



# Full wwPDB X-ray Structure Validation Report ⓘ

May 16, 2020 – 03:01 am BST

PDB ID : 2Y2O  
Title : PENICILLIN-BINDING PROTEIN 1B (PBP-1B) IN COMPLEX WITH AN ALKYL BORONATE (EO9)  
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Deposited on : 2010-12-15  
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.

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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	:	2.11
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

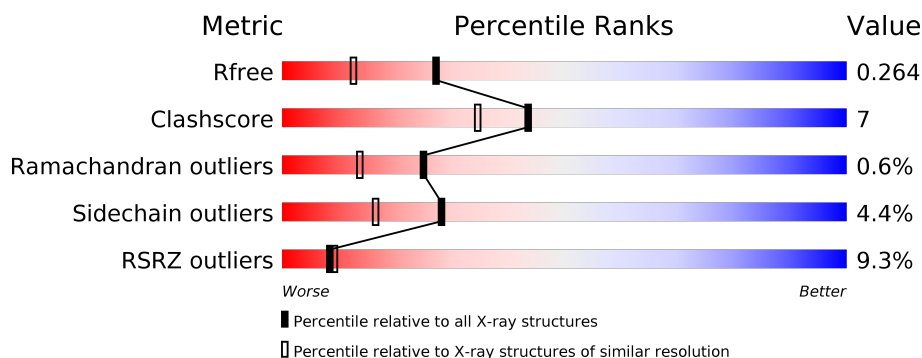
# 1 Overall quality at a glance ⓘ

The following experimental techniques were used to determine the structure:

## *X-RAY DIFFRACTION*

The reported resolution of this entry is 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 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	494	<div> <div>9%</div> <div>82%</div> <div>12%</div> <div>• 5%</div> </div>

## 2 Entry composition [i](#)

There are 6 unique types of molecules in this entry. The entry contains 3909 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.

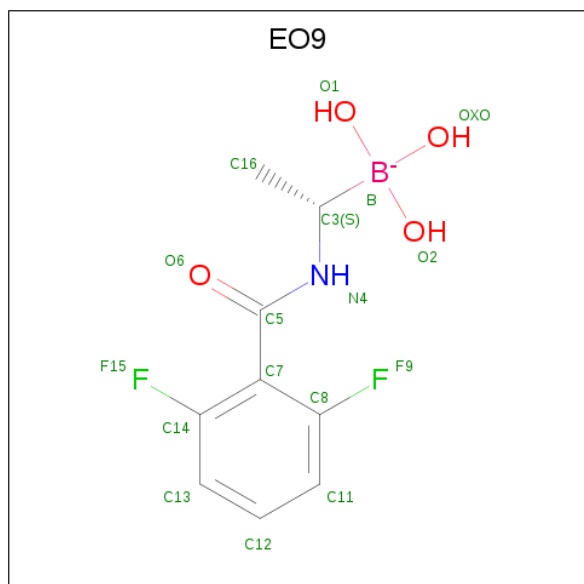
- Molecule 1 is a protein called PENICILLIN-BINDING PROTEIN 1B.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
1	A	471	3669	2297	625	732	15	0	6	0

There are 3 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	656	GLY	ASN	engineered mutation	UNP Q7CRA4
A	686	GLN	ARG	engineered mutation	UNP Q7CRA4
A	687	GLN	ARG	engineered mutation	UNP Q7CRA4

- Molecule 2 is [(1S)-1-[(2,6-difluorophenyl)carbonylamino]ethyl]-trihydroxy-boron (three-letter code: EO9) (formula: C<sub>9</sub>H<sub>11</sub>BF<sub>2</sub>NO<sub>4</sub>).



Mol	Chain	Residues	Atoms					ZeroOcc	AltConf
			Total	B	C	F	N	O	
2	A	1	16	1	9	2	1	3	0

- Molecule 3 is SULFATE ION (three-letter code: SO4) (formula: O<sub>4</sub>S).



Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
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	A	14	Total	Cl	0	0
			14	14		

- Molecule 5 is SODIUM ION (three-letter code: NA) (formula: Na).

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
5	A	1	Total	Na	0	0
			1	1		

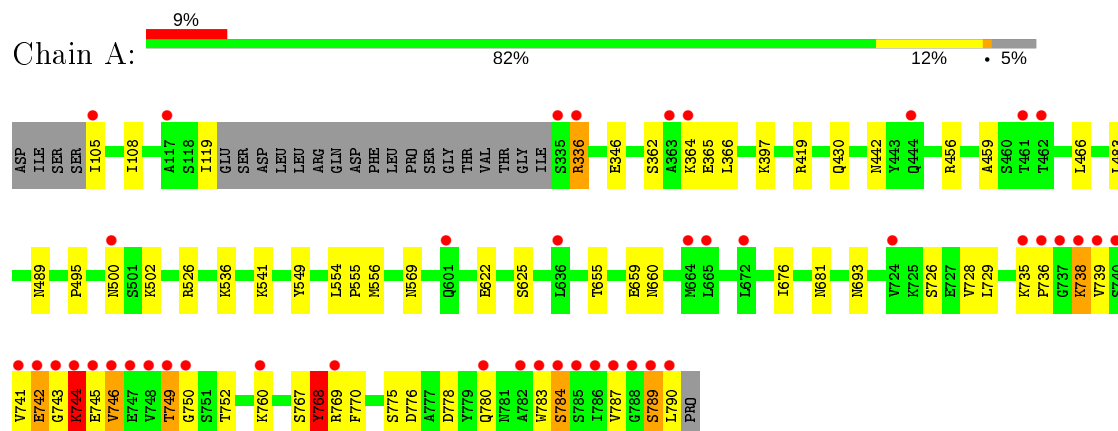
- Molecule 6 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
6	A	204	Total	O	0	0
			204	204		

### 3 Residue-property plots

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: PENICILLIN-BINDING PROTEIN 1B



## 4 Data and refinement statistics

Property	Value	Source
Space group	C 2 2 21	Depositor
Cell constants a, b, c, $\alpha$ , $\beta$ , $\gamma$	97.58 Å 149.11 Å 97.70 Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	41.92 – 1.88 41.92 – 1.88	Depositor EDS
% Data completeness (in resolution range)	92.2 (41.92-1.88) 92.2 (41.92-1.88)	Depositor EDS
$R_{merge}$	(Not available)	Depositor
$R_{sym}$	0.04	Depositor
$\langle I/\sigma(I) \rangle$ <sup>1</sup>	1.83 (at 1.88 Å)	Xtriage
Refinement program	REFMAC 5.6.0095	Depositor
R, $R_{free}$	0.222 , 0.264 0.221 , 0.264	Depositor DCC
$R_{free}$ test set	5458 reflections (10.17%)	wwPDB-VP
Wilson B-factor (Å <sup>2</sup> )	30.1	Xtriage
Anisotropy	0.110	Xtriage
Bulk solvent $k_{sol}$ (e/Å <sup>3</sup> ), $B_{sol}$ (Å <sup>2</sup> )	0.35 , 42.4	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	0.96	EDS
Total number of atoms	3909	wwPDB-VP
Average B, all atoms (Å <sup>2</sup> )	50.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 4.23% 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

### 5.1 Standard geometry

Bond lengths and bond angles in the following residue types are not validated in this section: NA, EO9, SO4, 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	0.77	3/3760 (0.1%)	0.70	2/5101 (0.0%)

Chiral center outliers are detected by calculating the chiral volume of a chiral center and verifying if the center is modelled as a planar moiety or with the opposite hand. A planarity outlier is detected by checking planarity of atoms in a peptide group, atoms in a mainchain group or atoms of a sidechain that are expected to be planar.

Mol	Chain	#Chirality outliers	#Planarity outliers
1	A	0	1

All (3) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	A	776	ASP	C-O	19.81	1.60	1.23
1	A	738	LYS	C-N	8.46	1.53	1.34
1	A	738	LYS	CD-CE	6.58	1.67	1.51

All (2) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	768	TYR	CB-CG-CD1	-6.90	116.86	121.00
1	A	768	TYR	CG-CD1-CE1	-5.71	116.73	121.30

There are no chirality outliers.

All (1) planarity outliers are listed below:

Mol	Chain	Res	Type	Group
1	A	768	TYR	Sidechain

## 5.2 Too-close contacts ⓘ

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	3669	0	3557	49	0
2	A	16	0	10	0	0
3	A	5	0	0	0	0
4	A	14	0	0	1	0
5	A	1	0	0	0	0
6	A	204	0	0	6	1
All	All	3909	0	3567	49	1

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.

All (49) 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:526:ARG:HD3	6:A:2090:HOH:O	1.76	0.84
1:A:770:PHE:HD2	1:A:783:TRP:CZ2	2.02	0.77
1:A:430[A]:GLN:OE1	6:A:2049:HOH:O	2.07	0.72
1:A:770:PHE:CD2	1:A:783:TRP:CZ2	2.82	0.67
1:A:728:VAL:O	1:A:752:THR:HB	1.95	0.67
1:A:768:TYR:CE1	1:A:783:TRP:CD1	2.84	0.65
1:A:105:ILE:O	1:A:105:ILE:HG13	1.97	0.64
1:A:489:ASN:HD22	1:A:495:PRO:HA	1.63	0.64
1:A:749:THR:OG1	1:A:750:GLY:N	2.31	0.62
1:A:336:ARG:HD2	1:A:336:ARG:H	1.67	0.60
1:A:741:VAL:O	1:A:742:GLU:O	2.19	0.59
1:A:655:THR:HG23	1:A:660:ASN:HB2	1.88	0.56
1:A:489:ASN:ND2	1:A:495:PRO:HA	2.21	0.56
1:A:105:ILE:N	6:A:2001:HOH:O	2.39	0.55
1:A:622:GLU:HA	1:A:625:SER:HB2	1.91	0.53
1:A:554:LEU:N	1:A:555:PRO:HD2	2.24	0.52
1:A:749:THR:CG2	1:A:790:LEU:HD13	2.41	0.51
1:A:554:LEU:N	1:A:555:PRO:CD	2.74	0.50
1:A:456:ARG:CZ	1:A:681[A]:ASN:OD1	2.61	0.49
1:A:655:THR:HG21	1:A:660:ASN:HD22	1.77	0.49
1:A:419:ARG:HG3	6:A:2044:HOH:O	2.12	0.48

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:541:LYS:HE3	6:A:2098:HOH:O	2.12	0.48
1:A:489:ASN:HD22	1:A:495:PRO:CA	2.25	0.48
1:A:741:VAL:O	1:A:742:GLU:C	2.51	0.48
1:A:397:LYS:HD2	6:A:2164:HOH:O	2.12	0.47
1:A:659:GLU:OE1	1:A:681[B]:ASN:ND2	2.48	0.46
1:A:738:LYS:O	1:A:739:VAL:HG23	2.16	0.46
1:A:729:LEU:HD23	1:A:752:THR:HG22	1.98	0.45
1:A:770:PHE:HD2	1:A:783:TRP:HZ2	1.62	0.45
1:A:336:ARG:CD	1:A:336:ARG:N	2.79	0.45
1:A:346:GLU:HG2	4:A:1212:CL:CL	2.54	0.44
1:A:536:LYS:HG3	1:A:549:TYR:CE1	2.53	0.44
1:A:743:GLY:O	1:A:744:LYS:C	2.56	0.44
1:A:738:LYS:HA	1:A:746:VAL:O	2.17	0.44
1:A:119:ILE:HD13	1:A:119:ILE:N	2.34	0.43
1:A:366:LEU:HD23	1:A:366:LEU:HA	1.95	0.43
1:A:459:ALA:HA	1:A:556:MET:O	2.18	0.43
1:A:775:SER:O	1:A:778:ASP:HB2	2.17	0.43
1:A:362:SER:OG	1:A:365:GLU:HG3	2.20	0.42
1:A:108:ILE:HG13	1:A:119:ILE:HD11	2.00	0.42
1:A:676:ILE:HD13	1:A:693:ASN:HB2	2.01	0.42
1:A:768:TYR:CD1	1:A:783:TRP:NE1	2.87	0.42
1:A:749:THR:HG22	1:A:790:LEU:HD13	2.01	0.41
1:A:780:GLN:O	1:A:784:SER:HB3	2.21	0.41
1:A:735:LYS:HA	1:A:736:PRO:HD3	1.94	0.41
1:A:787:VAL:C	1:A:789:SER:N	2.73	0.41
1:A:336:ARG:N	1:A:336:ARG:HD2	2.33	0.41
1:A:787:VAL:C	1:A:789:SER:H	2.24	0.41
1:A:336:ARG:CD	1:A:336:ARG:H	2.33	0.41

All (1) 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)
6:A:2104:HOH:O	6:A:2104:HOH:O[4_555]	1.70	0.50

## 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	473/494 (96%)	455 (96%)	15 (3%)	3 (1%)	25	14

All (3) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	742	GLU
1	A	744	LYS
1	A	442	ASN

### 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	393/408 (96%)	376 (96%)	17 (4%)	29	17

All (17) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	336	ARG
1	A	364	LYS
1	A	466	LEU
1	A	483	LEU
1	A	500	ASN
1	A	502	LYS
1	A	569	ASN
1	A	726	SER

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Mol	Chain	Res	Type
1	A	744	LYS
1	A	745	GLU
1	A	746	VAL
1	A	749	THR
1	A	760	LYS
1	A	767	SER
1	A	769	ARG
1	A	784	SER
1	A	789	SER

Some sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (3) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	424	ASN
1	A	489	ASN
1	A	699	HIS

### 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 17 ligands modelled in this entry, 15 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
2	EO9	A	1000	1,5	13,16,17	0.70	0	17,22,25	1.86	4 (23%)
3	SO4	A	1100	-	4,4,4	0.71	0	6,6,6	0.46	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
2	EO9	A	1000	1,5	-	0/7/12/14	0/1/1/1

There are no bond length outliers.

All (4) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
2	A	1000	EO9	C8-C7-C14	4.08	122.48	114.97
2	A	1000	EO9	C14-C7-C5	-3.86	116.86	122.27
2	A	1000	EO9	C13-C14-C7	-3.27	117.73	123.58
2	A	1000	EO9	F15-C14-C13	2.37	123.87	118.59

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 [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	471/494 (95%)	0.54	44 (9%) 8 9	26, 42, 112, 188	0

All (44) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	744	LYS	10.1
1	A	787	VAL	9.6
1	A	743	GLY	8.4
1	A	746	VAL	7.7
1	A	786	ILE	6.7
1	A	739	VAL	6.1
1	A	335	SER	5.9
1	A	748	VAL	5.6
1	A	741	VAL	5.3
1	A	749	THR	4.8
1	A	747	GLU	4.4
1	A	790	LEU	4.4
1	A	736	PRO	4.4
1	A	737	GLY	4.3
1	A	738	LYS	4.1
1	A	105	ILE	4.0
1	A	363	ALA	4.0
1	A	364	LYS	4.0
1	A	788	GLY	4.0
1	A	789	SER	3.9
1	A	740	SER	3.9
1	A	782	ALA	3.8
1	A	336	ARG	3.7
1	A	750	GLY	3.4
1	A	745	GLU	3.3
1	A	780	GLN	3.1
1	A	760	LYS	3.0

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Mol	Chain	Res	Type	RSRZ
1	A	724	VAL	2.8
1	A	742	GLU	2.7
1	A	601[A]	GLN	2.5
1	A	500	ASN	2.4
1	A	784	SER	2.3
1	A	735	LYS	2.3
1	A	769	ARG	2.3
1	A	665	LEU	2.2
1	A	636	LEU	2.2
1	A	444	GLN	2.2
1	A	785	SER	2.1
1	A	461	THR	2.1
1	A	783	TRP	2.1
1	A	672	LEU	2.1
1	A	664	MET	2.0
1	A	117	ALA	2.0
1	A	462	THR	2.0

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

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

## 6.3 Carbohydrates ⓘ

There are no carbohydrates in this entry.

## 6.4 Ligands ⓘ

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( $\text{\AA}^2$ )	Q<0.9
4	CL	A	1217	1/1	0.87	0.24	60,60,60,60	0
5	NA	A	1300	1/1	0.91	0.18	42,42,42,42	0
2	EO9	A	1000	16/17	0.92	0.11	39,51,63,63	0
4	CL	A	1216	1/1	0.95	0.11	49,49,49,49	0
4	CL	A	1206	1/1	0.96	0.17	49,49,49,49	0
4	CL	A	1202	1/1	0.97	0.07	49,49,49,49	0

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Mol	Type	Chain	Res	Atoms	RSCC	RSR	B-factors( $\text{\AA}^2$ )	Q<0.9
4	CL	A	1222	1/1	0.97	0.16	47,47,47,47	0
4	CL	A	1211	1/1	0.97	0.06	38,38,38,38	0
4	CL	A	1201	1/1	0.97	0.05	42,42,42,42	0
4	CL	A	1214	1/1	0.97	0.17	50,50,50,50	0
4	CL	A	1227	1/1	0.97	0.06	54,54,54,54	0
4	CL	A	1200	1/1	0.98	0.03	43,43,43,43	0
4	CL	A	1224	1/1	0.98	0.06	49,49,49,49	0
4	CL	A	1212	1/1	0.99	0.04	40,40,40,40	0
3	SO4	A	1100	5/5	0.99	0.09	34,38,45,49	0
4	CL	A	1791	1/1	0.99	0.17	32,32,32,32	1
4	CL	A	1213	1/1	1.00	0.16	46,46,46,46	0

## 6.5 Other polymers [i](#)

There are no such residues in this entry.