



Full wwPDB X-ray Structure Validation Report ⓘ

Mar 9, 2026 – 01:00 AM UTC

PDB ID : 5VAZ / pdb_00005vaz
Title : Crystal structure of a DNA primase domain from *Pseudomonas aeruginosa*
Authors : Seattle Structural Genomics Center for Infectious Disease (SSGCID)
Deposited on : 2017-03-28
Resolution : 2.40 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	:	4-5-2 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

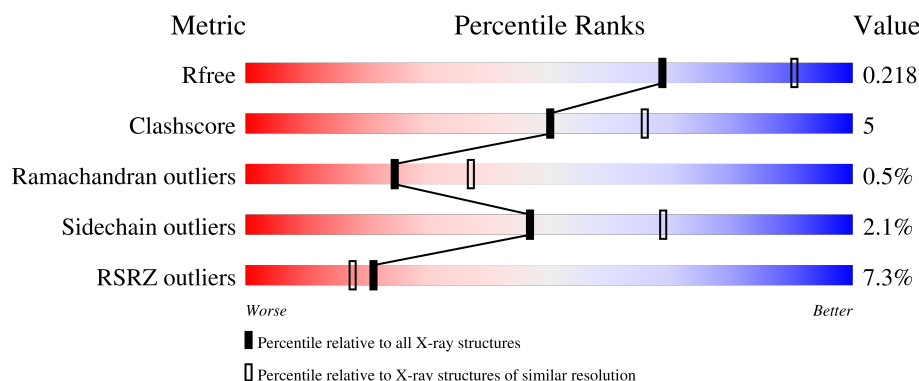
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 2.40 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}	180053	4912 (2.40-2.40)
Clashscore	190562	5391 (2.40-2.40)
Ramachandran outliers	187476	5320 (2.40-2.40)
Sidechain outliers	187428	5321 (2.40-2.40)
RSRZ outliers	180081	4916 (2.40-2.40)

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	389	 3% 72% 10% 18%
1	B	389	 9% 70% 13% 17%

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
2	SO4	B	501	-	-	X	-

2 Entry composition

There are 3 unique types of molecules in this entry. The entry contains 5138 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 DNA primase.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	320	Total	C	N	O	S	0	2	0
			2428	1543	430	448	7			
1	B	321	Total	C	N	O	S	0	0	0
			2433	1542	436	448	7			

There are 16 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	98	MET	-	initiating methionine	UNP Q9I5W0
A	99	ALA	-	expression tag	UNP Q9I5W0
A	100	HIS	-	expression tag	UNP Q9I5W0
A	101	HIS	-	expression tag	UNP Q9I5W0
A	102	HIS	-	expression tag	UNP Q9I5W0
A	103	HIS	-	expression tag	UNP Q9I5W0
A	104	HIS	-	expression tag	UNP Q9I5W0
A	105	HIS	-	expression tag	UNP Q9I5W0
B	98	MET	-	initiating methionine	UNP Q9I5W0
B	99	ALA	-	expression tag	UNP Q9I5W0
B	100	HIS	-	expression tag	UNP Q9I5W0
B	101	HIS	-	expression tag	UNP Q9I5W0
B	102	HIS	-	expression tag	UNP Q9I5W0
B	103	HIS	-	expression tag	UNP Q9I5W0
B	104	HIS	-	expression tag	UNP Q9I5W0
B	105	HIS	-	expression tag	UNP Q9I5W0

- Molecule 2 is SULFATE ION (CCD ID: SO4) (formula: O₄S).



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

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

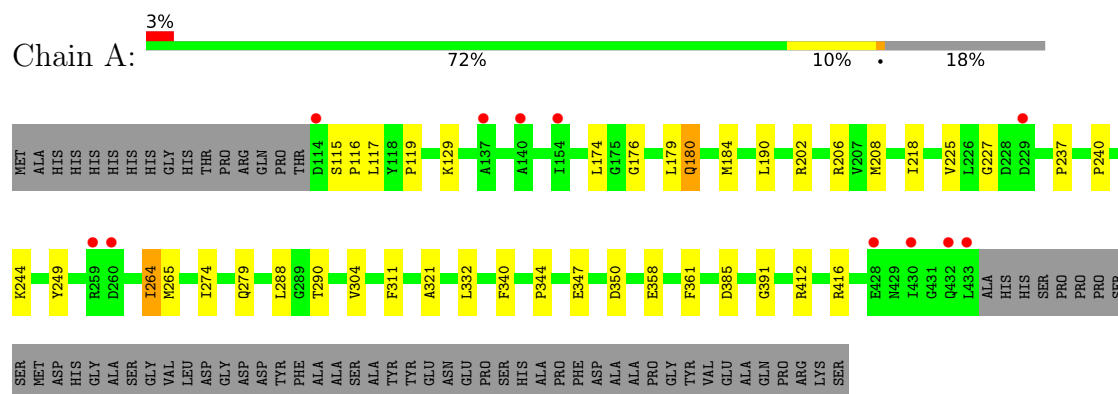
- Molecule 3 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
3	A	87	Total	O	0	0
			87	87		
3	B	115	Total	O	0	0
			115	115		

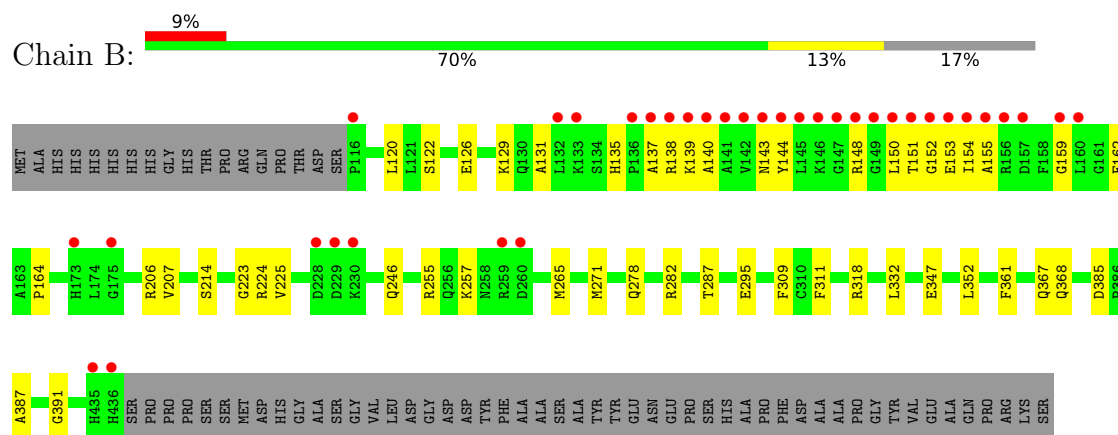
3 Residue-property plots

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: DNA primase



• Molecule 1: DNA primase



4 Data and refinement statistics

Property	Value	Source
Space group	P 32 2 1	Depositor
Cell constants a, b, c, α , β , γ	142.30Å 142.30Å 106.46Å 90.00° 90.00° 120.00°	Depositor
Resolution (Å)	48.87 – 2.40 48.87 – 2.40	Depositor EDS
% Data completeness (in resolution range)	100.0 (48.87-2.40) 100.0 (48.87-2.40)	Depositor EDS
R_{merge}	0.06	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	3.20 (at 2.39Å)	Xtriage
Refinement program	PHENIX	Depositor
R, R_{free}	0.187 , 0.214 0.192 , 0.218	Depositor DCC
R_{free} test set	2109 reflections (4.31%)	wwPDB-VP
Wilson B-factor (Å ²)	47.1	Xtriage
Anisotropy	0.197	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.34 , 61.9	EDS
L-test for twinning ²	$\langle L \rangle = 0.49$, $\langle L^2 \rangle = 0.32$	Xtriage
Estimated twinning fraction	0.026 for -h,-k,l	Xtriage
F_o, F_c correlation	0.95	EDS
Total number of atoms	5138	wwPDB-VP
Average B, all atoms (Å ²)	59.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 3.29% 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: 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	0.30	0/2483	0.48	0/3370
1	B	0.35	0/2483	0.54	0/3365
All	All	0.33	0/4966	0.51	0/6735

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

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	2428	0	2355	24	0
1	B	2433	0	2350	27	0
2	A	30	0	0	0	0
2	B	45	0	0	4	0
3	A	87	0	0	1	0
3	B	115	0	0	2	0
All	All	5138	0	4705	51	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 5.

All (51) 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:225:VAL:HG22	1:A:227:GLY:H	1.53	0.72
1:B:137:ALA:O	1:B:139:LYS:N	2.26	0.69
1:B:367:GLN:HG3	1:B:368:GLN:HG3	1.74	0.68
1:B:150:LEU:O	1:B:152:GLY:N	2.24	0.66
1:B:140:ALA:HA	1:B:143:ASN:HB2	1.78	0.66
1:B:257:LYS:HD3	1:B:282:ARG:HD3	1.77	0.65
1:A:344:PRO:HG2	1:A:347:GLU:HG3	1.81	0.61
1:A:311:PHE:HE2	1:A:340:PHE:HD2	1.51	0.58
1:B:385:ASP:O	1:B:391:GLY:HA3	2.03	0.58
1:A:129:LYS:NZ	3:A:602:HOH:O	2.39	0.55
1:B:309:PHE:HB3	1:B:311:PHE:CE2	2.43	0.54
1:A:184:MET:HE2	1:A:190:LEU:HD21	1.90	0.54
1:A:265:MET:HE1	1:A:361:PHE:HE1	1.73	0.53
1:B:347:GLU:HG3	1:B:352:LEU:HB2	1.89	0.53
1:A:279:GLN:O	1:A:358:GLU:HB2	2.09	0.52
1:B:153:GLU:N	1:B:153:GLU:OE1	2.41	0.51
1:B:207:VAL:O	1:B:223:GLY:HA2	2.10	0.51
1:B:144:TYR:OH	2:B:501:SO4:O1	2.28	0.51
1:A:206:ARG:HG2	1:A:225:VAL:HA	1.92	0.50
1:A:265:MET:HE1	1:A:361:PHE:CE1	2.46	0.50
1:A:244:LYS:HB3	1:A:290:THR:HG21	1.92	0.50
1:B:265:MET:HE1	1:B:361:PHE:HE1	1.76	0.50
1:B:131:ALA:HA	1:B:135:HIS:HB2	1.95	0.49
1:A:116:PRO:O	1:A:119:PRO:HD2	2.13	0.48
1:B:278:GLN:NE2	3:B:607:HOH:O	2.45	0.48
1:A:218:ILE:HD12	1:A:218:ILE:H	1.78	0.48
1:A:206:ARG:HB2	1:A:208:MET:CE	2.44	0.47
1:B:154:ILE:HD13	1:B:278:GLN:HB2	1.96	0.47
1:A:179:LEU:HD23	1:A:179:LEU:HA	1.72	0.47
1:A:249:TYR:HB2	1:A:288:LEU:HD21	1.96	0.47
1:B:255:ARG:NH1	2:B:506:SO4:O1	2.47	0.45
1:B:265:MET:HE1	1:B:361:PHE:CE1	2.51	0.45
1:A:311:PHE:CZ	1:A:321:ALA:HA	2.53	0.44
1:A:176:GLY:HA3	1:A:180:GLN:HG2	1.99	0.43
1:B:155:ALA:O	1:B:159:GLY:N	2.51	0.43
1:A:264:ILE:HG12	1:A:304:VAL:HG11	2.01	0.43
1:B:126:GLU:HA	1:B:129:LYS:HG2	2.01	0.43
1:A:412:ARG:O	1:A:416:ARG:HG3	2.18	0.42
1:A:117:LEU:HD11	1:A:240:PRO:HG2	2.01	0.42
1:B:318:ARG:NH2	3:B:601:HOH:O	2.22	0.42
1:A:385:ASP:O	1:A:391:GLY:HA3	2.20	0.42

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:B:387:ALA:HB3	2:B:503:SO4:O3	2.19	0.42
1:B:120:LEU:HD23	1:B:120:LEU:HA	1.89	0.42
1:B:162:PHE:CZ	1:B:164:PRO:HA	2.54	0.41
1:B:332:LEU:HD12	1:B:332:LEU:HA	1.96	0.41
1:B:246:GLN:HG2	1:B:295:GLU:HG2	2.03	0.41
1:B:206:ARG:HG2	1:B:225:VAL:HA	2.02	0.41
1:B:148:ARG:NH2	2:B:501:SO4:O2	2.52	0.41
1:A:288:LEU:HD23	1:A:288:LEU:HA	1.86	0.40
1:A:202:ARG:CZ	1:A:237:PRO:HD3	2.52	0.40
1:A:332:LEU:HD12	1:A:332:LEU:HA	1.91	0.40

There are no symmetry-related clashes.

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	320/389 (82%)	312 (98%)	7 (2%)	1 (0%)	36	50
1	B	319/389 (82%)	297 (93%)	20 (6%)	2 (1%)	21	32
All	All	639/778 (82%)	609 (95%)	27 (4%)	3 (0%)	24	37

All (3) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	B	138	ARG
1	B	151	THR
1	A	350	ASP

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	237/312 (76%)	232 (98%)	5 (2%)	47	69
1	B	235/312 (75%)	230 (98%)	5 (2%)	47	69
All	All	472/624 (76%)	462 (98%)	10 (2%)	47	69

All (10) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	115	SER
1	A	174	LEU
1	A	180	GLN
1	A	264	ILE
1	A	274	ILE
1	B	122	SER
1	B	214	SER
1	B	224	ARG
1	B	271	MET
1	B	287	THR

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (5) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	143	ASN
1	A	243	HIS
1	A	379	GLN
1	B	278	GLN
1	B	333	GLN

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 ⓘ

15 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	$\# Z > 2$
2	SO4	A	504	-	4,4,4	0.27	0	6,6,6	0.09	0
2	SO4	B	507	-	4,4,4	0.24	0	6,6,6	0.30	0
2	SO4	A	501	-	4,4,4	0.25	0	6,6,6	0.28	0
2	SO4	A	506	-	4,4,4	0.26	0	6,6,6	0.06	0
2	SO4	B	508	-	4,4,4	0.26	0	6,6,6	0.11	0
2	SO4	B	501	-	4,4,4	0.34	0	6,6,6	0.39	0
2	SO4	B	504	-	4,4,4	0.24	0	6,6,6	0.18	0
2	SO4	B	503	-	4,4,4	0.29	0	6,6,6	0.40	0
2	SO4	A	505	-	4,4,4	0.24	0	6,6,6	0.12	0
2	SO4	A	503	-	4,4,4	0.27	0	6,6,6	0.29	0
2	SO4	B	506	-	4,4,4	0.23	0	6,6,6	0.13	0
2	SO4	B	502	-	4,4,4	0.28	0	6,6,6	0.16	0
2	SO4	A	502	-	4,4,4	0.21	0	6,6,6	0.16	0
2	SO4	B	505	-	4,4,4	0.26	0	6,6,6	0.17	0
2	SO4	B	509	-	4,4,4	0.22	0	6,6,6	0.12	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.

3 monomers are involved in 4 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
2	B	501	SO4	2	0
2	B	503	SO4	1	0
2	B	506	SO4	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

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	320/389 (82%)	0.02	11 (3%) 48 44	24, 57, 103, 136	2 (0%)
1	B	321/389 (82%)	0.24	36 (11%) 10 7	33, 51, 99, 128	0
All	All	641/778 (82%)	0.13	47 (7%) 21 17	24, 54, 101, 136	2 (0%)

All (47) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	B	436	HIS	6.0
1	B	229	ASP	5.9
1	B	116	PRO	5.9
1	A	114	ASP	5.0
1	B	228	ASP	5.0
1	B	151	THR	5.0
1	A	229	ASP	4.6
1	B	143	ASN	4.5
1	B	142	VAL	4.4
1	B	152	GLY	4.3
1	A	433	LEU	4.1
1	B	150	LEU	4.1
1	B	259	ARG	4.1
1	B	157	ASP	3.8
1	A	432	GLN	3.7
1	B	144	TYR	3.6
1	B	147	GLY	3.5
1	B	132	LEU	3.4
1	B	155	ALA	3.2
1	B	260	ASP	3.2
1	B	138	ARG	3.2
1	B	133	LYS	3.2
1	B	145	LEU	3.1
1	A	259	ARG	3.1

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Mol	Chain	Res	Type	RSRZ
1	B	146	LYS	3.0
1	B	160	LEU	2.9
1	B	141	ALA	2.8
1	B	149	GLY	2.7
1	B	156	ARG	2.7
1	B	173	HIS	2.6
1	B	435	HIS	2.6
1	B	153	GLU	2.5
1	B	139	LYS	2.4
1	B	159	GLY	2.4
1	B	137	ALA	2.4
1	A	154	ILE	2.3
1	A	430	ILE	2.3
1	A	428	GLU	2.3
1	B	140	ALA	2.3
1	A	137	ALA	2.2
1	A	140	ALA	2.2
1	B	136	PRO	2.2
1	B	148	ARG	2.1
1	B	175	GLY	2.1
1	B	230	LYS	2.1
1	A	260	ASP	2.1
1	B	154	ILE	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.

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Mol	Type	Chain	Res	Atoms	RSCC	RSR	B-factors($\text{\AA}^2$)	Q<0.9
2	SO4	A	504	5/5	0.61	0.18	118,127,129,130	0
2	SO4	A	506	5/5	0.64	0.15	157,157,158,163	0
2	SO4	A	501	5/5	0.66	0.18	115,124,126,127	0
2	SO4	B	509	5/5	0.69	0.15	148,149,149,151	0
2	SO4	A	505	5/5	0.72	0.12	143,144,144,145	0
2	SO4	B	508	5/5	0.75	0.22	145,148,153,153	0
2	SO4	B	507	5/5	0.76	0.17	122,124,127,128	0
2	SO4	B	506	5/5	0.77	0.14	132,134,135,136	0
2	SO4	B	503	5/5	0.78	0.32	109,118,124,127	0
2	SO4	B	501	5/5	0.86	0.13	67,89,92,98	0
2	SO4	B	502	5/5	0.88	0.21	97,101,114,115	0
2	SO4	A	502	5/5	0.89	0.19	98,113,119,122	0
2	SO4	B	504	5/5	0.90	0.10	85,91,96,98	0
2	SO4	B	505	5/5	0.93	0.14	71,77,84,88	0
2	SO4	A	503	5/5	0.96	0.12	62,64,69,76	0

6.5 Other polymers [i](#)

There are no such residues in this entry.