



# Full wwPDB X-ray Structure Validation Report ⓘ

Aug 20, 2020 – 05:41 PM BST

PDB ID : 2JAD  
Title : Yellow fluorescent protein - glutaredoxin fusion protein  
Authors : Hakansson, K.O.; Winther, J.R.  
Deposited on : 2006-11-27  
Resolution : 2.70 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.

---

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 : 2.13.1  
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) : 2.13.1

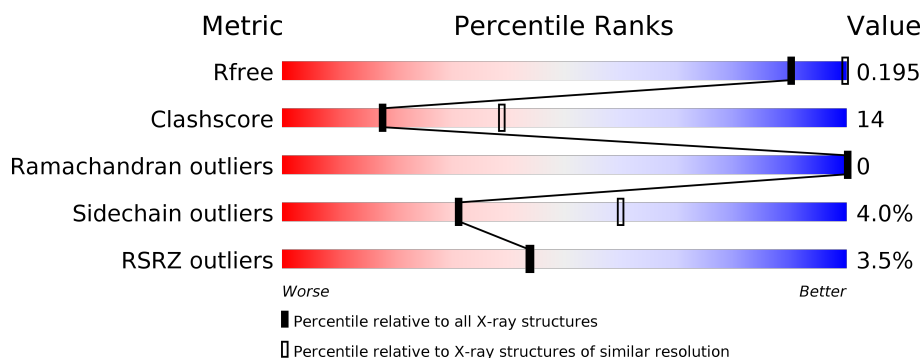
# 1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

## *X-RAY DIFFRACTION*

The reported resolution of this entry is 2.70 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	2808 (2.70-2.70)
Clashscore	141614	3122 (2.70-2.70)
Ramachandran outliers	138981	3069 (2.70-2.70)
Sidechain outliers	138945	3069 (2.70-2.70)
RSRZ outliers	127900	2737 (2.70-2.70)

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	362	<div> <div>3%</div> <div>67%</div> <div>27%</div> <div>• •</div> </div>

## 2 Entry composition

There are 3 unique types of molecules in this entry. The entry contains 2818 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 YELLOW FLUORESCENT PROTEIN GLUTAREDOXIN FUSION PROTEIN.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	347	Total	C	N	O	S	0	0	0
			2753	1752	466	525	10			

There are 19 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	68	LEU	VAL	conflict	UNP P42212
A	234	HIS	ASP	conflict	UNP P42212
A	239	SER	-	linker	UNP P42212
A	240	GLY	-	linker	UNP P42212
A	241	SER	-	linker	UNP P42212
A	242	GLY	-	linker	UNP P42212
A	243	SER	-	linker	UNP P42212
A	244	GLY	-	linker	UNP P42212
A	245	SER	-	linker	UNP P42212
A	246	GLY	-	linker	UNP P42212
A	276	SER	CYS	engineered mutation	UNP P25373
A	357	LEU	-	expression tag	UNP P42212
A	358	GLU	-	expression tag	UNP P42212
A	359	HIS	-	expression tag	UNP P42212
A	360	HIS	-	expression tag	UNP P42212
A	361	HIS	-	expression tag	UNP P42212
A	362	HIS	-	expression tag	UNP P42212
A	363	HIS	-	expression tag	UNP P42212
A	364	HIS	-	expression tag	UNP P42212

- Molecule 2 is SULFATE ION (three-letter code: SO4) (formula: O<sub>4</sub>S).



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		

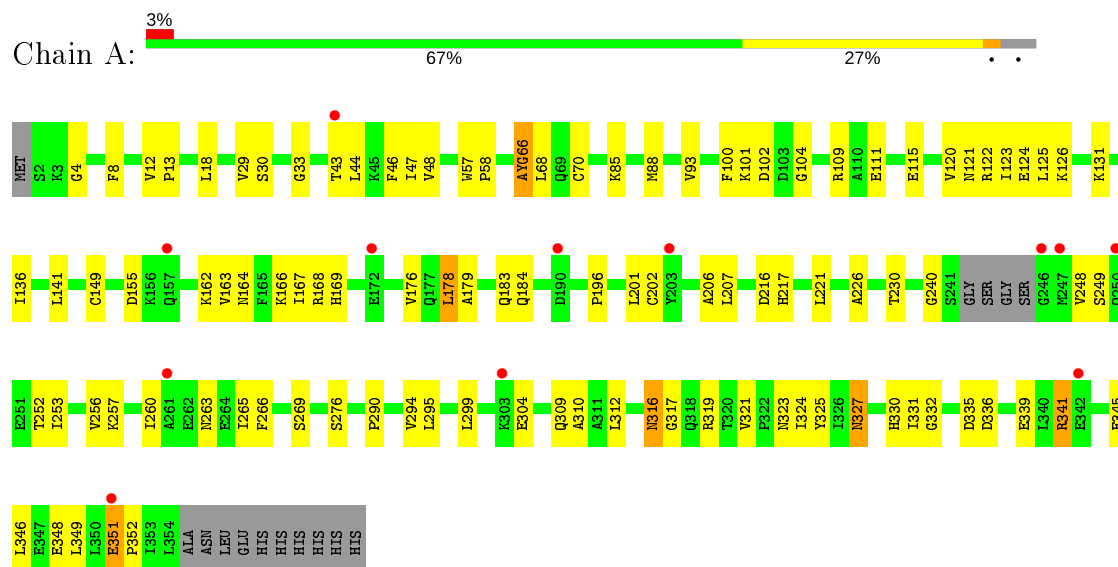
- Molecule 3 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
3	A	55	Total	O	0	0
			55	55		

### 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: YELLOW FLUORESCENT PROTEIN GLUTAREDOXIN FUSION PROTEIN



## 4 Data and refinement statistics

Property	Value	Source
Space group	P 64	Depositor
Cell constants a, b, c, $\alpha$ , $\beta$ , $\gamma$	132.11Å 132.11Å 58.72Å 90.00° 90.00° 120.00°	Depositor
Resolution (Å)	20.00 – 2.70 19.57 – 2.70	Depositor EDS
% Data completeness (in resolution range)	96.7 (20.00-2.70) 96.7 (19.57-2.70)	Depositor EDS
$R_{merge}$	0.10	Depositor
$R_{sym}$	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ <sup>1</sup>	1.61 (at 2.71Å)	Xtriage
Refinement program	CNS 1.0	Depositor
R, $R_{free}$	0.214 , 0.247 0.199 , 0.195	Depositor DCC
$R_{free}$ test set	806 reflections (5.13%)	wwPDB-VP
Wilson B-factor (Å <sup>2</sup> )	46.2	Xtriage
Anisotropy	0.002	Xtriage
Bulk solvent $k_{sol}$ (e/Å <sup>3</sup> ), $B_{sol}$ (Å <sup>2</sup> )	0.36 , 63.9	EDS
L-test for twinning <sup>2</sup>	$\langle  L  \rangle = 0.48$ , $\langle L^2 \rangle = 0.31$	Xtriage
Estimated twinning fraction	0.048 for h,-h-k,-l	Xtriage
$F_o, F_c$ correlation	0.93	EDS
Total number of atoms	2818	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 3.76% 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: PIA, 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	0.35	0/2789	0.63	0/3768

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	2753	0	2691	74	0
2	A	10	0	0	1	0
3	A	55	0	0	3	0
All	All	2818	0	2691	74	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 14.

All (74) 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:120:VAL:HG11	1:A:122:ARG:NH1	1.93	0.84

*Continued on next page...*

*Continued from previous page...*

Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:330:HIS:HE1	1:A:332:GLY:HA2	1.45	0.81
1:A:48:VAL:CG1	1:A:216:ASP:HB3	2.14	0.77
1:A:166:LYS:HD2	1:A:178:LEU:HD11	1.70	0.74
1:A:66:PIA:N2	1:A:66:PIA:HD1	2.03	0.73
1:A:330:HIS:CE1	1:A:332:GLY:HA2	2.25	0.72
1:A:48:VAL:HG11	1:A:216:ASP:HB3	1.72	0.71
1:A:125:LEU:C	1:A:125:LEU:HD23	2.12	0.69
1:A:346:LEU:HA	1:A:349:LEU:HD12	1.76	0.68
1:A:102:ASP:O	1:A:131:LYS:HE2	1.96	0.66
1:A:155:ASP:OD2	1:A:162:LYS:HE2	1.96	0.66
1:A:341:ARG:HG2	1:A:346:LEU:HD23	1.82	0.61
1:A:263:ASN:ND2	1:A:295:LEU:HD22	2.17	0.59
1:A:169:HIS:HB3	3:A:2034:HOH:O	2.01	0.59
1:A:163:VAL:C	1:A:164:ASN:HD22	2.06	0.58
1:A:33:GLY:HA3	1:A:43:THR:O	2.06	0.56
1:A:168:ARG:HB3	1:A:176:VAL:HG11	1.88	0.56
1:A:141:LEU:HB3	3:A:2034:HOH:O	2.07	0.55
1:A:269:SER:HB2	1:A:276:SER:HB3	1.88	0.55
1:A:115:GLU:OE1	1:A:122:ARG:NH1	2.40	0.54
1:A:48:VAL:HG12	1:A:216:ASP:O	2.07	0.54
1:A:101:LYS:HB2	1:A:178:LEU:HB3	1.89	0.54
1:A:345:GLU:O	1:A:348:GLU:HG2	2.08	0.53
1:A:43:THR:HG23	3:A:2005:HOH:O	2.08	0.53
1:A:4:GLY:HA2	1:A:85:LYS:O	2.10	0.52
1:A:201:LEU:HD23	1:A:226:ALA:HA	1.92	0.51
1:A:136:ILE:HD12	1:A:136:ILE:N	2.26	0.51
1:A:290:PRO:HA	2:A:1355:SO4:O2	2.10	0.51
1:A:125:LEU:HD23	1:A:126:LYS:N	2.25	0.51
1:A:8:PHE:HZ	1:A:88:MET:HG3	1.76	0.50
1:A:312:LEU:O	1:A:316:ASN:ND2	2.45	0.50
1:A:149:CYS:HA	1:A:202:CYS:HA	1.93	0.50
1:A:207:LEU:HD23	1:A:207:LEU:N	2.27	0.50
1:A:57:TRP:N	1:A:58:PRO:CD	2.75	0.49
1:A:120:VAL:HG11	1:A:122:ARG:HH12	1.77	0.49
1:A:266:PHE:HB3	1:A:325:TYR:HB2	1.94	0.49
1:A:167:ILE:HB	1:A:179:ALA:HB3	1.94	0.49
1:A:316:ASN:HD22	1:A:317:GLY:N	2.11	0.48
1:A:336:ASP:O	1:A:339:GLU:HB3	2.13	0.48
1:A:331:ILE:N	1:A:331:ILE:HD12	2.29	0.48
1:A:48:VAL:HG12	1:A:216:ASP:HB3	1.91	0.47
1:A:100:PHE:HB2	1:A:104:GLY:O	2.14	0.47

*Continued on next page...*



*Continued from previous page...*

Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:46:PHE:O	1:A:217:HIS:HB2	2.13	0.47
1:A:269:SER:HB2	1:A:276:SER:CB	2.43	0.47
1:A:206:ALA:C	1:A:207:LEU:HD23	2.36	0.46
1:A:248:VAL:CG1	1:A:252:THR:HB	2.45	0.46
1:A:299:LEU:HD13	1:A:309:GLN:HB2	1.97	0.46
1:A:269:SER:HA	1:A:321:VAL:HB	1.98	0.46
1:A:29:VAL:HG12	1:A:30:SER:N	2.31	0.46
1:A:163:VAL:HB	1:A:183:GLN:HB3	1.98	0.46
1:A:43:THR:HG22	1:A:221:LEU:CD1	2.46	0.46
1:A:248:VAL:HG21	1:A:310:ALA:HB3	1.97	0.45
1:A:29:VAL:HG13	1:A:47:ILE:O	2.16	0.45
1:A:109:ARG:HH11	1:A:109:ARG:HG2	1.82	0.44
1:A:125:LEU:CD2	1:A:125:LEU:C	2.82	0.44
1:A:324:ILE:HG22	1:A:325:TYR:N	2.32	0.44
1:A:123:ILE:HG22	1:A:124:GLU:N	2.32	0.44
1:A:44:LEU:HD13	1:A:46:PHE:HZ	1.82	0.44
1:A:68:LEU:HD21	1:A:121:ASN:HB2	1.99	0.44
1:A:93:VAL:HG22	1:A:111:GLU:HG2	1.98	0.44
1:A:43:THR:HG22	1:A:221:LEU:HD11	1.98	0.44
1:A:327:ASN:HA	1:A:327:ASN:HD22	1.60	0.43
1:A:256:VAL:O	1:A:260:ILE:HG13	2.18	0.43
1:A:351:GLU:HB3	1:A:352:PRO:CD	2.49	0.43
1:A:265:ILE:HG22	1:A:294:VAL:HG13	2.02	0.42
1:A:240:GLY:O	1:A:319:ARG:HD2	2.20	0.42
1:A:18:LEU:HD23	1:A:18:LEU:C	2.38	0.42
1:A:330:HIS:CE1	1:A:332:GLY:CA	3.00	0.42
1:A:253:ILE:HG22	1:A:257:LYS:HE3	2.01	0.41
1:A:263:ASN:ND2	1:A:295:LEU:CD2	2.84	0.41
1:A:249:SER:O	1:A:253:ILE:HG12	2.21	0.41
1:A:12:VAL:HA	1:A:13:PRO:HD3	1.89	0.40
1:A:265:ILE:CG2	1:A:294:VAL:HG13	2.51	0.40
1:A:263:ASN:HD21	1:A:295:LEU:HD22	1.84	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	340/362 (94%)	325 (96%)	15 (4%)	0	100	100

There are no Ramachandran outliers to report.

### 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	297/313 (95%)	285 (96%)	12 (4%)	31	60

All (12) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	70	CYS
1	A	178	LEU
1	A	184	GLN
1	A	196	PRO
1	A	230	THR
1	A	304	GLU
1	A	316	ASN
1	A	323	ASN
1	A	327	ASN
1	A	335	ASP
1	A	341	ARG
1	A	351	GLU

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

Mol	Chain	Res	Type
1	A	164	ASN
1	A	184	GLN

*Continued on next page...*

*Continued from previous page...*

Mol	Chain	Res	Type
1	A	234	HIS
1	A	263	ASN
1	A	323	ASN
1	A	327	ASN
1	A	330	HIS

### 5.3.3 RNA ⓘ

There are no RNA molecules in this entry.

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

1 non-standard protein/DNA/RNA residue is 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
1	PIA	A	66	1	21,21,22	5.39	6 (28%)	27,29,31	3.61	6 (22%)

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
1	PIA	A	66	1	-	0/8/27/28	0/2/2/2

All (6) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	A	66	PIA	CB2-CA2	22.00	1.53	1.35
1	A	66	PIA	CA2-C2	-9.40	1.39	1.48
1	A	66	PIA	CG2-CB2	3.45	1.53	1.46
1	A	66	PIA	C2-N3	-2.88	1.33	1.39

*Continued on next page...*

*Continued from previous page...*

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	A	66	PIA	C1-N3	-2.25	1.33	1.37
1	A	66	PIA	CA2-N2	-2.24	1.33	1.38

All (6) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	66	PIA	CG2-CB2-CA2	-11.76	115.54	129.94
1	A	66	PIA	CA2-C2-N3	9.86	108.03	103.37
1	A	66	PIA	O2-C2-CA2	-8.69	126.08	130.96
1	A	66	PIA	C2-CA2-N2	-3.32	106.61	108.93
1	A	66	PIA	CA2-N2-C1	2.83	107.86	105.77
1	A	66	PIA	N3-C1-N2	-2.03	110.05	111.45

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
1	A	66	PIA	1	0

## 5.5 Carbohydrates [i](#)

There are no monosaccharides in this entry.

## 5.6 Ligand geometry [i](#)

2 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	1356	-	4,4,4	0.29	0	6,6,6	0.10	0
2	SO4	A	1355	-	4,4,4	0.25	0	6,6,6	0.07	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
2	A	1355	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 [i](#)

### 6.1 Protein, DNA and RNA chains [i](#)

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	346/362 (95%)	0.06	12 (3%) 44 44	6, 47, 85, 118	4 (1%)

All (12) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	43	THR	6.5
1	A	303	LYS	3.7
1	A	247	MET	3.6
1	A	351	GLU	3.6
1	A	203	TYR	3.3
1	A	190	ASP	2.7
1	A	261	ALA	2.7
1	A	250	GLN	2.5
1	A	246	GLY	2.4
1	A	157	GLN	2.2
1	A	172	GLU	2.1
1	A	342	GLU	2.1

### 6.2 Non-standard residues in protein, DNA, RNA chains [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, 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(Å <sup>2</sup> )	Q<0.9
1	PIA	A	66	20/21	0.95	0.20	49,49,49,49	0

### 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, 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
2	SO4	A	1356	5/5	0.94	0.13	87,87,87,87	0
2	SO4	A	1355	5/5	0.95	0.25	89,89,89,89	0

### 6.5 Other polymers [i](#)

There are no such residues in this entry.