



# wwPDB X-ray Structure Validation Summary Report ⓘ

Mar 4, 2026 – 09:47 PM UTC

PDB ID : 6BPG / pdb\_00006bpg  
Title : Crystal structure of betaine aldehyde dehydrogenase from *Pseudomonas aeruginosa* with bound rubidium ions  
Authors : Lopez-Orduna, E.F.; Munoz-Clares, R.A.; Gonzalez-Segura, L.  
Deposited on : 2017-11-23  
Resolution : 3.09 Å(reported)

This is a wwPDB X-ray Structure Validation Summary 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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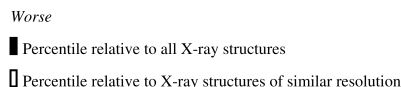
The following versions of software and data (see [references ⓘ](#)) were used in the production of this report:

MolProbity	:	4-5-2 with Phenix2.0
Xtriage (Phenix)	:	2.0
EDS	:	3.0
Percentile statistics	:	20250101.v01 (using entries in the PDB archive January 1st 2025)
CCP4	:	9.0.010 (Gargrove)
Density-Fitness	:	1.0.12
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, RNA)	:	Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP)	:	2.49

**i**

## X-RAY DIFFRACTION

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))
$R_{free}$	180053	2010 (3.10-3.06)
Clashscore	190562	2102 (3.10-3.06)
Ramachandran outliers	187476	1982 (3.10-3.06)
Sidechain outliers	187428	1981 (3.10-3.06)
RSRZ outliers	180081	2010 (3.10-3.06)

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	490	<div><div></div></div> 84%	16%
1	B	490	<div><div></div></div> 82%	17%
1	C	490	<div><div></div></div> 81%	18%
1	D	490	<div><div></div></div> 82%	17%
1	E	490	<div><div></div></div> 83%	17%

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Mol	Chain	Length	Quality of chain	
1	F	490		
1	G	490		
1	H	490		

## 2 Entry composition

There are 2 unique types of molecules in this entry. The entry contains 29968 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 NAD/NADP-dependent betaine aldehyde dehydrogenase.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	489	Total	C	N	O	S	0	0	0
			3744	2351	657	722	14			
1	B	489	Total	C	N	O	S	0	0	0
			3744	2351	657	722	14			
1	C	489	Total	C	N	O	S	0	0	0
			3744	2351	657	722	14			
1	D	489	Total	C	N	O	S	0	0	0
			3744	2351	657	722	14			
1	E	489	Total	C	N	O	S	0	0	0
			3744	2351	657	722	14			
1	F	489	Total	C	N	O	S	0	0	0
			3744	2351	657	722	14			
1	G	489	Total	C	N	O	S	0	0	0
			3744	2351	657	722	14			
1	H	489	Total	C	N	O	S	0	0	0
			3744	2351	657	722	14			

- Molecule 2 is RUBIDIUM ION (CCD ID: RB) (formula: Rb).

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
2	A	2	Total	Rb	0	0
			2	2		
2	B	2	Total	Rb	0	0
			2	2		
2	C	2	Total	Rb	0	0
			2	2		
2	D	2	Total	Rb	0	0
			2	2		
2	E	2	Total	Rb	0	0
			2	2		
2	F	2	Total	Rb	0	0
			2	2		

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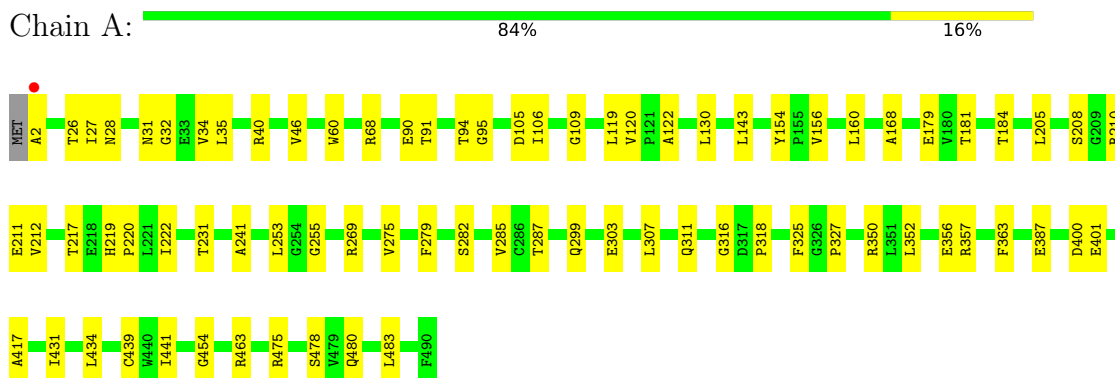
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Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
2	G	3	Total 3	Rb 3	0	0
2	H	1	Total 1	Rb 1	0	0

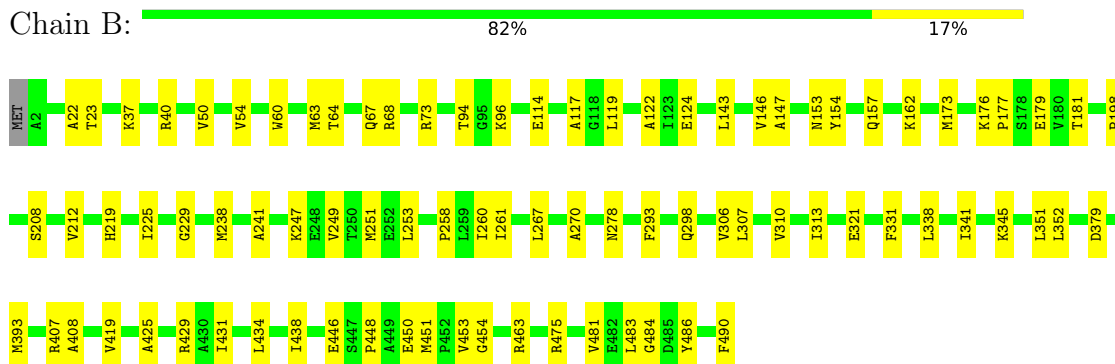
### 3 Residue-property plots

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.

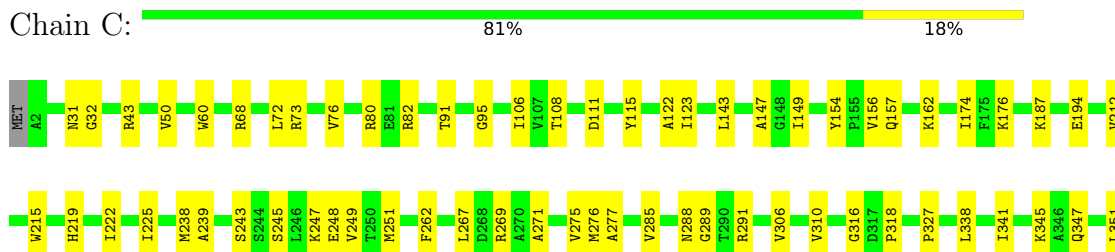
- Molecule 1: NAD/NADP-dependent betaine aldehyde dehydrogenase



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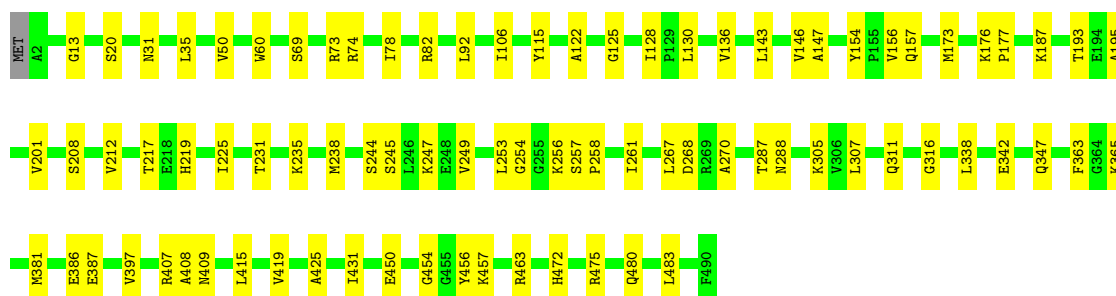
- Molecule 1: NAD/NADP-dependent betaine aldehyde dehydrogenase

Chain D: 82% 17%



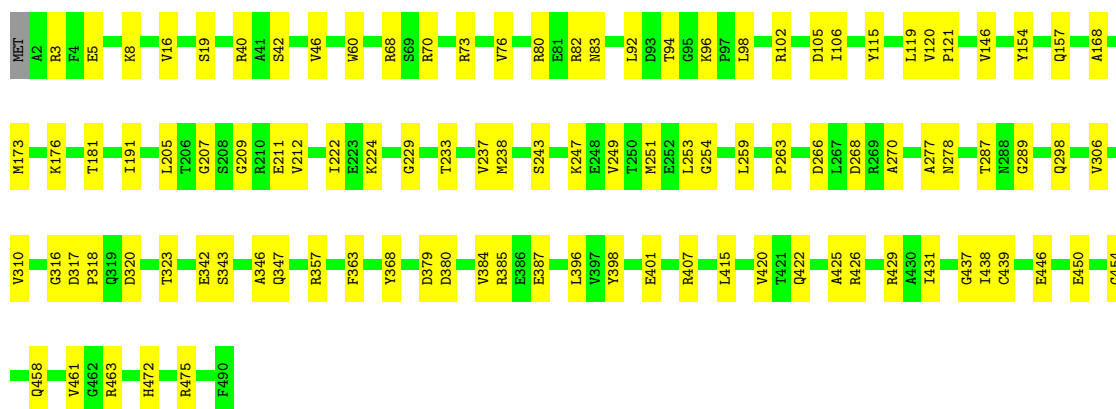
- Molecule 1: NAD/NADP-dependent betaine aldehyde dehydrogenase

Chain E: 83% 17%



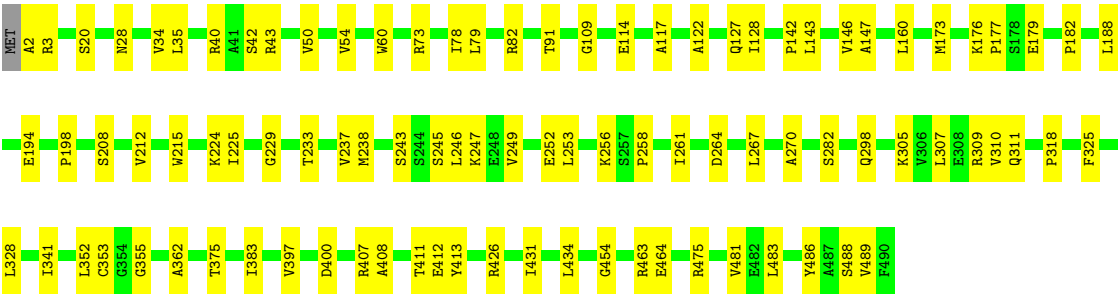
- Molecule 1: NAD/NADP-dependent betaine aldehyde dehydrogenase

Chain F: 79% 21%

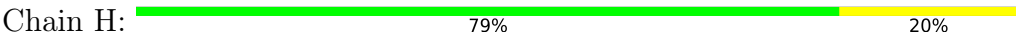


- Molecule 1: NAD/NADP-dependent betaine aldehyde dehydrogenase

Chain G: 81% 19%



● Molecule 1: NAD/NADP-dependent betaine aldehyde dehydrogenase





## 4 Data and refinement statistics

Property	Value	Source
Space group	C 1 2 1	Depositor
Cell constants a, b, c, $\alpha$ , $\beta$ , $\gamma$	325.95Å 130.36Å 100.69Å 90.00° 94.93° 90.00°	Depositor
Resolution (Å)	29.22 – 3.09 29.22 – 3.09	Depositor EDS
% Data completeness (in resolution range)	98.3 (29.22-3.09) 98.2 (29.22-3.09)	Depositor EDS
$R_{merge}$	0.12	Depositor
$R_{sym}$	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ <sup>1</sup>	2.25 (at 3.11Å)	Xtriage
Refinement program	PHENIX (1.12_2829: ???)	Depositor
R, $R_{free}$	0.181 , 0.234 0.184 , 0.233	Depositor DCC
$R_{free}$ test set	3826 reflections (4.94%)	wwPDB-VP
Wilson B-factor (Å <sup>2</sup> )	55.9	Xtriage
Anisotropy	0.149	Xtriage
Bulk solvent $k_{sol}$ (e/Å <sup>3</sup> ), $B_{sol}$ (Å <sup>2</sup> )	0.37 , 35.5	EDS
L-test for twinning <sup>2</sup>	$\langle  L  \rangle = 0.46$ , $\langle L^2 \rangle = 0.28$	Xtriage
Estimated twinning fraction	No twinning to report.	Xtriage
$F_o, F_c$ correlation	0.93	EDS
Total number of atoms	29968	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 2.59% 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: RB

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	0.39	0/3812	0.64	0/5166
1	B	0.42	0/3812	0.68	0/5166
1	C	0.37	0/3812	0.64	0/5166
1	D	0.41	0/3812	0.62	0/5166
1	E	0.41	0/3812	0.65	1/5166 (0.0%)
1	F	0.40	0/3812	0.65	0/5166
1	G	0.43	0/3812	0.65	0/5166
1	H	0.38	0/3812	0.65	0/5166
All	All	0.40	0/30496	0.65	1/41328 (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	E	20	SER	N-CA-C	-5.33	108.54	114.62

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	3744	0	3716	50	0
1	B	3744	0	3716	58	0

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Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
1	C	3744	0	3715	66	0
1	D	3744	0	3716	55	0
1	E	3744	0	3715	50	0
1	F	3744	0	3716	65	0
1	G	3744	0	3716	77	0
1	H	3744	0	3716	73	0
2	A	2	0	0	0	0
2	B	2	0	0	0	0
2	C	2	0	0	0	0
2	D	2	0	0	0	0
2	E	2	0	0	0	0
2	F	2	0	0	0	0
2	G	3	0	0	0	0
2	H	1	0	0	0	0
All	All	29968	0	29726	440	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 7.

The worst 5 of 440 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:H:309:ARG:HH11	1:H:312:ARG:HH22	1.16	0.93
1:A:106:ILE:HD13	1:A:156:VAL:HG11	1.61	0.82
1:H:217:THR:O	1:H:247:LYS:HE2	1.81	0.80
1:D:231:THR:HA	1:D:253:LEU:HD13	1.67	0.77
1:C:347:GLN:NE2	1:C:381:MET:HA	2.00	0.77

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	487/490 (99%)	473 (97%)	13 (3%)	1 (0%)	43	71
1	B	487/490 (99%)	475 (98%)	11 (2%)	1 (0%)	43	71
1	C	487/490 (99%)	473 (97%)	14 (3%)	0	100	100
1	D	487/490 (99%)	475 (98%)	12 (2%)	0	100	100
1	E	487/490 (99%)	473 (97%)	14 (3%)	0	100	100
1	F	487/490 (99%)	473 (97%)	14 (3%)	0	100	100
1	G	487/490 (99%)	474 (97%)	13 (3%)	0	100	100
1	H	487/490 (99%)	475 (98%)	12 (2%)	0	100	100
All	All	3896/3920 (99%)	3791 (97%)	103 (3%)	2 (0%)	48	76

All (2) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	350	ARG
1	B	313	ILE

### 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	390/391 (100%)	390 (100%)	0	100	100
1	B	390/391 (100%)	390 (100%)	0	100	100
1	C	390/391 (100%)	390 (100%)	0	100	100
1	D	390/391 (100%)	390 (100%)	0	100	100
1	E	390/391 (100%)	390 (100%)	0	100	100
1	F	390/391 (100%)	390 (100%)	0	100	100
1	G	390/391 (100%)	390 (100%)	0	100	100
1	H	390/391 (100%)	390 (100%)	0	100	100
All	All	3120/3128 (100%)	3120 (100%)	0	100	100

There are no protein residues with a non-rotameric sidechain to report.

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. 5 of 13 such sidechains are listed below:

Mol	Chain	Res	Type
1	E	127	GLN
1	E	298	GLN
1	G	7	GLN
1	F	319	GLN
1	F	422	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 oligosaccharides in this entry.

## 5.6 Ligand geometry [i](#)

Of 16 ligands modelled in this entry, 16 are monoatomic - leaving 0 for Mogul analysis.

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 [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	489/490 (99%)	-0.46	1 (0%) 91 83	32, 49, 65, 74	0
1	B	489/490 (99%)	-0.53	0 100 100	33, 40, 53, 62	0
1	C	489/490 (99%)	-0.44	0 100 100	33, 53, 71, 85	0
1	D	489/490 (99%)	-0.51	0 100 100	34, 42, 54, 64	0
1	E	489/490 (99%)	-0.48	0 100 100	32, 43, 56, 78	0
1	F	489/490 (99%)	-0.41	0 100 100	31, 51, 77, 87	0
1	G	489/490 (99%)	-0.56	0 100 100	32, 40, 49, 70	0
1	H	489/490 (99%)	-0.43	0 100 100	32, 52, 73, 82	0
All	All	3912/3920 (99%)	-0.48	1 (0%) 100 100	31, 44, 69, 87	0

All (1) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	2	ALA	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 oligosaccharides 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
2	RB	C	502	1/1	0.94	0.05	77,77,77,77	0
2	RB	E	502	1/1	0.96	0.04	67,67,67,67	0
2	RB	G	501	1/1	0.96	0.04	58,58,58,58	0
2	RB	H	501	1/1	0.96	0.07	79,79,79,79	0
2	RB	D	502	1/1	0.97	0.03	58,58,58,58	0
2	RB	G	502	1/1	0.97	0.04	52,52,52,52	0
2	RB	F	502	1/1	0.97	0.04	71,71,71,71	0
2	RB	E	501	1/1	0.98	0.03	43,43,43,43	0
2	RB	A	501	1/1	0.98	0.04	70,70,70,70	0
2	RB	B	502	1/1	0.98	0.04	50,50,50,50	0
2	RB	A	502	1/1	0.99	0.03	54,54,54,54	0
2	RB	F	501	1/1	0.99	0.02	50,50,50,50	0
2	RB	G	503	1/1	0.99	0.05	55,55,55,55	0
2	RB	B	501	1/1	0.99	0.02	46,46,46,46	0
2	RB	D	501	1/1	1.00	0.02	52,52,52,52	0
2	RB	C	501	1/1	1.00	0.01	55,55,55,55	0

## 6.5 Other polymers [i](#)

There are no such residues in this entry.