sup>2</sup>	$\langle  L  \rangle = 0.50$ , $\langle L^2 \rangle = 0.33$	Xtrriage
Estimated twinning fraction	No twinning to report.	Xtrriage
$F_o, F_c$ correlation	0.96	EDS
Total number of atoms	7676	wwPDB-VP
Average B, all atoms (Å <sup>2</sup> )	41.0	wwPDB-VP

Xtrriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 5.86% 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: PG4, K

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	0.65	0/3604	0.71	2/4874 (0.0%)
1	B	0.64	0/3638	0.70	4/4926 (0.1%)
All	All	0.64	0/7242	0.70	6/9800 (0.1%)

There are no bond length outliers.

All (6) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	B	436	ARG	NE-CZ-NH1	7.63	124.12	120.30
1	B	399	ASP	CB-CG-OD1	7.46	125.01	118.30
1	A	399	ASP	CB-CG-OD1	6.03	123.72	118.30
1	B	436	ARG	NE-CZ-NH2	-5.88	117.36	120.30
1	B	359	LEU	CA-CB-CG	5.22	127.32	115.30
1	A	132	ARG	NE-CZ-NH2	-5.15	117.73	120.30

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	3503	0	3502	17	0
1	B	3509	0	3451	11	0
2	A	1	0	0	0	0

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Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
2	B	1	0	0	0	0
3	A	13	0	18	0	0
3	B	13	0	18	0	0
4	A	333	0	0	4	0
4	B	303	0	0	0	0
All	All	7676	0	6989	28	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 2.

All (28) 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:408:LEU:HG	1:B:440:ILE:HD11	1.70	0.73
1:A:195:THR:HG23	4:A:533:HOH:O	1.90	0.72
1:B:248:ASP:O	1:B:272:LYS:NZ	2.29	0.66
1:B:251:SER:OG	1:B:272:LYS:NZ	2.32	0.61
1:A:108:TRP:CZ3	1:A:133:LYS:HG3	2.40	0.56
1:A:50[B]:THR:HG23	1:A:51:ILE:HG23	1.89	0.54
1:A:126:ILE:HD13	1:A:131:THR:HB	1.91	0.52
1:A:195:THR:CG2	4:A:533:HOH:O	2.55	0.51
1:B:213:ASN:O	1:B:348:ARG:HD3	2.13	0.49
1:B:48:VAL:O	1:B:51:ILE:HG22	2.12	0.49
1:A:408:LEU:HD21	1:A:435:ALA:HB2	1.95	0.49
1:A:133:LYS:NZ	4:A:573:HOH:O	2.47	0.47
1:B:163:LYS:HD2	1:B:164:ARG:O	2.14	0.47
1:B:121:LYS:O	1:B:125:GLU:HG2	2.15	0.47
1:A:213:ASN:ND2	4:A:579:HOH:O	2.44	0.47
1:A:227:PRO:HD2	1:A:353:ALA:HA	1.96	0.47
1:A:62:VAL:HG22	1:A:62:VAL:O	2.15	0.46
1:A:401:PHE:CD1	1:A:425:SER:HB2	2.51	0.46
1:A:196:ILE:HG13	1:A:200:ASN:CB	2.46	0.45
1:A:240:VAL:HG11	1:A:270:LEU:HD21	1.99	0.43
1:B:6:VAL:HG12	1:B:8:LEU:HG	2.00	0.43
1:A:217:MET:HG3	1:A:260:PHE:CD2	2.54	0.43
1:B:51:ILE:HG12	1:B:79:ARG:CZ	2.49	0.43
1:A:354:LYS:HA	1:A:451:ARG:O	2.20	0.42
1:B:235:ASP:OD1	1:B:235:ASP:C	2.58	0.41
1:B:126:ILE:HG22	1:B:127:ASP:N	2.36	0.41
1:A:381:TRP:CE3	1:A:382:ILE:HG13	2.55	0.41
1:A:422:PRO:HG3	1:A:448:ARG:HA	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	456/464 (98%)	448 (98%)	7 (2%)	1 (0%)	47	37
1	B	463/464 (100%)	453 (98%)	10 (2%)	0	100	100
All	All	919/928 (99%)	901 (98%)	17 (2%)	1 (0%)	51	41

All (1) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	191	HIS

### 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	362/378 (96%)	359 (99%)	3 (1%)	81	80
1	B	360/378 (95%)	354 (98%)	6 (2%)	60	54
All	All	722/756 (96%)	713 (99%)	9 (1%)	69	67

All (9) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	296	ARG
1	A	350	VAL

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Mol	Chain	Res	Type
1	A	376	ARG
1	B	9	TYR
1	B	61	LEU
1	B	126	ILE
1	B	127	ASP
1	B	350	VAL
1	B	376	ARG

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (1) such sidechains are listed below:

Mol	Chain	Res	Type
1	B	56	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 monosaccharides in this entry.

## 5.6 Ligand geometry [i](#)

Of 4 ligands modelled in this entry, 2 are monoatomic - leaving 2 for Mogul analysis.

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	PG4	B	454	-	12,12,12	0.31	0	11,11,11	0.36	0

Mol	Type	Chain	Res	Link	Bond lengths			Bond angles		
					Counts	RMSZ	# Z  > 2	Counts	RMSZ	# Z  > 2
3	PG4	A	454	-	12,12,12	0.37	0	11,11,11	0.58	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	PG4	B	454	-	-	2/10/10/10	-
3	PG4	A	454	-	-	6/10/10/10	-

There are no bond length outliers.

There are no bond angle outliers.

There are no chirality outliers.

All (8) torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
3	A	454	PG4	O3-C5-C6-O4
3	A	454	PG4	O2-C3-C4-O3
3	A	454	PG4	C4-C3-O2-C2
3	A	454	PG4	O1-C1-C2-O2
3	B	454	PG4	C5-C6-O4-C7
3	A	454	PG4	C6-C5-O3-C4
3	A	454	PG4	C1-C2-O2-C3
3	B	454	PG4	O3-C5-C6-O4

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 [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	452/464 (97%)	0.54	44 (9%) <b>7</b> <b>8</b>	32, 39, 49, 60	0
1	B	454/464 (97%)	0.65	55 (12%) <b>4</b> <b>4</b>	32, 39, 49, 60	0
All	All	906/928 (97%)	0.59	99 (10%) <b>5</b> <b>6</b>	32, 39, 49, 60	0

All (99) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	54	PHE	8.8
1	B	38	LEU	6.6
1	B	10	GLU	6.3
1	B	40	SER	6.1
1	B	17	ILE	5.8
1	A	426	ILE	5.7
1	B	14	TYR	5.5
1	A	59	GLY	4.4
1	B	35	ALA	4.4
1	A	57	LEU	4.3
1	A	98	VAL	4.1
1	A	202	LEU	4.0
1	B	37	PHE	3.9
1	B	426	ILE	3.7
1	B	16	ASP	3.7
1	B	98	VAL	3.7
1	A	56	ASN	3.5
1	A	50[A]	THR	3.5
1	B	0	HIS	3.4
1	A	372	GLY	3.4
1	B	9	TYR	3.4
1	B	15	LEU	3.4
1	B	31	SER	3.3
1	B	43	ILE	3.3

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<b>Mol</b>	<b>Chain</b>	<b>Res</b>	<b>Type</b>	<b>RSRZ</b>
1	A	101	LEU	3.3
1	B	41	ASN	3.2
1	B	353	ALA	3.2
1	A	1	MET	3.2
1	B	42	GLY	3.1
1	A	353	ALA	3.1
1	B	23	GLU	3.1
1	A	58	LEU	3.1
1	B	88	TYR	3.1
1	B	99	ALA	3.1
1	B	100	LEU	3.1
1	B	359	LEU	3.0
1	B	372	GLY	3.0
1	B	45	ALA	3.0
1	B	44	GLU	3.0
1	B	143	THR	3.0
1	B	13	LYS	3.0
1	A	413	GLN	2.9
1	A	255	ILE	2.9
1	A	126	ILE	2.9
1	B	95	ILE	2.9
1	A	324	GLU	2.8
1	A	99	ALA	2.8
1	B	195	THR	2.8
1	B	36	LYS	2.8
1	A	350	VAL	2.8
1	B	168	GLN	2.7
1	A	127	ASP	2.7
1	A	352	GLY	2.7
1	A	100	LEU	2.7
1	B	369	ILE	2.6
1	A	355	SER	2.6
1	B	19	ARG	2.6
1	A	284	GLN	2.6
1	B	350	VAL	2.6
1	A	277	ILE	2.5
1	A	220	VAL	2.5
1	B	349	VAL	2.5
1	A	201	ILE	2.5
1	B	360	ILE	2.5
1	B	96	GLY	2.4
1	A	204	ALA	2.4

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Mol	Chain	Res	Type	RSRZ
1	A	210	MET	2.4
1	A	222	VAL	2.4
1	B	126	ILE	2.4
1	A	23	GLU	2.3
1	A	349	VAL	2.3
1	B	101	LEU	2.3
1	B	271	LYS	2.3
1	B	324	GLU	2.3
1	B	238	GLU	2.2
1	A	103	ALA	2.2
1	A	207	ALA	2.2
1	A	357	ALA	2.2
1	B	11	LYS	2.2
1	A	55	GLU	2.2
1	A	95	ILE	2.2
1	B	269	SER	2.2
1	A	440	ILE	2.1
1	B	357	ALA	2.1
1	A	225	GLN	2.1
1	B	226	SER	2.1
1	B	252	PHE	2.1
1	A	143	THR	2.1
1	B	50	THR	2.1
1	B	309	LYS	2.1
1	B	227	PRO	2.1
1	B	47	ASP	2.1
1	B	149	ILE	2.1
1	A	25	GLY	2.0
1	A	256	LEU	2.0
1	B	51	ILE	2.0
1	A	326	ASN	2.0
1	B	358	VAL	2.0
1	A	61	LEU	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	PG4	A	454	13/13	0.91	0.15	34,47,52,52	0
3	PG4	B	454	13/13	0.95	0.12	34,40,47,49	0
2	K	A	453	1/1	0.99	0.09	33,33,33,33	0
2	K	B	453	1/1	1.00	0.12	33,33,33,33	0

## 6.5 Other polymers [i](#)

There are no such residues in this entry.