



# Full wwPDB X-ray Structure Validation Report ⓘ

Feb 13, 2017 – 09:43 pm GMT

PDB ID : 4NQ8  
Title : Crystal structure of a trap periplasmic solute binding protein from *Bordetella bronchiseptica* (bb3421), target EFI-510039, with density modeled as pantoate  
Authors : Vetting, M.W.; Al Obaidi, N.F.; Morisco, L.L.; Wasserman, S.R.; Sojitra, S.; Stead, M.; Attonito, J.D.; Scott Glenn, A.; Chowdhury, S.; Evans, B.; Hillerich, B.; Love, J.; Seidel, R.D.; Imker, H.J.; Gerlt, J.A.; Almo, S.C.; Enzyme Function Initiative (EFI)  
Deposited on : 2013-11-24  
Resolution : 1.50 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

<http://wwpdb.org/validation/2016/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  
Mogul : 1.7.2 (RC1), CSD as538be (2017)  
Xtriage (Phenix) : 1.9-1692  
EDS : trunk28620  
Percentile statistics : 20161228.v01 (using entries in the PDB archive December 28th 2016)  
Refmac : 5.8.0135  
CCP4 : 6.5.0  
Ideal geometry (proteins) : Engh & Huber (2001)  
Ideal geometry (DNA, RNA) : Parkinson et al. (1996)  
Validation Pipeline (wwPDB-VP) : recalc28949

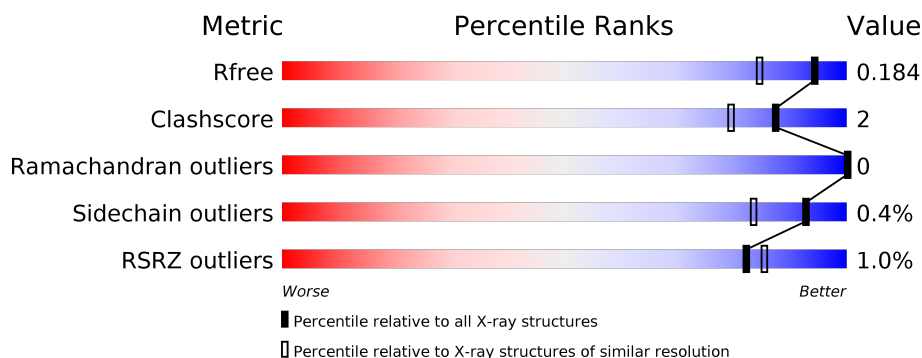
# 1 Overall quality at a glance ⓘ

The following experimental techniques were used to determine the structure:

## *X-RAY DIFFRACTION*

The reported resolution of this entry is 1.50 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))
$R_{free}$	100719	2279 (1.50-1.50)
Clashscore	112137	2503 (1.50-1.50)
Ramachandran outliers	110173	2445 (1.50-1.50)
Sidechain outliers	110143	2443 (1.50-1.50)
RSRZ outliers	101464	2305 (1.50-1.50)

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. 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	342	<div> <div style="width: 100%; height: 10px; position: relative;"> <div style="position: absolute; top: -10px; left: 0; width: 100%; text-align: center;">%</div> <div style="position: absolute; top: 10px; left: 0; width: 100%; text-align: center;">84%</div> <div style="position: absolute; top: 10px; right: 0; width: 100%; text-align: right;">12%</div> </div> </div>
1	B	342	<div> <div style="width: 100%; height: 10px; position: relative;"> <div style="position: absolute; top: -10px; left: 0; width: 100%; text-align: center;">%</div> <div style="position: absolute; top: 10px; left: 0; width: 100%; text-align: center;">84%</div> <div style="position: absolute; top: 10px; right: 0; width: 100%; text-align: right;">12%</div> </div> </div>

The following table lists non-polymeric compounds, carbohydrate monomers and non-standard residues in protein, DNA, RNA chains that are outliers for geometric or electron-density-fit criteria:

Mol	Type	Chain	Res	Chirality	Geometry	Clashes	Electron density
3	SO4	A	402	-	-	-	X
4	CL	A	404	-	-	-	X

## 2 Entry composition

There are 5 unique types of molecules in this entry. The entry contains 9883 atoms, of which 4584 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 Putative periplasmic substrate-binding transport protein.

Mol	Chain	Residues	Atoms						ZeroOcc	AltConf	Trace
1	A	300	Total	C	H	N	O	S	0	0	0
			4544	1438	2276	388	436	6			
1	B	301	Total	C	H	N	O	S	0	1	0
			4596	1451	2308	393	438	6			

There are 36 discrepancies between the modelled and reference sequences:

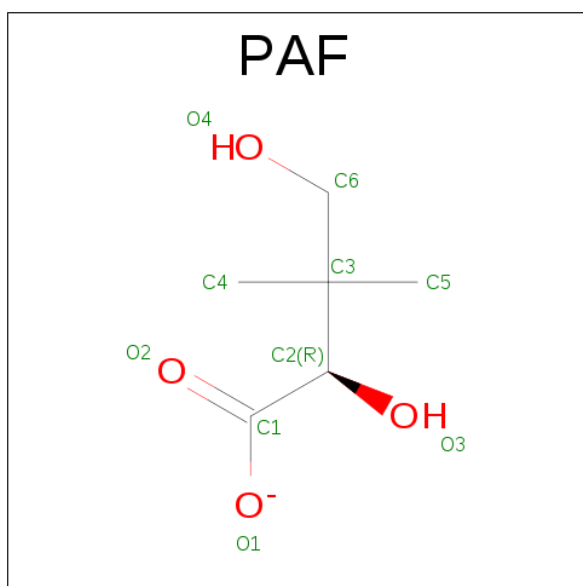
Chain	Residue	Modelled	Actual	Comment	Reference
A	325	ALA	-	EXPRESSION TAG	UNP Q7WGZ0
A	326	GLU	-	EXPRESSION TAG	UNP Q7WGZ0
A	327	ASN	-	EXPRESSION TAG	UNP Q7WGZ0
A	328	LEU	-	EXPRESSION TAG	UNP Q7WGZ0
A	329	TYR	-	EXPRESSION TAG	UNP Q7WGZ0
A	330	PHE	-	EXPRESSION TAG	UNP Q7WGZ0
A	331	GLN	-	EXPRESSION TAG	UNP Q7WGZ0
A	332	GLY	-	EXPRESSION TAG	UNP Q7WGZ0
A	333	HIS	-	EXPRESSION TAG	UNP Q7WGZ0
A	334	HIS	-	EXPRESSION TAG	UNP Q7WGZ0
A	335	HIS	-	EXPRESSION TAG	UNP Q7WGZ0
A	336	HIS	-	EXPRESSION TAG	UNP Q7WGZ0
A	337	HIS	-	EXPRESSION TAG	UNP Q7WGZ0
A	338	HIS	-	EXPRESSION TAG	UNP Q7WGZ0
A	339	HIS	-	EXPRESSION TAG	UNP Q7WGZ0
A	340	HIS	-	EXPRESSION TAG	UNP Q7WGZ0
A	341	HIS	-	EXPRESSION TAG	UNP Q7WGZ0
A	342	HIS	-	EXPRESSION TAG	UNP Q7WGZ0
B	325	ALA	-	EXPRESSION TAG	UNP Q7WGZ0
B	326	GLU	-	EXPRESSION TAG	UNP Q7WGZ0
B	327	ASN	-	EXPRESSION TAG	UNP Q7WGZ0
B	328	LEU	-	EXPRESSION TAG	UNP Q7WGZ0
B	329	TYR	-	EXPRESSION TAG	UNP Q7WGZ0
B	330	PHE	-	EXPRESSION TAG	UNP Q7WGZ0
B	331	GLN	-	EXPRESSION TAG	UNP Q7WGZ0

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Chain	Residue	Modelled	Actual	Comment	Reference
B	332	GLY	-	EXPRESSION TAG	UNP Q7WGZ0
B	333	HIS	-	EXPRESSION TAG	UNP Q7WGZ0
B	334	HIS	-	EXPRESSION TAG	UNP Q7WGZ0
B	335	HIS	-	EXPRESSION TAG	UNP Q7WGZ0
B	336	HIS	-	EXPRESSION TAG	UNP Q7WGZ0
B	337	HIS	-	EXPRESSION TAG	UNP Q7WGZ0
B	338	HIS	-	EXPRESSION TAG	UNP Q7WGZ0
B	339	HIS	-	EXPRESSION TAG	UNP Q7WGZ0
B	340	HIS	-	EXPRESSION TAG	UNP Q7WGZ0
B	341	HIS	-	EXPRESSION TAG	UNP Q7WGZ0
B	342	HIS	-	EXPRESSION TAG	UNP Q7WGZ0

- Molecule 2 is PANTOATE (three-letter code: PAF) (formula:  $C_6H_{11}O_4$ ).



Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
2	A	1	Total	C	O	0	0
			10	6	4		
2	B	1	Total	C	O	0	0
			10	6	4		

- Molecule 3 is SULFATE ION (three-letter code: SO4) (formula:  $O_4S$ ).



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

- Molecule 4 is CHLORIDE ION (three-letter code: CL) (formula: Cl).

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
4	B	1	Total	Cl	0	0
			1	1		
4	A	1	Total	Cl	0	0
			1	1		

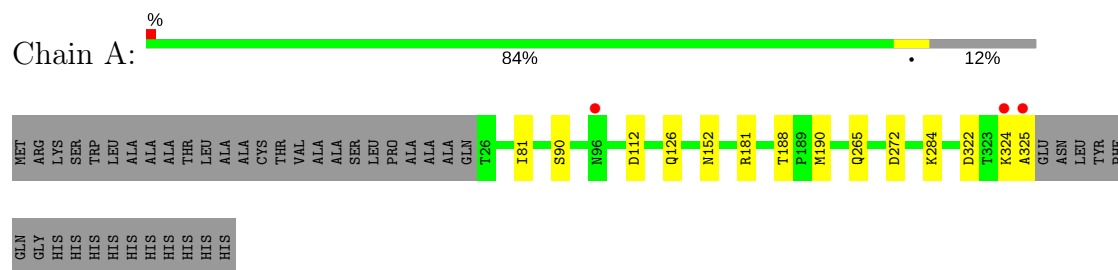
- Molecule 5 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
5	A	373	Total	O	0	0
			373	373		
5	B	338	Total	O	0	0
			338	338		

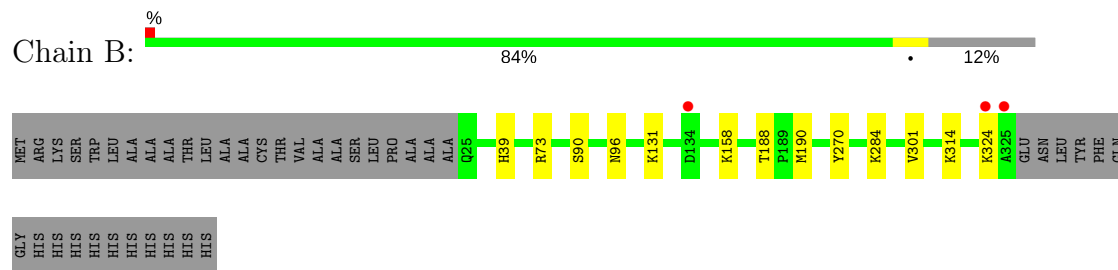
### 3 Residue-property plots [i](#)

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: Putative periplasmic substrate-binding transport protein



- Molecule 1: Putative periplasmic substrate-binding transport protein



## 4 Data and refinement statistics

Property	Value	Source
Space group	P 1	Depositor
Cell constants a, b, c, $\alpha$ , $\beta$ , $\gamma$	39.00Å 56.35Å 75.61Å 99.21° 92.01° 106.23°	Depositor
Resolution (Å)	25.30 – 1.50 25.30 – 1.50	Depositor EDS
% Data completeness (in resolution range)	91.2 (25.30-1.50) 85.3 (25.30-1.50)	Depositor EDS
$R_{merge}$	0.07	Depositor
$R_{sym}$	0.07	Depositor
$\langle I/\sigma(I) \rangle$ <sup>1</sup>	1.95 (at 1.50Å)	Xtriage
Refinement program	PHENIX (phenix.refine: 1.8.1_1168)	Depositor
R, $R_{free}$	0.158 , 0.184 0.158 , 0.184	Depositor DCC
$R_{free}$ test set	4379 reflections (4.93%)	DCC
Wilson B-factor (Å <sup>2</sup> )	16.3	Xtriage
Anisotropy	0.319	Xtriage
Bulk solvent $k_{sol}$ (e/Å <sup>3</sup> ), $B_{sol}$ (Å <sup>2</sup> )	0.41 , 46.9	EDS
L-test for twinning <sup>2</sup>	$\langle  L  \rangle = 0.49$ , $\langle L^2 \rangle = 0.32$	Xtriage
Estimated twinning fraction	No twinning to report.	Xtriage
$F_o, F_c$ correlation	0.97	EDS
Total number of atoms	9883	wwPDB-VP
Average B, all atoms (Å <sup>2</sup> )	21.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 9.55% 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: SO4, PAF, CL

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	0.51	0/2310	0.62	0/3131
1	B	0.49	0/2330	0.59	0/3155
All	All	0.50	0/4640	0.60	0/6286

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 [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	2268	2276	2270	12	2
1	B	2288	2308	2302	10	2
2	A	10	0	11	1	0
2	B	10	0	11	1	0
3	A	10	0	0	0	0
4	A	1	0	0	1	0
4	B	1	0	0	0	0
5	A	373	0	0	6	0
5	B	338	0	0	7	0
All	All	5299	4584	4594	22	2

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 (22) 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:272:ASP:OD1	5:A:742:HOH:O	2.04	0.75
1:B:73:ARG:NE	5:B:605:HOH:O	2.20	0.74
1:B:158:LYS:O	5:B:819:HOH:O	2.13	0.65
1:B:131:LYS:NZ	5:B:733:HOH:O	2.30	0.62
1:A:322:ASP:OD2	5:A:789:HOH:O	2.16	0.60
1:A:265:GLN:HG2	5:A:868:HOH:O	2.05	0.56
1:B:73:ARG:CZ	5:B:605:HOH:O	2.52	0.54
1:A:181:ARG:NE	5:A:582:HOH:O	2.34	0.53
1:A:322:ASP:OD1	5:A:784:HOH:O	2.18	0.51
1:B:90:SER:HB3	2:B:401:PAF:O4	2.12	0.50
1:A:284:LYS:HD3	5:A:695:HOH:O	2.13	0.49
1:B:96:ASN:HB2	5:B:813:HOH:O	2.13	0.48
1:A:126:GLN:NE2	4:A:404:CL:CL	2.76	0.47
1:B:314:LYS:HG2	5:B:720:HOH:O	2.13	0.46
1:A:90:SER:HB3	2:A:401:PAF:O4	2.15	0.46
1:B:188:THR:HG22	1:B:190:MET:HG3	2.01	0.43
1:A:324:LYS:O	1:A:325:ALA:HB3	2.19	0.42
1:B:39:HIS:HB3	1:B:270:TYR:CD1	2.55	0.42
1:A:324:LYS:O	1:A:325:ALA:CB	2.68	0.42
1:B:284:LYS:HG3	5:B:627:HOH:O	2.19	0.41
1:A:188:THR:HG22	1:A:190:MET:HG3	2.03	0.41
1:A:81:ILE:HG22	1:A:81:ILE:O	2.20	0.41

All (2) 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:112:ASP:OD2	1:B:324:LYS:HZ1[1_556]	1.39	0.21
1:A:112:ASP:OD2	1:B:324:LYS:NZ[1_556]	2.11	0.09

## 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	298/342 (87%)	295 (99%)	3 (1%)	0	100	100
1	B	300/342 (88%)	297 (99%)	3 (1%)	0	100	100
All	All	598/684 (87%)	592 (99%)	6 (1%)	0	100	100

There are no Ramachandran outliers to report.

### 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	233/266 (88%)	232 (100%)	1 (0%)	93	83
1	B	236/266 (89%)	235 (100%)	1 (0%)	93	83
All	All	469/532 (88%)	467 (100%)	2 (0%)	93	83

All (2) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	152	ASN
1	B	301	VAL

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

### 5.3.3 RNA ⓘ

There are no RNA molecules in this entry.

## 5.4 Non-standard residues in protein, DNA, RNA chains ⓘ

There are no non-standard protein/DNA/RNA residues in this entry.

## 5.5 Carbohydrates

There are no carbohydrates in this entry.

## 5.6 Ligand geometry

Of 6 ligands modelled in this entry, 2 are monoatomic - leaving 4 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	$\# Z  > 2$
2	PAF	A	401	-	5,9,9	2.29	2 (40%)	7,13,13	2.11	1 (14%)
3	SO4	A	402	-	4,4,4	0.35	0	6,6,6	0.29	0
3	SO4	A	403	-	4,4,4	0.23	0	6,6,6	0.12	0
2	PAF	B	401	-	5,9,9	1.86	2 (40%)	7,13,13	2.65	2 (28%)

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
2	PAF	A	401	-	-	0/9/13/13	0/0/0/0
3	SO4	A	402	-	-	0/0/0/0	0/0/0/0
3	SO4	A	403	-	-	0/0/0/0	0/0/0/0
2	PAF	B	401	-	-	0/9/13/13	0/0/0/0

All (4) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
2	A	401	PAF	C3-C2	-4.26	1.51	1.55
2	B	401	PAF	C3-C2	-3.09	1.52	1.55
2	B	401	PAF	C4-C3	-2.45	1.48	1.53
2	A	401	PAF	C4-C3	-2.16	1.49	1.53

All (3) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
2	B	401	PAF	C3-C2-C1	-6.14	109.94	115.58
2	A	401	PAF	C3-C2-C1	-4.66	111.30	115.58
2	B	401	PAF	C5-C3-C6	-2.23	104.94	109.06

There are no chirality outliers.

There are no torsion outliers.

There are no ring outliers.

2 monomers are involved in 2 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
2	A	401	PAF	1	0
2	B	401	PAF	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	300/342 (87%)	-0.41	3 (1%) 82 85	9, 16, 29, 51	0
1	B	301/342 (88%)	-0.32	3 (0%) 82 85	10, 18, 33, 50	0
All	All	601/684 (87%)	-0.37	6 (0%) 82 85	9, 17, 33, 51	0

All (6) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	325	ALA	5.9
1	B	325	ALA	4.4
1	B	324	LYS	2.8
1	B	134	ASP	2.7
1	A	324	LYS	2.6
1	A	96	ASN	2.2

### 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. LLDF column lists the quality of electron density of the group with respect to its neighbouring residues in protein, DNA or RNA chains. 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	LLDF	B-factors( $\text{\AA}^2$ )	Q<0.9
3	SO4	A	402	5/5	0.90	0.24	6.15	37,38,41,44	0
4	CL	A	404	1/1	0.98	0.15	2.95	33,33,33,33	0
2	PAF	A	401	10/10	0.96	0.12	1.96	12,14,17,17	0
2	PAF	B	401	10/10	0.96	0.09	1.40	13,15,16,18	0
4	CL	B	402	1/1	0.99	0.12	-	31,31,31,31	0
3	SO4	A	403	5/5	0.94	0.26	-	54,59,61,64	0

## 6.5 Other polymers [i](#)

There are no such residues in this entry.