



Full wwPDB X-ray Structure Validation Report ⓘ

Apr 25, 2026 – 12:18 PM EDT

PDB ID : 2Y2O / pdb_00002y2o
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

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>.

The following versions of software and data (see [references ⓘ](#)) were used in the production of this report:

MolProbity	:	4-5-2 with Phenix2.0
Mogul	:	2022.3.0, CSD as543be (2022)
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

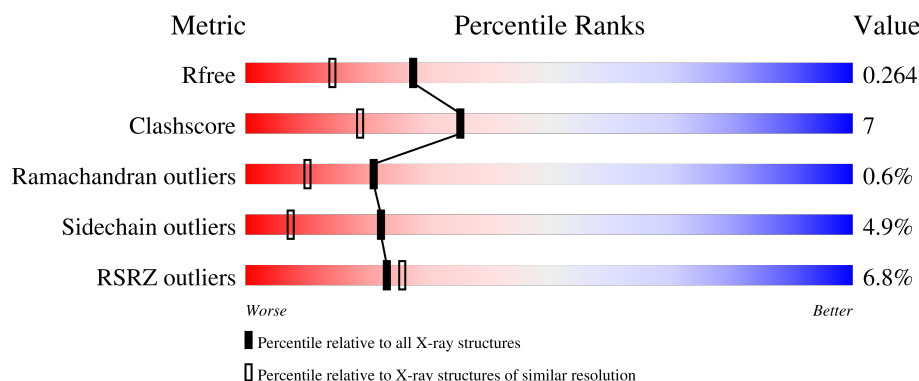
1 Overall quality at a glance

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}	180053	1220 (1.88-1.88)
Clashscore	190562	1234 (1.88-1.88)
Ramachandran outliers	187476	1222 (1.88-1.88)
Sidechain outliers	187428	1222 (1.88-1.88)
RSRZ outliers	180081	1220 (1.88-1.88)

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 ≥ 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	

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.

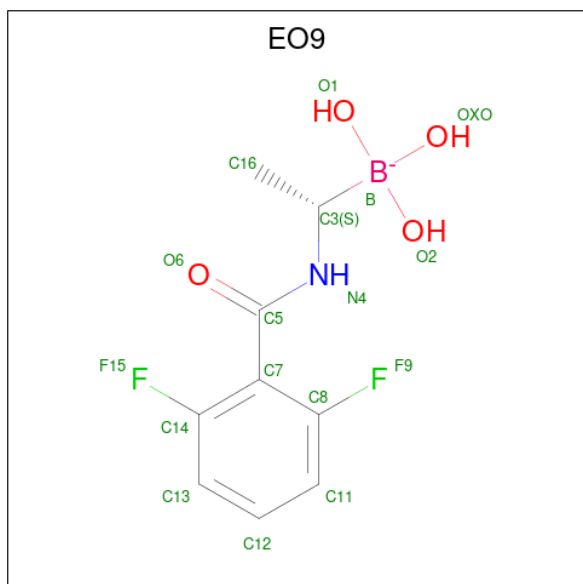
- Molecule 1 is a protein called PENICILLIN-BINDING PROTEIN 1B.

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 (CCD ID: EO9) (formula: C₉H₁₁BF₂NO₄).



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

- Molecule 3 is SULFATE ION (CCD ID: SO4) (formula: O₄S).



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

- Molecule 4 is CHLORIDE ION (CCD ID: CL) (formula: Cl).

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

- Molecule 5 is SODIUM ION (CCD ID: NA) (formula: Na).

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

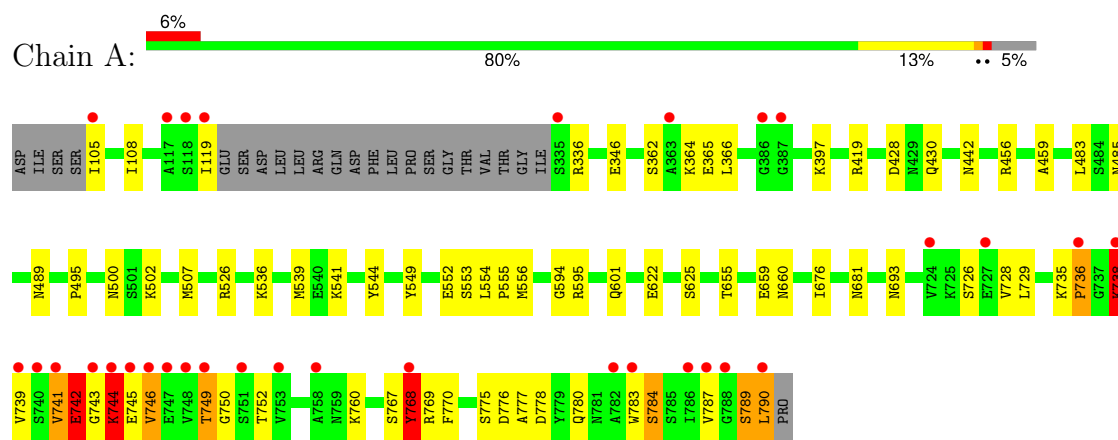
- Molecule 6 is water.

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

3 Residue-property plots [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: PENICILLIN-BINDING PROTEIN 1B



4 Data and refinement statistics

Property	Value	Source
Space group	C 2 2 21	Depositor
Cell constants a, b, c, α , β , γ	97.58Å 149.11Å 97.70Å 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
$\langle I/\sigma(I) \rangle$ ¹	1.83 (at 1.88Å)	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 ²)	30.1	Xtriage
Anisotropy	0.110	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.35 , 44.6	EDS
L-test for twinning ²	$\langle L \rangle = 0.49$, $\langle L^2 \rangle = 0.32$	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 ²)	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.*

¹Intensities estimated from amplitudes.

²Theoretical 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, CL, EO9, SO4

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	0.99	6/3760 (0.2%)	0.94	4/5101 (0.1%)

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 (6) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	A	776	ASP	C-O	29.51	1.60	1.24
1	A	738	LYS	C-N	14.61	1.53	1.33
1	A	738	LYS	C-O	7.09	1.32	1.23
1	A	776	ASP	C-N	6.63	1.42	1.33
1	A	736	PRO	C-N	5.40	1.39	1.33
1	A	738	LYS	CD-CE	5.09	1.67	1.52

All (4) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	776	ASP	O-C-N	5.79	129.00	122.22
1	A	768	TYR	O-C-N	5.57	127.82	122.03
1	A	777	ALA	N-CA-C	-5.34	105.36	111.07
1	A	552	GLU	N-CA-C	5.11	116.85	111.28

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	54	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	54	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 (54) 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:H	1:A:336:ARG:HD2	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:741:VAL:O	1:A:742:GLU:C	2.51	0.53
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

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
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
1:A:743:GLY:O	1:A:744:LYS:C	2.56	0.48
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: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:787:VAL:C	1:A:789:SER:H	2.24	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:553:SER:C	1:A:555:PRO:HD2	2.42	0.44
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:539:MET:HE3	1:A:544:TYR:CD2	2.53	0.44
1:A:738:LYS:HA	1:A:746:VAL:O	2.17	0.44
1:A:787:VAL:C	1:A:789:SER:N	2.73	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:428:ASP:OD1	1:A:428:ASP:C	2.62	0.42
1:A:362:SER:OG	1:A:365:GLU:HG3	2.20	0.42
1:A:594:GLY:O	1:A:595:ARG:C	2.62	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:485:ASN:CB	1:A:507:MET:HE3	2.51	0.41
1:A:336:ARG:HD2	1:A:336:ARG:N	2.33	0.41
1:A:336:ARG:H	1:A:336:ARG:CD	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%)	21 10

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%)	373 (95%)	20 (5%)	21 7

All (20) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	364	LYS
1	A	483	LEU
1	A	500	ASN

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Mol	Chain	Res	Type
1	A	502	LYS
1	A	601[A]	GLN
1	A	601[B]	GLN
1	A	726	SER
1	A	738	LYS
1	A	741	VAL
1	A	742	GLU
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
1	A	790	LEU

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (7) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	368	ASN
1	A	403	GLN
1	A	424	ASN
1	A	489	ASN
1	A	531	ASN
1	A	635	ASN
1	A	695	ASN

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 oligosaccharides in this entry.

5.6 Ligand geometry

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	$\# Z > 2$
3	SO4	A	1100	-	4,4,4	0.77	0	6,6,6	0.51	0
2	EO9	A	1000	5,1	13,16,17	0.74	0	17,22,25	1.83	4 (23%)

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	5,1	-	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	4.38	122.48	114.93
2	A	1000	EO9	C14-C7-C5	-3.53	116.86	122.21
2	A	1000	EO9	C13-C14-C7	-3.13	117.73	123.48
2	A	1000	EO9	F15-C14-C13	2.25	123.87	118.65

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

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 ⓘ

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, 95th 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 ²)	Q<0.9
1	A	471/494 (95%)	0.42	32 (6%) 23 26	25, 42, 112, 188	6 (1%)

All (32) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	105	ILE	5.4
1	A	790	LEU	5.3
1	A	335	SER	4.9
1	A	743	GLY	4.3
1	A	741	VAL	4.2
1	A	739	VAL	4.0
1	A	748	VAL	4.0
1	A	744	LYS	3.8
1	A	768	TYR	3.5
1	A	786	ILE	3.4
1	A	746	VAL	3.3
1	A	787	VAL	3.3
1	A	783	TRP	3.3
1	A	745	GLU	3.1
1	A	387	GLY	2.8
1	A	751	SER	2.8
1	A	736	PRO	2.7
1	A	724	VAL	2.6
1	A	386	GLY	2.6
1	A	788	GLY	2.6
1	A	758	ALA	2.5
1	A	738	LYS	2.5
1	A	740	SER	2.4
1	A	749	THR	2.4
1	A	363	ALA	2.4
1	A	747	GLU	2.3
1	A	782	ALA	2.2

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Mol	Chain	Res	Type	RSRZ
1	A	727	GLU	2.2
1	A	117	ALA	2.2
1	A	118	SER	2.2
1	A	119	ILE	2.1
1	A	753	VAL	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 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, 95th 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
2	EO9	A	1000	16/17	0.84	0.12	39,51,63,63	0
4	CL	A	1217	1/1	0.90	0.20	60,60,60,60	0
5	NA	A	1300	1/1	0.91	0.14	42,42,42,42	0
4	CL	A	1216	1/1	0.93	0.17	49,49,49,49	0
4	CL	A	1202	1/1	0.94	0.12	49,49,49,49	0
3	SO4	A	1100	5/5	0.96	0.19	34,38,45,49	0
4	CL	A	1227	1/1	0.96	0.10	54,54,54,54	0
4	CL	A	1200	1/1	0.96	0.11	43,43,43,43	0
4	CL	A	1206	1/1	0.97	0.18	49,49,49,49	0
4	CL	A	1222	1/1	0.97	0.17	47,47,47,47	0
4	CL	A	1224	1/1	0.97	0.08	49,49,49,49	0
4	CL	A	1211	1/1	0.97	0.11	38,38,38,38	0
4	CL	A	1201	1/1	0.97	0.09	42,42,42,42	0
4	CL	A	1214	1/1	0.98	0.14	50,50,50,50	0
4	CL	A	1213	1/1	0.99	0.28	46,46,46,46	0
4	CL	A	1791	1/1	0.99	0.05	32,32,32,32	1
4	CL	A	1212	1/1	0.99	0.11	40,40,40,40	0

6.5 Other polymers [i](#)

There are no such residues in this entry.