



Full wwPDB X-ray Structure Validation Report ⓘ

Aug 22, 2023 – 06:43 AM EDT

PDB ID : 3BDG
Title : Crystal structure of wild-type/T155V mixed dimer of E. coli alkaline phosphatase
Authors : Grigg, J.C.; Murphy, M.E.
Deposited on : 2007-11-14
Resolution : 1.40 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 : 4.02b-467
Mogul : 1.8.5 (274361), CSD as541be (2020)
Xtriage (Phenix) : 1.13
EDS : 2.35
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) : 2.35

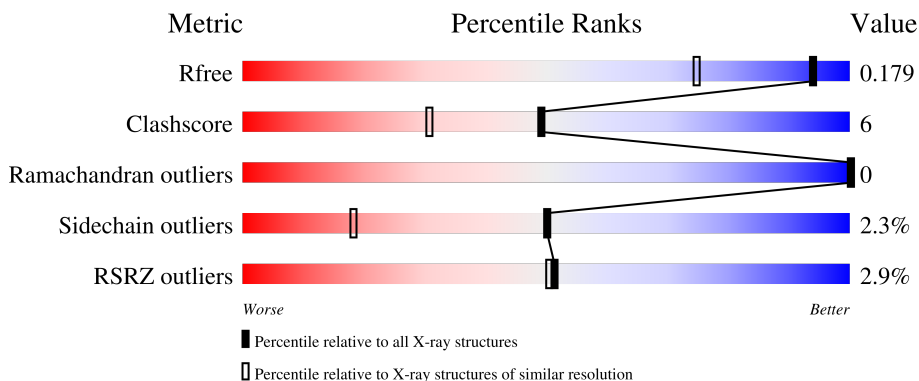
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

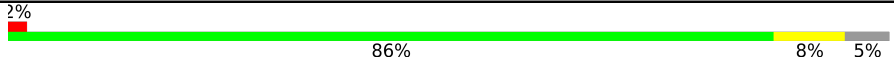
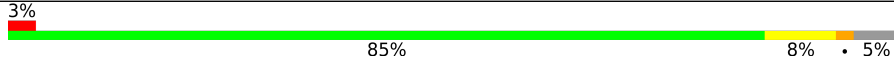
The reported resolution of this entry is 1.40 Å.

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	1714 (1.40-1.40)
Clashscore	141614	1812 (1.40-1.40)
Ramachandran outliers	138981	1763 (1.40-1.40)
Sidechain outliers	138945	1762 (1.40-1.40)
RSRZ outliers	127900	1674 (1.40-1.40)

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	458	
2	B	458	

2 Entry composition [i](#)

There are 4 unique types of molecules in this entry. The entry contains 7839 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 Alkaline phosphatase.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
1	A	434	3317	2055	584	665	13	0	16	0

There are 9 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	155	VAL	THR	engineered mutation	UNP P00634
A	450	LEU	-	expression tag	UNP P00634
A	451	GLU	-	expression tag	UNP P00634
A	452	HIS	-	expression tag	UNP P00634
A	453	HIS	-	expression tag	UNP P00634
A	454	HIS	-	expression tag	UNP P00634
A	455	HIS	-	expression tag	UNP P00634
A	456	HIS	-	expression tag	UNP P00634
A	457	HIS	-	expression tag	UNP P00634

- Molecule 2 is a protein called Alkaline phosphatase.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
2	B	433	3245	2011	572	649	13	0	10	0

There are 8 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
B	450	LEU	-	expression tag	UNP P00634
B	451	GLU	-	expression tag	UNP P00634
B	452	GLU	-	expression tag	UNP P00634
B	453	GLU	-	expression tag	UNP P00634
B	454	GLU	-	expression tag	UNP P00634
B	455	GLU	-	expression tag	UNP P00634
B	456	GLU	-	expression tag	UNP P00634

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Chain	Residue	Modelled	Actual	Comment	Reference
B	457	GLU	-	expression tag	UNP P00634

- Molecule 3 is SULFATE ION (three-letter code: SO4) (formula: O₄S).



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

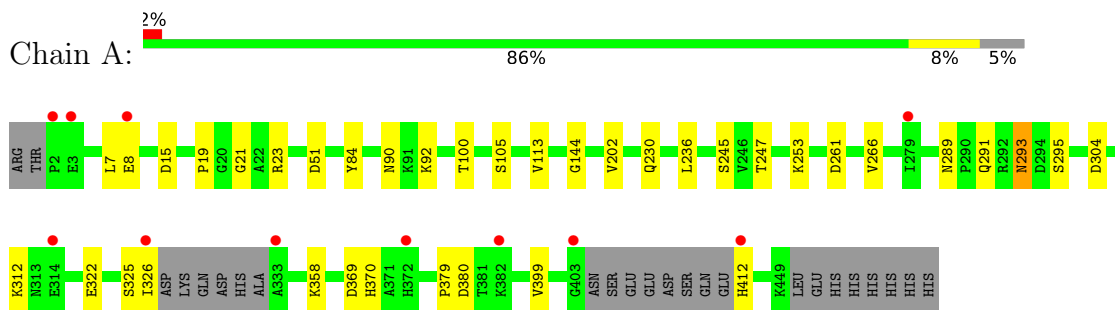
- Molecule 4 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
4	A	651	Total	O	0	0
			651	651		
4	B	606	Total	O	0	0
			606	606		

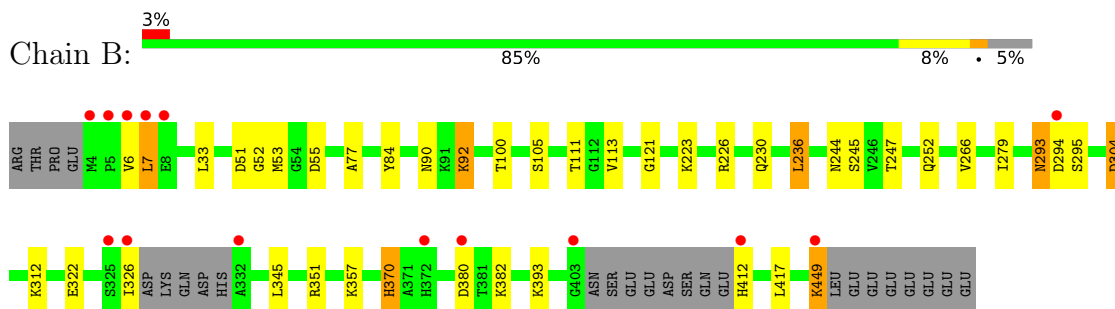
3 Residue-property plots [i](#)

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: Alkaline phosphatase



- Molecule 2: Alkaline phosphatase



4 Data and refinement statistics i

Property	Value	Source
Space group	P 1 21 1	Depositor
Cell constants a, b, c, α , β , γ	55.32Å 103.35Å 88.29Å 90.00° 105.78° 90.00°	Depositor
Resolution (Å)	50.00 – 1.40 47.33 – 1.40	Depositor EDS
% Data completeness (in resolution range)	97.3 (50.00-1.40) 97.2 (47.33-1.40)	Depositor EDS
R_{merge}	0.04	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	2.10 (at 1.40Å)	Xtrriage
Refinement program	REFMAC refmac_5.2.0019	Depositor
R, R_{free}	0.160 , 0.180 0.159 , 0.179	Depositor DCC
R_{free} test set	9115 reflections (5.01%)	wwPDB-VP
Wilson B-factor (Å ²)	11.3	Xtrriage
Anisotropy	0.101	Xtrriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.38 , 54.4	EDS
L-test for twinning ²	$\langle L \rangle = 0.50$, $\langle L^2 \rangle = 0.33$	Xtrriage
Estimated twinning fraction	0.016 for h,-k,-h-l	Xtrriage
F_o, F_c correlation	0.97	EDS
Total number of atoms	7839	wwPDB-VP
Average B, all atoms (Å ²)	15.0	wwPDB-VP

Xtrriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 4.41% 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 [i](#)

5.1 Standard geometry [i](#)

Bond lengths and bond angles in the following residue types are not validated in this section: 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	0.62	0/3369	0.78	2/4566 (0.0%)
2	B	0.62	0/3296	0.77	1/4471 (0.0%)
All	All	0.62	0/6665	0.77	3/9037 (0.0%)

There are no bond length outliers.

All (3) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	369	ASP	CB-CG-OD2	5.79	123.51	118.30
2	B	7	LEU	CB-CG-CD1	5.77	120.81	111.00
1	A	23	ARG	NE-CZ-NH1	-5.46	117.57	120.30

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	3317	0	3277	27	0
2	B	3245	0	3206	51	0
3	A	5	0	0	0	0
3	B	15	0	0	0	1
4	A	651	0	0	10	0
4	B	606	0	0	20	1

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Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
All	All	7839	0	6483	77	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 6.

All (77) 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)
2:B:252:GLN:HG2	4:B:1133:HOH:O	1.43	1.16
2:B:294:ASP:HB2	4:B:1506:HOH:O	1.58	1.01
1:A:230:GLN:HG2	4:A:1435:HOH:O	1.63	0.98
1:A:293:ASN:HD22	1:A:295:SER:H	1.13	0.96
2:B:294:ASP:HB2	4:B:1507:HOH:O	1.68	0.92
2:B:6:VAL:CG2	2:B:357:LYS:HD3	2.01	0.91
2:B:293:ASN:HD22	2:B:295:SER:H	1.22	0.87
2:B:90:ASN:OD1	2:B:92:LYS:HG2	1.78	0.84
1:A:412:HIS:HB2	4:A:1406:HOH:O	1.81	0.81
2:B:244:ASN:HB3	4:B:1226:HOH:O	1.80	0.80
1:A:370:HIS:HD2	4:A:1104:HOH:O	1.66	0.79
1:A:90:ASN:OD1	1:A:92:LYS:HG2	1.83	0.79
2:B:6:VAL:HG21	2:B:357:LYS:HD3	1.68	0.75
1:A:293:ASN:ND2	1:A:295:SER:H	1.86	0.74
2:B:230:GLN:HG2	2:B:236:LEU:HD22	1.74	0.69
1:A:326:ILE:HD11	4:A:1520:HOH:O	1.93	0.68
2:B:223:LYS:HE2	4:B:1504:HOH:O	1.94	0.67
2:B:293:ASN:ND2	2:B:295:SER:H	1.92	0.66
2:B:92:LYS:NZ	4:B:1462:HOH:O	2.29	0.66
2:B:6:VAL:HG23	2:B:357:LYS:HD3	1.78	0.66
2:B:279:ILE:CD1	2:B:382:LYS:HG2	2.27	0.65
1:A:370:HIS:CD2	4:A:1104:HOH:O	2.46	0.63
1:A:289:ASN:HD21	1:A:291:GLN:HE21	1.45	0.63
2:B:230:GLN:HG2	2:B:236:LEU:CD2	2.29	0.61
2:B:51:ASP:OD2	2:B:322:GLU:OE2	2.19	0.61
2:B:100:THR:HG21	2:B:105[B]:SER:OG	2.00	0.60
1:A:245[A]:SER:OG	4:A:1525:HOH:O	2.13	0.57
2:B:113[B]:VAL:CG2	4:B:1104:HOH:O	2.52	0.57
2:B:294:ASP:CB	4:B:1506:HOH:O	2.34	0.56
2:B:6:VAL:HG23	2:B:357:LYS:CD	2.37	0.55
2:B:279:ILE:HD12	2:B:382:LYS:HG2	1.89	0.55
2:B:266:VAL:HG22	4:B:1040:HOH:O	2.07	0.55
1:A:8:GLU:HG2	4:A:1270:HOH:O	2.08	0.54

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:51:ASP:OD2	1:A:322:GLU:OE2	2.25	0.54
2:B:252:GLN:CG	4:B:1133:HOH:O	2.23	0.53
2:B:279:ILE:HD11	2:B:382:LYS:CG	2.38	0.53
2:B:113[B]:VAL:HG21	4:B:1104:HOH:O	2.07	0.53
2:B:247:THR:O	2:B:312:LYS:NZ	2.41	0.51
1:A:100:THR:HG21	1:A:105[B]:SER:OG	2.10	0.51
2:B:279:ILE:CD1	2:B:382:LYS:CG	2.88	0.51
1:A:19:PRO:HA	2:B:113[B]:VAL:HG12	1.92	0.50
2:B:226:ARG:O	2:B:230:GLN:HG3	2.11	0.50
2:B:230:GLN:HG2	4:B:1274:HOH:O	2.11	0.49
1:A:113[B]:VAL:CG1	4:A:1151:HOH:O	2.62	0.48
2:B:53[B]:MET:SD	2:B:345:LEU:HD23	2.53	0.47
1:A:15:ASP:O	1:A:21:GLY:HA3	2.15	0.46
1:A:266:VAL:HG12	1:A:326:ILE:HD13	1.97	0.46
2:B:279:ILE:HD11	2:B:382:LYS:HG3	1.97	0.46
2:B:6:VAL:CG2	2:B:357:LYS:CD	2.82	0.46
2:B:245:SER:HB2	4:B:1196:HOH:O	2.16	0.46
2:B:279:ILE:HD11	2:B:382:LYS:HG2	1.98	0.46
2:B:111:THR:OG1	2:B:113[B]:VAL:HG22	2.15	0.45
1:A:358:LYS:HE3	4:A:1372:HOH:O	2.15	0.45
1:A:7:LEU:CD1	4:A:1596:HOH:O	2.65	0.45
2:B:370:HIS:CE1	2:B:412:HIS:CD2	3.05	0.45
2:B:6:VAL:HG12	2:B:77:ALA:HB1	2.00	0.44
2:B:294:ASP:CB	4:B:1507:HOH:O	2.44	0.44
2:B:393:LYS:NZ	4:B:1330:HOH:O	2.50	0.44
1:A:144:GLY:HA2	1:A:202:VAL:O	2.18	0.43
1:A:247:THR:O	1:A:312:LYS:NZ	2.51	0.43
1:A:293:ASN:HD22	1:A:295:SER:N	1.97	0.43
1:A:230:GLN:HG2	1:A:236[A]:LEU:HD12	2.01	0.43
2:B:293:ASN:HD22	2:B:293:ASN:C	2.22	0.42
2:B:326:ILE:HD11	4:B:1482:HOH:O	2.18	0.42
2:B:417:LEU:HB2	4:B:1526:HOH:O	2.19	0.42
2:B:230:GLN:CG	2:B:236:LEU:CD2	2.96	0.42
1:A:289:ASN:HD21	1:A:291:GLN:NE2	2.14	0.42
2:B:304:ASP:OD2	2:B:351:ARG:NH2	2.46	0.42
1:A:326:ILE:N	1:A:326:ILE:HD12	2.35	0.42
2:B:121:GLY:HA3	4:B:1130:HOH:O	2.20	0.42
1:A:379:PRO:HA	1:A:399:VAL:HG21	2.01	0.41
2:B:7:LEU:CD1	4:B:1236:HOH:O	2.69	0.41
2:B:52:GLY:HA2	2:B:370:HIS:O	2.20	0.41
2:B:55:ASP:N	4:B:1526:HOH:O	2.53	0.40

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
2:B:33:LEU:HD12	2:B:33:LEU:HA	1.93	0.40
2:B:449:LYS:H	2:B:449:LYS:HG2	1.76	0.40
1:A:379:PRO:HA	1:A:399:VAL:CG2	2.51	0.40

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)
3:B:963:SO4:O3	4:B:1487:HOH:O[2_656]	2.16	0.04

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	446/458 (97%)	440 (99%)	6 (1%)	0	100	100
2	B	437/458 (95%)	431 (99%)	6 (1%)	0	100	100
All	All	883/916 (96%)	871 (99%)	12 (1%)	0	100	100

There are no Ramachandran outliers to report.

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	344/349 (99%)	336 (98%)	8 (2%)	50	18

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Mol	Chain	Analysed	Rotameric	Outliers	Percentiles	
2	B	334/349 (96%)	326 (98%)	8 (2%)	49	16
All	All	678/698 (97%)	662 (98%)	16 (2%)	50	16

All (16) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	84	TYR
1	A	253	LYS
1	A	261[A]	ASP
1	A	261[B]	ASP
1	A	293	ASN
1	A	304	ASP
1	A	325	SER
1	A	380	ASP
2	B	84	TYR
2	B	92	LYS
2	B	236	LEU
2	B	293	ASN
2	B	304	ASP
2	B	370	HIS
2	B	380	ASP
2	B	449	LYS

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	291	GLN
1	A	293	ASN
1	A	313	ASN
1	A	370	HIS
2	B	293	ASN
2	B	370	HIS
2	B	391	ASN

5.3.3 RNA

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 monosaccharides in this entry.

5.6 Ligand geometry [i](#)

4 ligands are modelled in this entry.

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	B	959	-	4,4,4	0.14	0	6,6,6	0.68	0
3	SO4	B	962	-	4,4,4	0.36	0	6,6,6	0.74	0
3	SO4	B	963	-	4,4,4	0.26	0	6,6,6	0.25	0
3	SO4	A	961	-	4,4,4	0.18	0	6,6,6	0.61	0

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.

1 monomer is involved in 1 short contact:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
3	B	963	SO4	0	1

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

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	434/458 (94%)	-0.13	11 (2%) 57 57	6, 10, 21, 40	0
2	B	433/458 (94%)	-0.01	14 (3%) 47 46	6, 11, 22, 36	0
All	All	867/916 (94%)	-0.07	25 (2%) 51 50	6, 11, 22, 40	0

All (25) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	2	PRO	10.6
1	A	326	ILE	8.3
2	B	326	ILE	7.6
2	B	5	PRO	6.8
2	B	7	LEU	6.6
2	B	6	VAL	6.3
2	B	332	ALA	6.0
2	B	403	GLY	5.6
2	B	8	GLU	5.2
1	A	403	GLY	5.0
1	A	3	GLU	4.4
2	B	449	LYS	3.3
1	A	412	HIS	3.0
1	A	8	GLU	3.0
2	B	4	MET	2.9
1	A	382	LYS	2.4
2	B	294	ASP	2.3
1	A	333	ALA	2.2
1	A	279	ILE	2.2
2	B	325	SER	2.1
2	B	372	HIS	2.1
2	B	380	ASP	2.1
1	A	372	HIS	2.1
1	A	314	GLU	2.0

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Mol	Chain	Res	Type	RSRZ
2	B	412	HIS	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 monosaccharides 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(Å ²)	Q<0.9
3	SO4	A	961	5/5	0.95	0.10	15,20,20,21	0
3	SO4	B	959	5/5	0.95	0.11	23,28,29,30	0
3	SO4	B	963	5/5	0.95	0.16	29,29,29,31	0
3	SO4	B	962	5/5	0.97	0.11	14,15,20,22	0

6.5 Other polymers [i](#)

There are no such residues in this entry.