



# Full wwPDB X-ray Structure Validation Report ⓘ

Jun 12, 2016 – 04:47 AM EDT

PDB ID : 5I23  
Title : Crystal Structure of Agd31B, alpha-transglucosylase in Glycoside Hydrolase Family 31, in complex with Cyclophellitol Aziridine probe CF022  
Authors : Wu, L.; Davies, G.J.  
Deposited on : 2016-02-08  
Resolution : 1.95 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 : 1.7.1 (RC1), CSD as537be (2016)  
Xtriage (Phenix) : 1.9-1692  
EDS : rb-20027674  
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) : rb-20027674

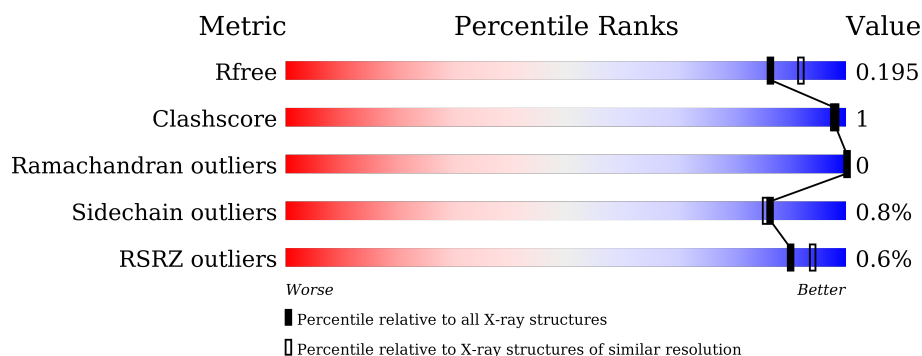
# 1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

*X-RAY DIFFRACTION*

The reported resolution of this entry is 1.95 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	1833 (1.96-1.96)
Clashscore	102246	1953 (1.96-1.96)
Ramachandran outliers	100387	1936 (1.96-1.96)
Sidechain outliers	100360	1936 (1.96-1.96)
RSRZ outliers	91569	1835 (1.96-1.96)

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	836	<div> <div style="width: 100%; height: 10px; background: linear-gradient(to right, red, orange, yellow, green, grey); position: relative;"> <span style="position: absolute; left: 0; top: -10px;">%</span> <span style="position: absolute; left: 90%; top: -10px;">90%</span> <span style="position: absolute; left: 100%; top: -10px;">7%</span> </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
2	PG4	A	901	-	-	-	X
3	SO4	A	906	-	-	-	X

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Mol	Type	Chain	Res	Chirality	Geometry	Clashes	Electron density
3	SO4	A	907	-	-	-	X
4	EDO	A	909	-	-	-	X
5	66V	A	910	-	-	-	X

## 2 Entry composition

There are 6 unique types of molecules in this entry. The entry contains 6993 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 Oligosaccharide 4-alpha-D-glucosyltransferase.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
1	A	779	6288	4015	1080	1172	21	0	7	0

There are 44 discrepancies between the modelled and reference sequences:

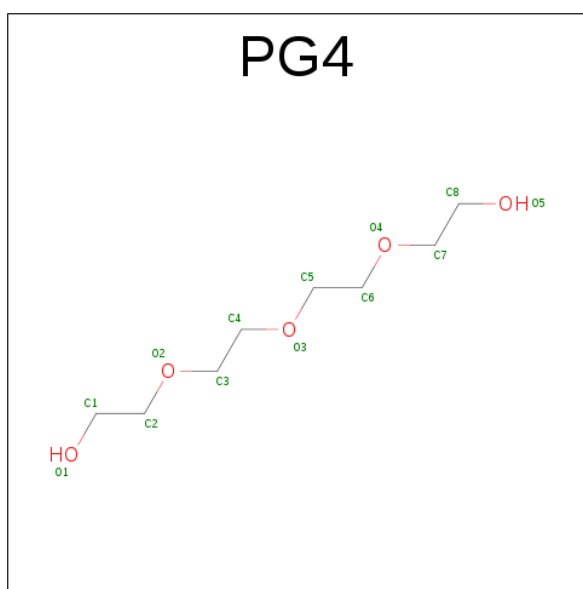
Chain	Residue	Modelled	Actual	Comment	Reference
A	24	MET	-	initiating methionine	UNP B3PEE6
A	817	LYS	-	expression tag	UNP B3PEE6
A	818	GLY	-	expression tag	UNP B3PEE6
A	819	GLY	-	expression tag	UNP B3PEE6
A	820	ARG	-	expression tag	UNP B3PEE6
A	821	ALA	-	expression tag	UNP B3PEE6
A	822	ASP	-	expression tag	UNP B3PEE6
A	823	PRO	-	expression tag	UNP B3PEE6
A	824	ALA	-	expression tag	UNP B3PEE6
A	825	PHE	-	expression tag	UNP B3PEE6
A	826	LEU	-	expression tag	UNP B3PEE6
A	827	TYR	-	expression tag	UNP B3PEE6
A	828	LYS	-	expression tag	UNP B3PEE6
A	829	VAL	-	expression tag	UNP B3PEE6
A	830	VAL	-	expression tag	UNP B3PEE6
A	831	ILE	-	expression tag	UNP B3PEE6
A	832	ASN	-	expression tag	UNP B3PEE6
A	833	SER	-	expression tag	UNP B3PEE6
A	834	LYS	-	expression tag	UNP B3PEE6
A	835	LEU	-	expression tag	UNP B3PEE6
A	836	GLU	-	expression tag	UNP B3PEE6
A	837	GLY	-	expression tag	UNP B3PEE6
A	838	LYS	-	expression tag	UNP B3PEE6
A	839	PRO	-	expression tag	UNP B3PEE6
A	840	ILE	-	expression tag	UNP B3PEE6
A	841	PRO	-	expression tag	UNP B3PEE6
A	842	ASN	-	expression tag	UNP B3PEE6

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Chain	Residue	Modelled	Actual	Comment	Reference
A	843	PRO	-	expression tag	UNP B3PEE6
A	844	LEU	-	expression tag	UNP B3PEE6
A	845	LEU	-	expression tag	UNP B3PEE6
A	846	GLY	-	expression tag	UNP B3PEE6
A	847	LEU	-	expression tag	UNP B3PEE6
A	848	ASP	-	expression tag	UNP B3PEE6
A	849	SER	-	expression tag	UNP B3PEE6
A	850	THR	-	expression tag	UNP B3PEE6
A	851	ARG	-	expression tag	UNP B3PEE6
A	852	THR	-	expression tag	UNP B3PEE6
A	853	GLY	-	expression tag	UNP B3PEE6
A	854	HIS	-	expression tag	UNP B3PEE6
A	855	HIS	-	expression tag	UNP B3PEE6
A	856	HIS	-	expression tag	UNP B3PEE6
A	857	HIS	-	expression tag	UNP B3PEE6
A	858	HIS	-	expression tag	UNP B3PEE6
A	859	HIS	-	expression tag	UNP B3PEE6

- Molecule 2 is TETRAETHYLENE GLYCOL (three-letter code: PG4) (formula:  $C_8H_{18}O_5$ ).



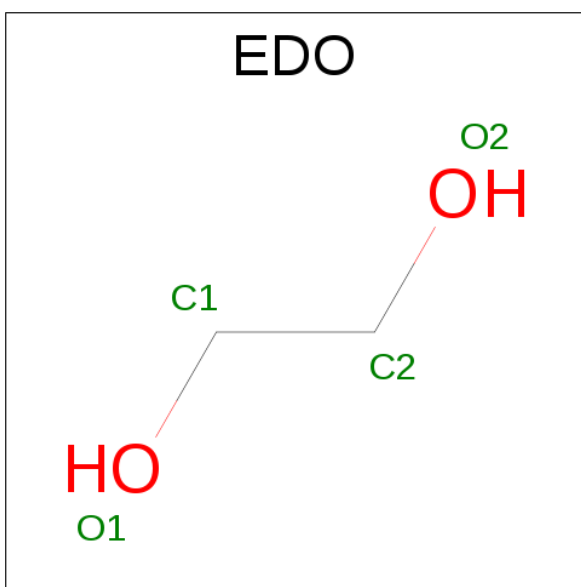
Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
2	A	1	Total	C	O	0	0
			13	8	5		

- Molecule 3 is SULFATE ION (three-letter code: SO4) (formula:  $O_4S$ ).



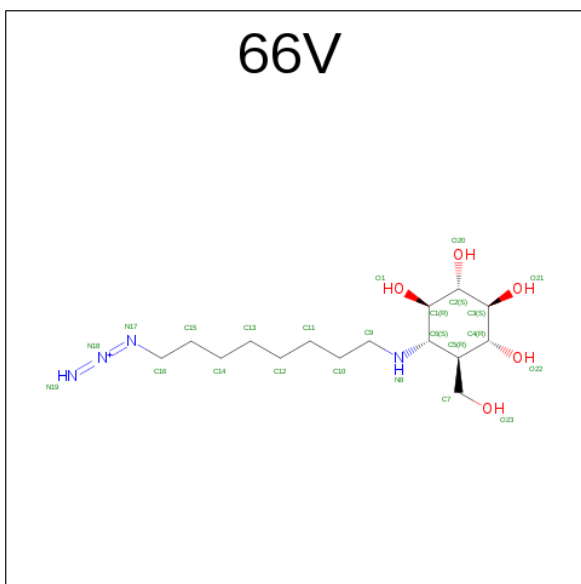
Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
3	A	1	Total	O	S	0	0
			5	4	1		
3	A	1	Total	O	S	0	0
			5	4	1		
3	A	1	Total	O	S	0	0
			5	4	1		
3	A	1	Total	O	S	0	0
			5	4	1		
3	A	1	Total	O	S	0	0
			5	4	1		

- Molecule 4 is 1,2-ETHANEDIOL (three-letter code: EDO) (formula: C<sub>2</sub>H<sub>6</sub>O<sub>2</sub>).



Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
4	A	1	Total	C	O	0	0
			4	2	2		
4	A	1	Total	C	O	0	0
			4	2	2		

- Molecule 5 is 1-(8-{[(1S,2R,3S,4S,5R,6R)-2,3,4,5-tetrahydroxy-6-(hydroxymethyl)cyclohexyl]amino}octyl)triaza-1,2-dien-2-ium (three-letter code: 66V) (formula: C<sub>15</sub>H<sub>31</sub>N<sub>4</sub>O<sub>5</sub>).



Mol	Chain	Residues	Atoms				ZeroOcc	AltConf
5	A	1	Total	C	N	O	0	0
			23	15	4	4		

- Molecule 6 is water.

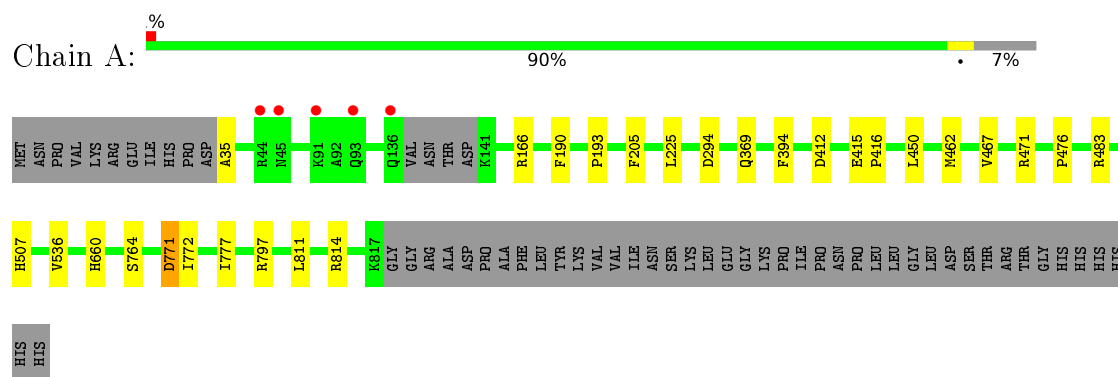
Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
6	A	631	Total 631	O 631	0	0



### 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: Oligosaccharide 4-alpha-D-glucosyltransferase



## 4 Data and refinement statistics

Property	Value	Source
Space group	P 6 2 2	Depositor
Cell constants a, b, c, $\alpha$ , $\beta$ , $\gamma$	198.00 Å   198.00 Å   103.00 Å 90.00°   90.00°   120.00°	Depositor
Resolution (Å)	171.47 – 1.95 85.74 – 1.95	Depositor EDS
% Data completeness (in resolution range)	100.0 (171.47-1.95) 100.0 (85.74-1.95)	Depositor EDS
$R_{merge}$	0.13	Depositor
$R_{sym}$	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ <sup>1</sup>	2.35 (at 1.95 Å)	Xtriage
Refinement program	REFMAC 5.8.0135	Depositor
R, $R_{free}$	0.163   ,   0.187 0.172   ,   0.195	Depositor DCC
$R_{free}$ test set	4304 reflections (5.24%)	DCC
Wilson B-factor (Å <sup>2</sup> )	29.0	Xtriage
Anisotropy	0.524	Xtriage
Bulk solvent $k_{sol}$ (e/Å <sup>3</sup> ), $B_{sol}$ (Å <sup>2</sup> )	0.35 , 42.0	EDS
L-test for twinning <sup>2</sup>	$\langle  L  \rangle = 0.49$ , $\langle L^2 \rangle = 0.32$	Xtriage
Estimated twinning fraction	No twinning to report.	Xtriage
$F_o, F_c$ correlation	0.97	EDS
Total number of atoms	6993	wwPDB-VP
Average B, all atoms (Å <sup>2</sup> )	36.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 3.46% 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 [i](#)

### 5.1 Standard geometry [i](#)

Bond lengths and bond angles in the following residue types are not validated in this section: 66V, PG4, SO4, EDO

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	0.65	1/6456 (0.0%)	0.82	7/8752 (0.1%)

All (1) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	A	412	ASP	CG-OD2	7.30	1.42	1.25

All (7) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	471	ARG	NE-CZ-NH2	-8.58	116.01	120.30
1	A	471	ARG	NE-CZ-NH1	8.13	124.36	120.30
1	A	771	ASP	CB-CG-OD1	7.10	124.69	118.30
1	A	771	ASP	CB-CG-OD2	-6.34	112.60	118.30
1	A	811	LEU	CA-CB-CG	5.27	127.43	115.30
1	A	483	ARG	NE-CZ-NH1	5.14	122.87	120.30
1	A	797	ARG	NE-CZ-NH1	5.05	122.83	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	6288	0	6101	13	0
2	A	13	0	18	0	0
3	A	30	0	0	0	0
4	A	8	0	12	1	0
5	A	23	0	0	0	0
6	A	631	0	0	1	0
All	All	6993	0	6131	13	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 1.

All (13) 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:772:ILE:HD12	1:A:777:ILE:HD13	1.86	0.57
1:A:462:MET:O	1:A:476:PRO:HA	2.06	0.55
1:A:205:PHE:HB2	1:A:225:LEU:HD13	1.93	0.50
1:A:507:HIS:CG	1:A:536:VAL:HB	2.51	0.46
1:A:660[B]:HIS:CD2	1:A:660[B]:HIS:H	2.37	0.43
1:A:772:ILE:HD12	1:A:777:ILE:CD1	2.49	0.42
1:A:450:LEU:HD23	1:A:450:LEU:HA	1.89	0.41
1:A:764:SER:HB2	4:A:909:EDO:H21	2.02	0.41
1:A:771:ASP:OD2	1:A:814:ARG:NH1	2.54	0.41
1:A:415:GLU:N	1:A:416:PRO:HA	2.36	0.41
1:A:193:PRO:HD2	1:A:467:VAL:HG23	2.03	0.41
1:A:660[B]:HIS:CD2	1:A:660[B]:HIS:N	2.89	0.41
1:A:35:ALA:N	6:A:1009:HOH:O	2.53	0.40

There are no symmetry-related clashes.

## 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	782/836 (94%)	759 (97%)	23 (3%)	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	663/706 (94%)	658 (99%)	5 (1%)	86	85

All (5) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	166	ARG
1	A	190	PHE
1	A	294	ASP
1	A	369	GLN
1	A	394	PHE

Some sidechains can be flipped to improve hydrogen bonding and reduce clashes. There are no such sidechains identified.

### 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

10 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	PG4	A	901	-	12,12,12	0.51	0	11,11,11	0.41	0
3	SO4	A	902	-	4,4,4	0.32	0	6,6,6	0.23	0
3	SO4	A	903	-	4,4,4	0.24	0	6,6,6	0.18	0
3	SO4	A	904	-	4,4,4	0.39	0	6,6,6	0.15	0
3	SO4	A	905	-	4,4,4	0.38	0	6,6,6	0.15	0
3	SO4	A	906	-	4,4,4	0.44	0	6,6,6	0.23	0
3	SO4	A	907	-	4,4,4	0.41	0	6,6,6	0.12	0
4	EDO	A	908	-	3,3,3	0.44	0	2,2,2	0.43	0
4	EDO	A	909	-	3,3,3	0.65	0	2,2,2	0.78	0
5	66V	A	910	1	22,23,24	1.38	1 (4%)	22,28,30	1.21	2 (9%)

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	PG4	A	901	-	-	0/10/10/10	0/0/0/0
3	SO4	A	902	-	-	0/0/0/0	0/0/0/0
3	SO4	A	903	-	-	0/0/0/0	0/0/0/0
3	SO4	A	904	-	-	0/0/0/0	0/0/0/0
3	SO4	A	905	-	-	0/0/0/0	0/0/0/0
3	SO4	A	906	-	-	0/0/0/0	0/0/0/0
3	SO4	A	907	-	-	0/0/0/0	0/0/0/0
4	EDO	A	908	-	-	0/1/1/1	0/0/0/0
4	EDO	A	909	-	-	0/1/1/1	0/0/0/0
5	66V	A	910	1	-	0/14/34/38	0/1/1/1

All (1) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
5	A	910	66V	N18-N17	5.64	1.38	1.23

All (2) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
5	A	910	66V	C9-N8-C6	-3.31	110.13	113.70
5	A	910	66V	C1-C2-C3	2.79	114.27	110.54

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
4	A	909	EDO	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	779/836 (93%)	-0.28	5 (0%) 90 94	24, 33, 57, 81	3 (0%)

All (5) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	91	LYS	3.2
1	A	136	GLN	2.8
1	A	45	ASN	2.7
1	A	44	ARG	2.2
1	A	93	GLN	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
3	SO4	A	907	5/5	0.91	0.31	6.78	84,84,89,91	0

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Mol	Type	Chain	Res	Atoms	RSCC	RSR	LLDF	B-factors( $\text{\AA}^2$ )	Q<0.9
4	EDO	A	909	4/4	0.85	0.24	4.92	38,38,40,41	0
3	SO4	A	906	5/5	0.98	0.12	4.20	41,42,43,49	0
2	PG4	A	901	13/13	0.83	0.19	3.57	43,54,65,65	0
5	66V	A	910	23/24	0.95	0.14	2.33	21,25,90,92	0
3	SO4	A	903	5/5	0.98	0.11	0.83	53,54,57,61	0
3	SO4	A	904	5/5	0.93	0.11	0.71	72,75,81,83	0
3	SO4	A	905	5/5	0.88	0.28	-	89,92,94,97	0
4	EDO	A	908	4/4	0.66	0.39	-	67,70,75,81	0
3	SO4	A	902	5/5	0.93	0.13	-	71,71,74,82	0

## 6.5 Other polymers [i](#)

There are no such residues in this entry.