



# Full wwPDB X-ray Structure Validation Report ⓘ

May 18, 2020 – 09:22 pm BST

PDB ID : 2I3C  
Title : Crystal Structure of an Aspartoacylase from Homo Sapiens  
Authors : Bitto, E.; Wesenberg, G.E.; Phillips Jr., G.N.; McCoy, J.G.; Bingman, C.A.;  
Center for Eukaryotic Structural Genomics (CESG)  
Deposited on : 2006-08-17  
Resolution : 2.80 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 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	:	2.11
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

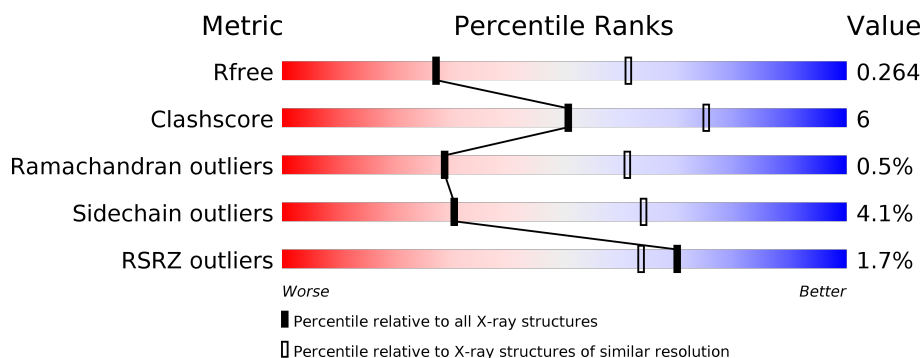
# 1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

## *X-RAY DIFFRACTION*

The reported resolution of this entry is 2.80 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	3140 (2.80-2.80)
Clashscore	141614	3569 (2.80-2.80)
Ramachandran outliers	138981	3498 (2.80-2.80)
Sidechain outliers	138945	3500 (2.80-2.80)
RSRZ outliers	127900	3078 (2.80-2.80)

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	315	<div> <div>2%</div> <div> <div></div> <div>80%</div> <div>15%</div> <div>• •</div> </div> </div>
1	B	315	<div> <div>%</div> <div> <div></div> <div>82%</div> <div>13%</div> <div>• •</div> </div> </div>

## 2 Entry composition

There are 4 unique types of molecules in this entry. The entry contains 4938 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 Aspartoacylase.

Mol	Chain	Residues	Atoms						ZeroOcc	AltConf	Trace
1	A	302	Total	C	N	O	S	Se	0	2	0
			2430	1559	411	447	7	6			
1	B	302	Total	C	N	O	S	Se	0	2	0
			2430	1559	411	447	7	6			

There are 18 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	-1	ALA	-	CLONING ARTIFACT	UNP P45381
A	0	ILE	-	CLONING ARTIFACT	UNP P45381
A	1	ALA	-	CLONING ARTIFACT	UNP P45381
A	82	MSE	MET	MODIFIED RESIDUE	UNP P45381
A	122	MSE	MET	MODIFIED RESIDUE	UNP P45381
A	139	MSE	MET	MODIFIED RESIDUE	UNP P45381
A	195	MSE	MET	MODIFIED RESIDUE	UNP P45381
A	198	MSE	MET	MODIFIED RESIDUE	UNP P45381
A	261	MSE	MET	MODIFIED RESIDUE	UNP P45381
B	-1	ALA	-	CLONING ARTIFACT	UNP P45381
B	0	ILE	-	CLONING ARTIFACT	UNP P45381
B	1	ALA	-	CLONING ARTIFACT	UNP P45381
B	82	MSE	MET	MODIFIED RESIDUE	UNP P45381
B	122	MSE	MET	MODIFIED RESIDUE	UNP P45381
B	139	MSE	MET	MODIFIED RESIDUE	UNP P45381
B	195	MSE	MET	MODIFIED RESIDUE	UNP P45381
B	198	MSE	MET	MODIFIED RESIDUE	UNP P45381
B	261	MSE	MET	MODIFIED RESIDUE	UNP P45381

- Molecule 2 is ZINC ION (three-letter code: ZN) (formula: Zn).

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
2	B	1	Total	Zn	0	0
			1	1		

*Continued on next page...*

*Continued from previous page...*

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
2	A	1	Total	Zn	0	0
			1	1		

- Molecule 3 is PHOSPHATE ION (three-letter code: PO4) (formula: O<sub>4</sub>P).



Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
3	A	1	Total	O	P	0	0
			5	4	1		
3	A	1	Total	O	P	0	0
			5	4	1		
3	A	1	Total	O	P	0	0
			5	4	1		
3	A	1	Total	O	P	0	0
			5	4	1		
3	B	1	Total	O	P	0	0
			5	4	1		
3	B	1	Total	O	P	0	0
			5	4	1		
3	B	1	Total	O	P	0	0
			5	4	1		
3	B	1	Total	O	P	0	0
			5	4	1		

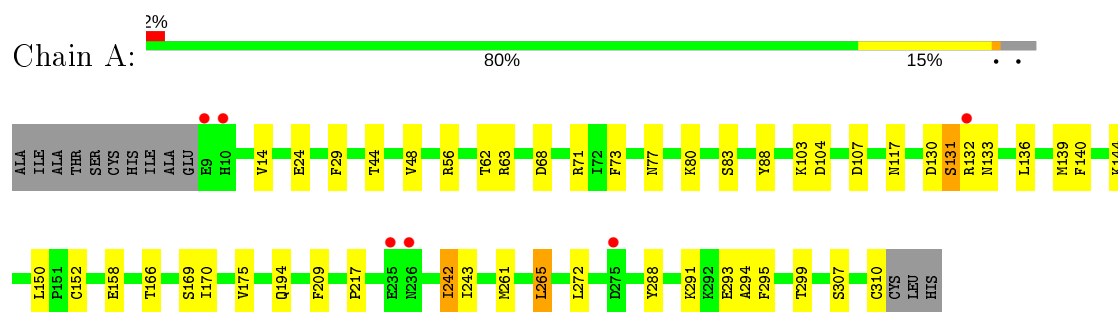
- Molecule 4 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
4	A	14	Total 14	O 14	0	0
4	B	22	Total 22	O 22	0	0

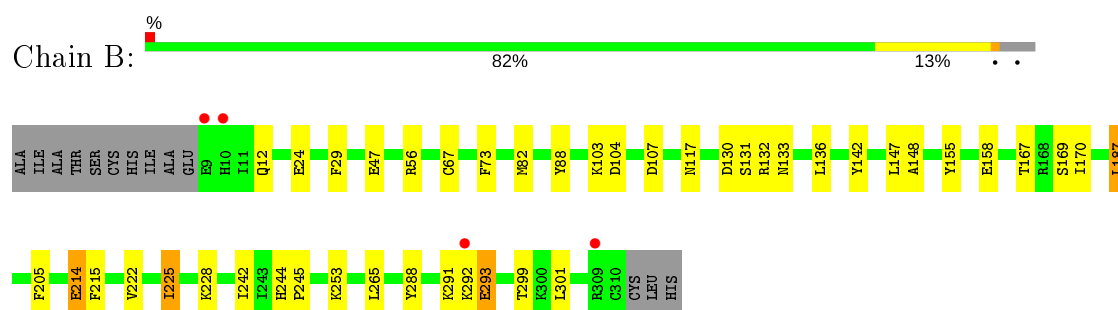
### 3 Residue-property plots [i](#)

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: Aspartoacylase



#### • Molecule 1: Aspartoacylase



## 4 Data and refinement statistics

Property	Value	Source
Space group	P 42 21 2	Depositor
Cell constants a, b, c, $\alpha$ , $\beta$ , $\gamma$	145.55Å 145.55Å 103.40Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	48.72 – 2.80 48.72 – 2.80	Depositor EDS
% Data completeness (in resolution range)	97.8 (48.72-2.80) 97.8 (48.72-2.80)	Depositor EDS
$R_{merge}$	0.16	Depositor
$R_{sym}$	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ <sup>1</sup>	2.58 (at 2.81Å)	Xtriage
Refinement program	REFMAC 5.2.0005	Depositor
R, $R_{free}$	0.195 , 0.243 0.221 , 0.264	Depositor DCC
$R_{free}$ test set	1374 reflections (5.03%)	wwPDB-VP
Wilson B-factor (Å <sup>2</sup> )	53.1	Xtriage
Anisotropy	0.295	Xtriage
Bulk solvent $k_{sol}$ (e/Å <sup>3</sup> ), $B_{sol}$ (Å <sup>2</sup> )	0.34 , 27.5	EDS
L-test for twinning <sup>2</sup>	$\langle  L  \rangle = 0.48$ , $\langle L^2 \rangle = 0.31$	Xtriage
Estimated twinning fraction	No twinning to report.	Xtriage
$F_o, F_c$ correlation	0.92	EDS
Total number of atoms	4938	wwPDB-VP
Average B, all atoms (Å <sup>2</sup> )	47.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 2.68% 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: ZN, PO4

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	0.70	0/2485	0.74	0/3358
1	B	0.77	2/2485 (0.1%)	0.75	1/3358 (0.0%)
All	All	0.74	2/4970 (0.0%)	0.74	1/6716 (0.0%)

All (2) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	B	293	GLU	CG-CD	5.41	1.60	1.51
1	B	67	CYS	CB-SG	-5.37	1.73	1.81

All (1) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	B	187	LEU	CB-CG-CD2	-5.06	102.40	111.00

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	2430	0	2414	36	0
1	B	2430	0	2414	24	0
2	A	1	0	0	0	0

*Continued on next page...*



*Continued from previous page...*

Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
2	B	1	0	0	0	0
3	A	20	0	0	1	0
3	B	20	0	0	0	0
4	A	14	0	0	0	0
4	B	22	0	0	1	0
All	All	4938	0	4828	55	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 (55) 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:261:MSE:HE2	1:A:295:PHE:CZ	1.85	1.10
1:A:261:MSE:HE2	1:A:295:PHE:HZ	1.08	1.08
1:A:242:ILE:HG21	1:B:187:LEU:HD23	1.43	0.97
1:A:261:MSE:CE	1:A:295:PHE:HZ	1.92	0.81
1:A:63:ARG:HG3	1:A:63:ARG:HH11	1.50	0.75
1:A:139:MSE:HE2	1:A:140:PHE:CE1	2.21	0.75
1:A:242:ILE:HG21	1:B:187:LEU:CD2	2.17	0.74
1:A:130:ASP:HB3	1:A:133:ASN:HB2	1.75	0.69
1:B:47:GLU:HG3	1:B:47:GLU:O	1.91	0.69
1:A:139:MSE:HE2	1:A:140:PHE:HE1	1.57	0.68
1:A:242:ILE:CG2	1:B:187:LEU:HD23	2.23	0.66
1:A:24:GLU:HG2	1:A:117:ASN:HB2	1.77	0.65
1:B:130:ASP:HB3	1:B:133:ASN:HB2	1.79	0.64
1:B:24:GLU:HG2	1:B:117:ASN:HB2	1.81	0.61
1:A:68:ASP:OD2	3:A:316:PO4:O2	2.22	0.58
1:A:56:ARG:HD3	1:A:88:TYR:CE1	2.39	0.58
1:A:103:LYS:O	1:A:104:ASP:HB2	2.02	0.57
1:A:139:MSE:CE	1:A:140:PHE:HE1	2.18	0.56
1:B:288:TYR:CD2	1:B:293:GLU:OE2	2.60	0.54
1:B:103:LYS:HG3	1:B:170:ILE:HA	1.90	0.54
1:A:261:MSE:HE3	1:A:272:LEU:HD13	1.89	0.53
1:B:228:LYS:HG2	1:B:293:GLU:OE1	2.09	0.53
1:B:228:LYS:NZ	4:B:329:HOH:O	2.42	0.52
1:A:63:ARG:NH1	1:A:63:ARG:HG3	2.22	0.50
1:A:261:MSE:HE2	1:A:295:PHE:CE1	2.42	0.50
1:A:29:PHE:HE2	1:B:265:LEU:HG	1.76	0.49
1:B:103:LYS:HE3	1:B:169:SER:OG	2.13	0.49
1:A:77:ASN:O	1:A:80:LYS:HG2	2.11	0.49

*Continued on next page...*

*Continued from previous page...*

Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:B:155:TYR:OH	1:B:225:ILE:HB	2.14	0.48
1:A:131:SER:HB3	1:A:158:GLU:OE2	2.14	0.48
1:B:288:TYR:HB3	1:B:293:GLU:HB3	1.95	0.48
1:A:243:ILE:HD11	1:A:294:ALA:HB1	1.96	0.47
1:A:139:MSE:CE	1:A:140:PHE:CE1	2.97	0.46
1:B:56:ARG:HD3	1:B:88:TYR:CE1	2.50	0.46
1:A:29:PHE:CE2	1:B:265:LEU:HG	2.50	0.45
1:A:217:PRO:HD3	1:A:307:SER:HB3	1.98	0.45
1:A:139:MSE:HE2	1:A:140:PHE:CD1	2.51	0.45
1:A:150:LEU:HD21	1:A:194:GLN:HG2	1.97	0.45
1:B:244:HIS:ND1	1:B:245:PRO:HD2	2.31	0.45
1:A:139:MSE:HE1	1:A:175:VAL:HG21	1.98	0.44
1:B:103:LYS:O	1:B:104:ASP:HB2	2.18	0.44
1:B:133:ASN:ND2	1:B:136:LEU:HD12	2.33	0.43
1:B:214:GLU:HG3	1:B:215:PHE:N	2.33	0.43
1:A:265:LEU:HG	1:A:265:LEU:H	1.61	0.42
1:A:288:TYR:HB3	1:A:293:GLU:HB3	2.01	0.42
1:A:166:THR:OG1	1:A:169:SER:HB3	2.20	0.42
1:B:222:VAL:HG23	1:B:301:LEU:HD23	2.02	0.42
1:B:73:PHE:CD1	1:B:167:THR:HA	2.55	0.41
1:B:147:LEU:O	1:B:148:ALA:C	2.59	0.41
1:B:142:TYR:CD2	1:B:205:PHE:HB2	2.55	0.41
1:A:144:LYS:HE2	1:A:152:CYS:O	2.20	0.41
1:A:73:PHE:CE2	1:A:170:ILE:HD11	2.55	0.41
1:A:136:LEU:HD23	1:A:136:LEU:HA	1.97	0.41
1:A:14:VAL:HG12	1:A:48:VAL:HG13	2.02	0.40
1:A:209:PHE:O	1:A:310:CYS:HB2	2.21	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	300/315 (95%)	284 (95%)	15 (5%)	1 (0%)	41	72
1	B	300/315 (95%)	283 (94%)	15 (5%)	2 (1%)	22	53
All	All	600/630 (95%)	567 (94%)	30 (5%)	3 (0%)	29	61

All (3) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	291	LYS
1	B	292	LYS
1	B	291	LYS

### 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	267/271 (98%)	257 (96%)	10 (4%)	34	68
1	B	267/271 (98%)	255 (96%)	12 (4%)	27	60
All	All	534/542 (98%)	512 (96%)	22 (4%)	30	64

All (22) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	44	THR
1	A	62	THR
1	A	71	ARG
1	A	83	SER
1	A	107	ASP
1	A	131	SER
1	A	132	ARG
1	A	242	ILE
1	A	265	LEU
1	A	299	THR
1	B	12	GLN
1	B	29	PHE
1	B	82	MSE

*Continued on next page...*

*Continued from previous page...*

Mol	Chain	Res	Type
1	B	107	ASP
1	B	131	SER
1	B	132	ARG
1	B	158	GLU
1	B	214	GLU
1	B	225	ILE
1	B	242	ILE
1	B	253	LYS
1	B	299	THR

Some sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (2) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	12	GLN
1	B	12	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](#)

Of 10 ligands modelled in this entry, 2 are monoatomic - leaving 8 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	PO4	B	317	-	4,4,4	0.93	0	6,6,6	0.65	0
3	PO4	A	315	2	4,4,4	0.86	0	6,6,6	1.01	1 (16%)
3	PO4	A	318	-	4,4,4	0.74	0	6,6,6	0.57	0
3	PO4	A	316	-	4,4,4	0.99	0	6,6,6	1.05	0
3	PO4	B	316	-	4,4,4	0.88	0	6,6,6	1.38	1 (16%)
3	PO4	B	318	-	4,4,4	0.66	0	6,6,6	0.85	0
3	PO4	B	315	2	4,4,4	1.20	0	6,6,6	0.88	0
3	PO4	A	317	-	4,4,4	0.83	0	6,6,6	0.82	0

There are no bond length outliers.

All (2) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
3	B	316	PO4	O3-P-O2	2.03	114.47	107.97
3	A	315	PO4	O4-P-O2	2.01	114.41	107.97

There are no chirality outliers.

There are no torsion outliers.

There are no ring outliers.

1 monomer is involved in 1 short contact:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
3	A	316	PO4	1	0

## 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, 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	296/315 (93%)	0.04	6 (2%) 65 56	33, 45, 59, 80	0
1	B	296/315 (93%)	-0.02	4 (1%) 75 70	33, 45, 59, 80	0
All	All	592/630 (93%)	0.01	10 (1%) 70 63	33, 45, 59, 80	0

All (10) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	B	9	GLU	4.3
1	A	9	GLU	3.5
1	A	236	ASN	3.2
1	A	132	ARG	3.1
1	A	235	GLU	2.9
1	A	10	HIS	2.8
1	B	292	LYS	2.7
1	A	275	ASP	2.4
1	B	309	ARG	2.1
1	B	10	HIS	2.1

### 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](#)

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	PO4	B	317	5/5	0.85	0.20	81,85,90,91	0
3	PO4	B	318	5/5	0.91	0.16	70,76,80,81	0
3	PO4	A	318	5/5	0.92	0.20	88,90,92,93	0
3	PO4	A	317	5/5	0.95	0.12	66,70,73,74	0
3	PO4	B	315	5/5	0.96	0.22	47,55,66,68	0
3	PO4	A	316	5/5	0.97	0.12	37,37,48,50	0
3	PO4	A	315	5/5	0.98	0.20	49,54,62,64	0
3	PO4	B	316	5/5	0.98	0.13	38,41,49,49	0
2	ZN	A	314	1/1	0.99	0.15	41,41,41,41	0
2	ZN	B	314	1/1	0.99	0.16	41,41,41,41	0

## 6.5 Other polymers [i](#)

There are no such residues in this entry.