



# Full wwPDB X-ray Structure Validation Report ⓘ

Feb 1, 2016 – 08:58 AM GMT

PDB ID : 3GRI  
Title : The Crystal Structure of a Dihydroorotase from Staphylococcus aureus  
Authors : Brunzelle, J.S.; Wawrzak, Z.; Skarina, T.; Onopriyenko, O.; Savchenko, A.; Anderson, W.F.; Center for Structural Genomics of Infectious Diseases (CS-GID)  
Deposited on : 2009-03-25  
Resolution : 2.00 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  
<http://wwpdb.org/validation/2016/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 : 1.7 (RC4), CSD as536be (2015)  
Xtriage (Phenix) : 1.9-1692  
EDS : rb-20026688  
Percentile statistics : 20151230.v01 (using entries in the PDB archive December 30th 2015)  
Refmac : 5.8.0135  
CCP4 : 6.5.0  
Ideal geometry (proteins) : Engh & Huber (2001)  
Ideal geometry (DNA, RNA) : Parkinson et al. (1996)  
Validation Pipeline (wwPDB-VP) : trunk26865

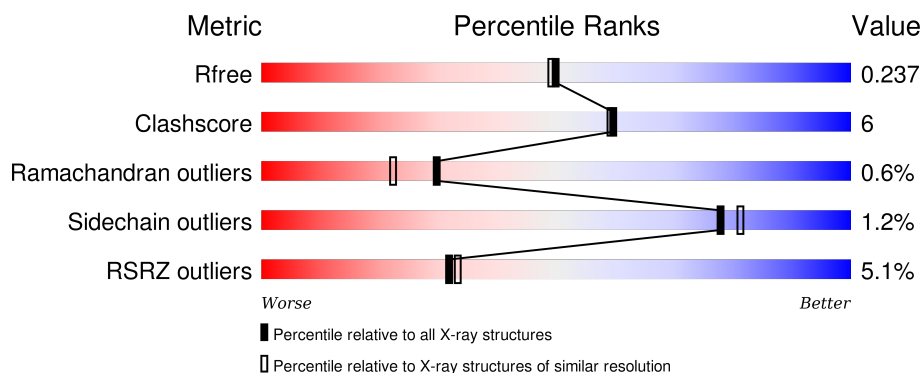
# 1 Overall quality at a glance ⓘ

The following experimental techniques were used to determine the structure:

## *X-RAY DIFFRACTION*

The reported resolution of this entry is 2.00 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))
$R_{free}$	91344	6249 (2.00-2.00)
Clashscore	102246	7340 (2.00-2.00)
Ramachandran outliers	100387	7248 (2.00-2.00)
Sidechain outliers	100360	7247 (2.00-2.00)
RSRZ outliers	91569	6262 (2.00-2.00)

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. 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	424	<div> <div>5%</div> <div>82%</div> <div>17%</div> <div>.</div> </div>
1	B	424	<div> <div>5%</div> <div>90%</div> <div>9%</div> </div>

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
4	CA	B	700	-	-	-	X

## 2 Entry composition

There are 5 unique types of molecules in this entry. The entry contains 6952 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 Dihydroorotase.

Mol	Chain	Residues	Atoms						ZeroOcc	AltConf	Trace
1	A	422	Total	C	N	O	S	Se	10	1	0
			3221	2036	547	621	8	9			
1	B	423	Total	C	N	O	S	Se	0	0	0
			3244	2048	548	632	7	9			

- Molecule 2 is ZINC ION (three-letter code: ZN) (formula: Zn).

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
2	B	1	Total	Zn	0	0
			1	1		
2	A	1	Total	Zn	0	0
			1	1		

- Molecule 3 is CHLORIDE ION (three-letter code: CL) (formula: Cl).

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
3	B	1	Total	Cl	0	0
			1	1		
3	A	2	Total	Cl	0	0
			2	2		

- Molecule 4 is CALCIUM ION (three-letter code: CA) (formula: Ca).

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
4	B	2	Total	Ca	0	0
			2	2		
4	A	2	Total	Ca	0	0
			2	2		

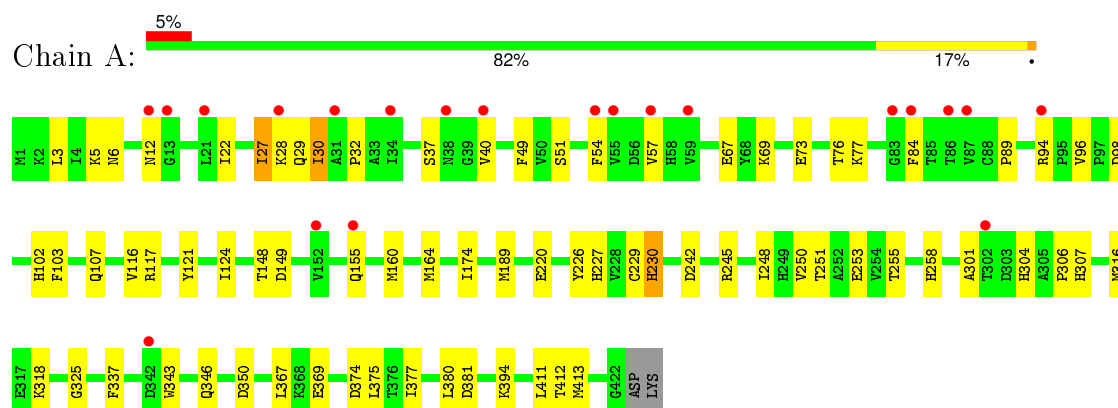
- Molecule 5 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
5	A	236	Total 236	O 236	0	0
5	B	242	Total 242	O 242	0	0

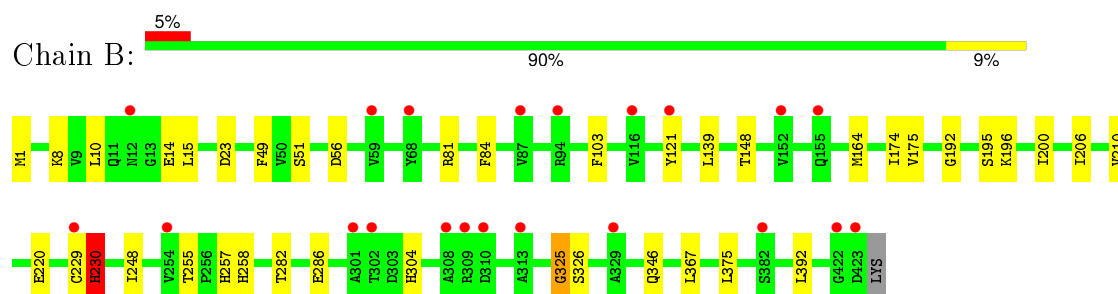
### 3 Residue-property plots

These plots are drawn for all protein, RNA and DNA chains in the entry. The first graphic for a chain summarises the proportions of errors 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: Dihydroorotase



#### • Molecule 1: Dihydroorotase



## 4 Data and refinement statistics

Property	Value	Source
Space group	P 1	Depositor
Cell constants a, b, c, $\alpha$ , $\beta$ , $\gamma$	50.22Å 55.23Å 85.65Å 88.33° 76.56° 76.97°	Depositor
Resolution (Å)	30.00 – 2.00 28.26 – 1.95	Depositor EDS
% Data completeness (in resolution range)	97.8 (30.00-2.00) 96.8 (28.26-1.95)	Depositor EDS
$R_{merge}$	0.08	Depositor
$R_{sym}$	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ <sup>1</sup>	3.75 (at 1.95Å)	Xtriage
Refinement program	REFMAC 5.2.0019	Depositor
R, $R_{free}$	0.189 , 0.237 0.191 , 0.237	Depositor DCC
$R_{free}$ test set	2934 reflections (5.37%)	DCC
Wilson B-factor (Å <sup>2</sup> )	27.6	Xtriage
Anisotropy	0.114	Xtriage
Bulk solvent $k_{sol}$ (e/Å <sup>3</sup> ), $B_{sol}$ (Å <sup>2</sup> )	0.35 , 46.1	EDS
Estimated twinning fraction	No twinning to report.	Xtriage
L-test for twinning <sup>2</sup>	$\langle  L  \rangle = 0.50$ , $\langle L^2 \rangle = 0.33$	Xtriage
Outliers	0 of 61661 reflections	Xtriage
$F_o, F_c$ correlation	0.95	EDS
Total number of atoms	6952	wwPDB-VP
Average B, all atoms (Å <sup>2</sup> )	26.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 6.42% 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, 0.375 respectively for untwinned datasets, and 0.333, 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: ZN, CA, 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	0.70	10/3278 (0.3%)	0.73	2/4436 (0.0%)
1	B	0.52	0/3301	0.66	0/4466
All	All	0.62	10/6579 (0.2%)	0.70	2/8902 (0.0%)

All (10) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	A	6	ASN	CG-OD1	8.98	1.43	1.24
1	A	28	LYS	C-O	8.76	1.40	1.23
1	A	5	LYS	CB-CG	-7.97	1.31	1.52
1	A	369	GLU	CD-OE2	7.70	1.34	1.25
1	A	6	ASN	CG-ND2	7.16	1.50	1.32
1	A	30	ILE	C-O	6.08	1.34	1.23
1	A	32	PRO	N-CD	6.01	1.56	1.47
1	A	29	GLN	C-O	-5.54	1.12	1.23
1	A	32	PRO	CG-CD	5.39	1.68	1.50
1	A	318	LYS	CG-CD	-5.32	1.34	1.52

All (2) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	5	LYS	CA-CB-CG	8.32	131.70	113.40
1	A	318	LYS	CB-CG-CD	8.19	132.89	111.60

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	3221	0	3174	46	0
1	B	3244	0	3205	27	0
2	A	1	0	0	0	0
2	B	1	0	0	0	0
3	A	2	0	0	0	0
3	B	1	0	0	0	0
4	A	2	0	0	0	0
4	B	2	0	0	0	0
5	A	236	0	0	4	0
5	B	242	0	0	1	0
All	All	6952	0	6379	73	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 6.

All (73) 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:367:LEU:CD1	1:A:375:LEU:HD21	1.62	1.26
1:A:367:LEU:HD13	1:A:375:LEU:HD21	1.19	1.11
1:A:367:LEU:HD13	1:A:375:LEU:CD2	1.96	0.94
1:A:367:LEU:HD11	1:A:375:LEU:HD21	1.49	0.91
1:A:69:LYS:NZ	1:A:307:HIS:HD2	1.83	0.76
1:B:121:TYR:CD1	1:B:148:THR:OG1	2.39	0.75
1:B:14:GLU:HG3	1:B:15:LEU:H	1.55	0.71
1:A:57:VAL:O	1:A:121:TYR:OH	2.04	0.69
1:A:227:HIS:HE1	1:A:253:GLU:OE1	1.79	0.66
1:A:375:LEU:HB2	1:A:413:MSE:HE2	1.77	0.66
1:A:381:ASP:HB2	5:A:435:HOH:O	1.95	0.66
1:B:121:TYR:HE1	1:B:175:VAL:HG21	1.62	0.64
1:A:242:ASP:OD1	1:A:245:ARG:NH2	2.31	0.63
1:A:155:GLN:HB3	5:A:657:HOH:O	1.99	0.62
1:A:121:TYR:CD1	1:A:148:THR:OG1	2.53	0.62
1:A:69:LYS:HZ2	1:A:307:HIS:HD2	1.48	0.61
1:B:255:THR:OG1	1:B:258:HIS:HD2	1.83	0.60

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:367:LEU:CD1	1:A:375:LEU:CD2	2.57	0.60
1:A:49:PHE:CZ	1:A:51:SER:HB2	2.37	0.59
1:B:282:THR:O	1:B:286:GLU:HG3	2.03	0.59
1:B:49:PHE:CZ	1:B:51:SER:HB2	2.38	0.59
1:B:121:TYR:HD1	1:B:148:THR:OG1	1.82	0.57
1:A:377:ILE:HD12	1:A:411:LEU:HD23	1.87	0.57
1:A:155:GLN:CB	5:A:657:HOH:O	2.53	0.56
1:A:164:MSE:HG2	1:A:174:ILE:HG13	1.87	0.56
1:B:192:GLY:O	1:B:196:LYS:HD3	2.06	0.56
1:B:14:GLU:HG3	1:B:15:LEU:N	2.21	0.56
1:A:121:TYR:HD1	1:A:148:THR:OG1	1.88	0.56
1:A:27:ILE:HG13	1:A:27:ILE:O	2.04	0.55
1:B:1:MSE:HE3	1:B:23:ASP:HB2	1.88	0.55
1:B:164:MSE:HG2	1:B:174:ILE:HG13	1.89	0.54
1:B:304:HIS:HD2	1:B:325:GLY:H	1.56	0.52
1:B:257:HIS:CD2	1:B:257:HIS:H	2.26	0.52
1:B:81:ARG:NH1	5:B:650:HOH:O	2.41	0.52
1:A:73:GLU:O	1:A:77:LYS:HG3	2.09	0.52
1:A:69:LYS:HZ1	1:A:307:HIS:HD2	1.54	0.52
1:A:67:GLU:O	1:A:394:LYS:NZ	2.30	0.52
1:A:117:ARG:NH2	1:A:374:ASP:OD2	2.42	0.51
1:A:107:GLN:HG3	5:A:481:HOH:O	2.12	0.50
1:B:367:LEU:HD21	1:B:375:LEU:HB3	1.94	0.50
1:B:206:ILE:O	1:B:210:VAL:HG22	2.12	0.49
1:A:255:THR:OG1	1:A:258:HIS:HD2	1.96	0.49
1:A:54:PHE:HB2	1:A:84:PHE:CD1	2.47	0.48
1:B:10:LEU:HB3	1:B:346:GLN:HE22	1.79	0.48
1:B:195:SER:HB2	1:B:200:ILE:O	2.14	0.48
1:A:22:ILE:HD13	1:A:413:MSE:SE	2.65	0.47
1:B:49:PHE:CE2	1:B:51:SER:HB2	2.50	0.47
1:A:89:PRO:O	1:A:121:TYR:HD2	1.98	0.46
1:A:124:ILE:HD12	1:A:149:ASP:HB2	1.97	0.46
1:A:76:THR:HB	1:A:116:VAL:HG22	1.96	0.46
1:A:220:GLU:HB2	1:A:248:ILE:HG12	1.96	0.46
1:B:56:ASP:HB2	1:B:84:PHE:CD1	2.51	0.46
1:A:94:ARG:HH21	1:A:96:VAL:H	1.64	0.46
1:A:69:LYS:HZ1	1:A:307:HIS:CD2	2.34	0.45
1:A:226:TYR:O	1:A:250:VAL:HA	2.17	0.45
1:A:227:HIS:HD2	1:A:251:THR:OG1	2.00	0.44
1:B:14:GLU:CG	1:B:15:LEU:H	2.27	0.44
1:B:8:LYS:HB3	1:B:15:LEU:HB3	1.99	0.44

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:229:CYS:O	1:A:230:HIS:C	2.57	0.44
1:A:304:HIS:CD2	1:A:306:PRO:HD3	2.53	0.43
1:B:255:THR:OG1	1:B:258:HIS:CD2	2.66	0.43
1:B:81:ARG:HD3	1:B:392:LEU:HG	1.99	0.43
1:A:411:LEU:HD12	1:A:412:THR:N	2.34	0.42
1:A:337:PHE:HB3	1:A:343:TRP:CG	2.54	0.42
1:B:304:HIS:HD2	1:B:326:SER:H	1.68	0.42
1:A:255:THR:HA	1:A:301:ALA:O	2.19	0.42
1:A:189:MSE:HB3	1:A:316:MSE:HE1	2.00	0.41
1:A:346:GLN:OE1	1:A:350:ASP:OD1	2.38	0.41
1:A:37:SER:H	1:A:40:VAL:HG21	1.86	0.41
1:A:27:ILE:CD1	1:A:30:ILE:HG13	2.50	0.41
1:A:98:ASP:OD1	1:A:102:HIS:HD2	2.04	0.41
1:B:220:GLU:HB2	1:B:248:ILE:HG12	2.04	0.40
1:B:229:CYS:O	1:B:230:HIS:C	2.59	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	421/424 (99%)	394 (94%)	24 (6%)	3 (1%)	26	19
1	B	421/424 (99%)	401 (95%)	18 (4%)	2 (0%)	34	26
All	All	842/848 (99%)	795 (94%)	42 (5%)	5 (1%)	30	22

All (5) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	230	HIS
1	B	230	HIS
1	A	12	ASN

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Mol	Chain	Res	Type
1	B	325	GLY
1	A	325	GLY

### 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	343/343 (100%)	338 (98%)	5 (2%)	72	75
1	B	350/343 (102%)	347 (99%)	3 (1%)	84	88
All	All	693/686 (101%)	685 (99%)	8 (1%)	78	81

All (8) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	3	LEU
1	A	27	ILE
1	A	103	PHE
1	A	160	MSE
1	A	380	LEU
1	B	103	PHE
1	B	139	LEU
1	B	230	HIS

Some sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (15) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	12	ASN
1	A	102	HIS
1	A	115	GLN
1	A	227	HIS
1	A	258	HIS
1	A	307	HIS
1	A	346	GLN
1	A	370	ASN

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Mol	Chain	Res	Type
1	B	177	HIS
1	B	257	HIS
1	B	258	HIS
1	B	304	HIS
1	B	314	GLN
1	B	346	GLN
1	B	370	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 carbohydrates in this entry.

## 5.6 Ligand geometry ⓘ

Of 9 ligands modelled in this entry, 9 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 ⓘ

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, 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	413/424 (97%)	0.26	21 (5%) 32 33	14, 25, 40, 44	4 (0%)
1	B	414/424 (97%)	0.24	21 (5%) 32 33	12, 26, 39, 43	0
All	All	827/848 (97%)	0.25	42 (5%) 32 33	12, 25, 39, 44	4 (0%)

All (42) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	34	ILE	3.8
1	A	152	VAL	3.7
1	B	152	VAL	3.7
1	B	423	ASP	3.4
1	A	21	LEU	3.4
1	B	308	ALA	3.3
1	A	84	PHE	3.3
1	A	155	GLN	3.2
1	B	155	GLN	3.1
1	A	57	VAL	3.1
1	B	12	ASN	3.1
1	A	87	VAL	3.1
1	A	59	VAL	3.1
1	B	59	VAL	3.1
1	B	116	VAL	3.0
1	B	302	THR	3.0
1	A	94	ARG	2.8
1	A	38	ASN	2.7
1	B	121	TYR	2.7
1	A	83	GLY	2.6
1	B	309	ARG	2.6
1	B	422	GLY	2.6
1	B	87	VAL	2.5
1	A	302	THR	2.5

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Mol	Chain	Res	Type	RSRZ
1	A	31	ALA	2.4
1	B	254	VAL	2.4
1	A	342	ASP	2.3
1	A	12	ASN	2.3
1	A	54	PHE	2.3
1	B	94	ARG	2.3
1	B	382	SER	2.2
1	A	86	THR	2.2
1	A	40	VAL	2.2
1	A	13	GLY	2.2
1	A	55	VAL	2.2
1	B	310	ASP	2.1
1	A	28	LYS	2.1
1	B	301	ALA	2.1
1	B	329	ALA	2.1
1	B	313	ALA	2.1
1	B	229	CYS	2.1
1	B	68	TYR	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 carbohydrates 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. LLDF column lists the quality of electron density of the group with respect to its neighbouring residues in protein, DNA or RNA chains. 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	LLDF	B-factors(Å <sup>2</sup> )	Q<0.9
4	CA	B	700	1/1	0.98	0.20	3.41	45,45,45,45	0
2	ZN	A	500	1/1	0.92	0.20	0.46	47,47,47,47	1
3	CL	B	600	1/1	0.96	0.13	-0.17	27,27,27,27	0

*Continued on next page...*



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Mol	Type	Chain	Res	Atoms	RSCC	RSR	LLDF	B-factors( $\text{\AA}^2$ )	Q<0.9
4	CA	A	701	1/1	0.99	0.10	-0.26	26,26,26,26	0
3	CL	A	600	1/1	0.97	0.12	-0.33	28,28,28,28	0
3	CL	A	601	1/1	0.76	0.15	-0.39	66,66,66,66	0
4	CA	B	701	1/1	0.98	0.09	-1.52	28,28,28,28	0
4	CA	A	700	1/1	0.99	0.19	-	34,34,34,34	0
2	ZN	B	500	1/1	0.90	0.26	-	42,42,42,42	1

## 6.5 Other polymers [i](#)

There are no such residues in this entry.