



# Full wwPDB X-ray Structure Validation Report ⓘ

Feb 13, 2017 – 08:16 pm GMT

PDB ID : 4GWO  
Title : Crystal structure of ligand binding domain of LysR family member, CysB in complex with sulfate from *Salmonella typhimurium* LT2  
Authors : Mittal, M.; Singh, A.K.; Kumaran, S.  
Deposited on : 2012-09-03  
Resolution : 2.39 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 : 1.7.2 (RC1), CSD as538be (2017)  
Xtriage (Phenix) : 1.9-1692  
EDS : trunk28620  
Percentile statistics : 20161228.v01 (using entries in the PDB archive December 28th 2016)  
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) : recalc28949

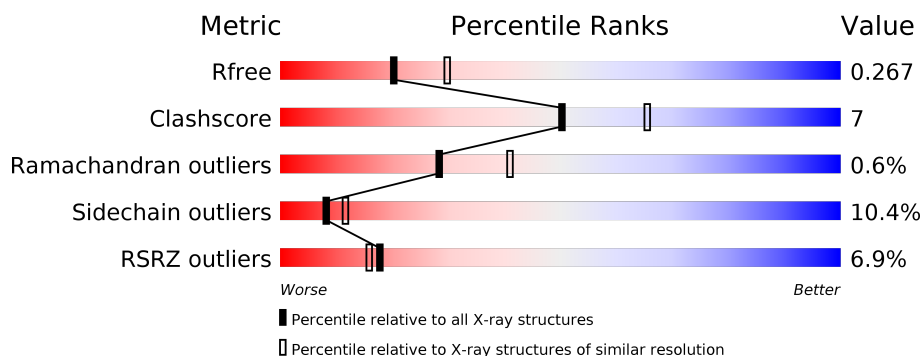
# 1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

*X-RAY DIFFRACTION*

The reported resolution of this entry is 2.39 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))
$R_{free}$	100719	3166 (2.40-2.40)
Clashscore	112137	3674 (2.40-2.40)
Ramachandran outliers	110173	3616 (2.40-2.40)
Sidechain outliers	110143	3617 (2.40-2.40)
RSRZ outliers	101464	3195 (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 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	330	<div> <div>5%</div> <div>55%</div> <div>15%</div> <div>•</div> <div>28%</div> </div>
1	B	330	<div> <div>5%</div> <div>53%</div> <div>17%</div> <div>•</div> <div>28%</div> </div>

## 2 Entry composition

There are 4 unique types of molecules in this entry. The entry contains 3760 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.

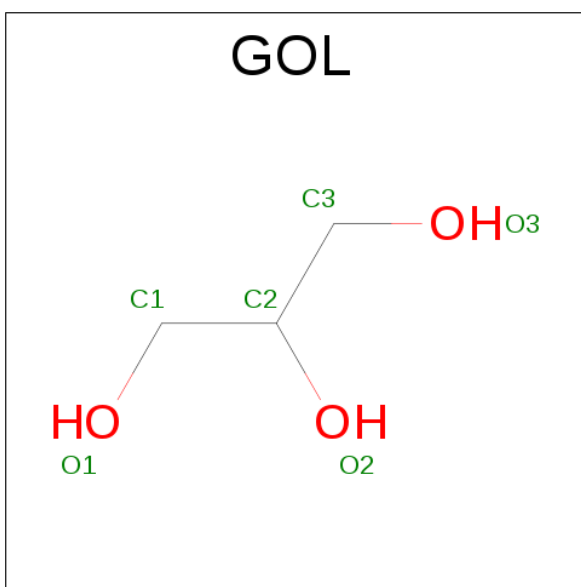
- Molecule 1 is a protein called HTH-type transcriptional regulator CysB.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	239	Total	C	N	O	S	0	0	0
			1852	1187	312	347	6			
1	B	239	Total	C	N	O	S	0	0	0
			1875	1200	322	347	6			

There are 12 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	-5	HIS	-	EXPRESSION TAG	UNP P06614
A	-4	HIS	-	EXPRESSION TAG	UNP P06614
A	-3	HIS	-	EXPRESSION TAG	UNP P06614
A	-2	HIS	-	EXPRESSION TAG	UNP P06614
A	-1	HIS	-	EXPRESSION TAG	UNP P06614
A	0	HIS	-	EXPRESSION TAG	UNP P06614
B	-5	HIS	-	EXPRESSION TAG	UNP P06614
B	-4	HIS	-	EXPRESSION TAG	UNP P06614
B	-3	HIS	-	EXPRESSION TAG	UNP P06614
B	-2	HIS	-	EXPRESSION TAG	UNP P06614
B	-1	HIS	-	EXPRESSION TAG	UNP P06614
B	0	HIS	-	EXPRESSION TAG	UNP P06614

- Molecule 2 is GLYCEROL (three-letter code: GOL) (formula: C<sub>3</sub>H<sub>8</sub>O<sub>3</sub>).



Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
2	A	1	Total	C	O	0	0
			6	3	3		

- Molecule 3 is SULFATE ION (three-letter code: SO4) (formula: O<sub>4</sub>S).



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		

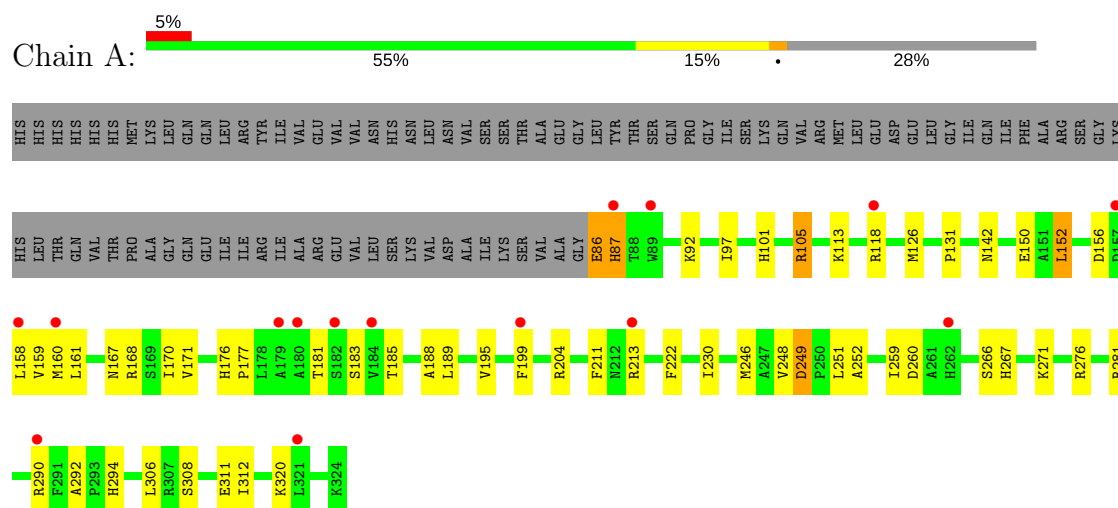
- Molecule 4 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
4	A	6	Total 6	O 6	0	0
4	B	11	Total 11	O 11	0	0

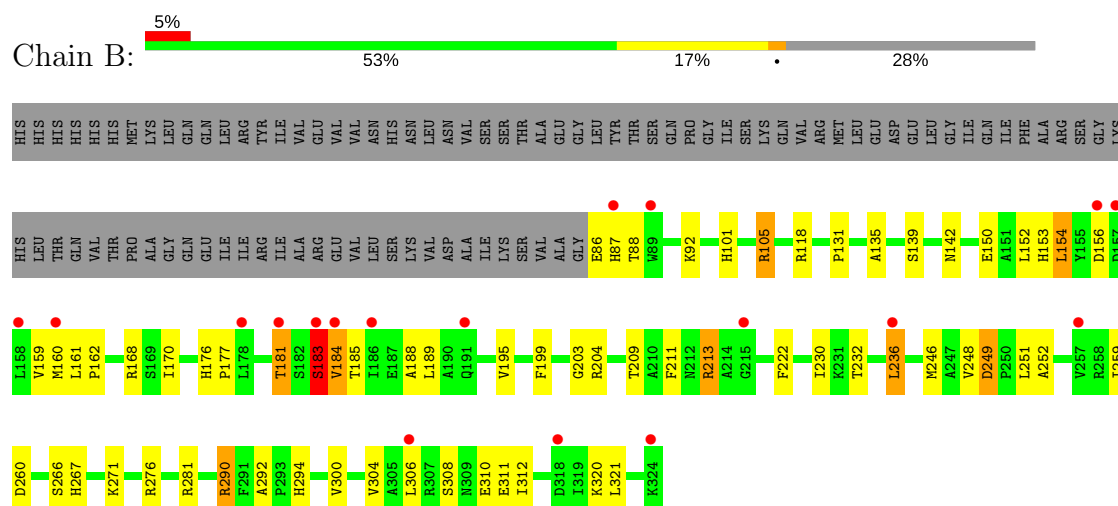
### 3 Residue-property plots

These plots are drawn for all protein, RNA and DNA chains in the entry. The first graphic for a chain summarises the proportions of 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: HTH-type transcriptional regulator CysB



#### • Molecule 1: HTH-type transcriptional regulator CysB



## 4 Data and refinement statistics

Property	Value	Source
Space group	P 1 21 1	Depositor
Cell constants a, b, c, $\alpha$ , $\beta$ , $\gamma$	46.92Å 105.30Å 47.75Å 90.00° 103.26° 90.00°	Depositor
Resolution (Å)	26.32 – 2.39 45.67 – 2.39	Depositor EDS
% Data completeness (in resolution range)	90.8 (26.32-2.39) 87.1 (45.67-2.39)	Depositor EDS
$R_{merge}$	0.03	Depositor
$R_{sym}$	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ <sup>1</sup>	9.34 (at 2.39Å)	Xtriage
Refinement program	PHENIX (phenix.refine: 1.8_1069)	Depositor
R, $R_{free}$	0.198 , 0.268 0.190 , 0.267	Depositor DCC
$R_{free}$ test set	822 reflections (5.09%)	DCC
Wilson B-factor (Å <sup>2</sup> )	46.1	Xtriage
Anisotropy	0.735	Xtriage
Bulk solvent $k_{sol}$ (e/Å <sup>3</sup> ), $B_{sol}$ (Å <sup>2</sup> )	0.36 , 30.7	EDS
L-test for twinning <sup>2</sup>	$\langle  L  \rangle = 0.46$ , $\langle L^2 \rangle = 0.29$	Xtriage
Estimated twinning fraction	0.114 for l,-k,h	Xtriage
$F_o, F_c$ correlation	0.95	EDS
Total number of atoms	3760	wwPDB-VP
Average B, all atoms (Å <sup>2</sup> )	49.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 6.16% 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: GOL, 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	0.49	1/1900 (0.1%)	0.78	3/2597 (0.1%)
1	B	0.49	1/1923 (0.1%)	0.77	6/2622 (0.2%)
All	All	0.49	2/3823 (0.1%)	0.78	9/5219 (0.2%)

Chiral center outliers are detected by calculating the chiral volume of a chiral center and verifying if the center is modelled as a planar moiety or with the opposite hand. A planarity outlier is detected by checking planarity of atoms in a peptide group, atoms in a mainchain group or atoms of a sidechain that are expected to be planar.

Mol	Chain	#Chirality outliers	#Planarity outliers
1	A	0	1
1	B	0	1
All	All	0	2

All (2) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	B	142	ASN	CG-ND2	-5.31	1.19	1.32
1	A	142	ASN	CG-ND2	-5.20	1.19	1.32

All (9) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	290	ARG	NE-CZ-NH2	-13.84	113.38	120.30
1	A	290	ARG	NE-CZ-NH1	13.26	126.93	120.30
1	B	290	ARG	NE-CZ-NH1	-13.15	113.72	120.30
1	B	290	ARG	NE-CZ-NH2	11.35	125.98	120.30
1	B	236	LEU	CA-CB-CG	8.90	135.78	115.30
1	A	290	ARG	CD-NE-CZ	6.60	132.84	123.60
1	B	290	ARG	CD-NE-CZ	6.04	132.06	123.60

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Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	B	184	VAL	CB-CA-C	-5.37	101.20	111.40
1	B	236	LEU	CB-CG-CD2	5.25	119.93	111.00

There are no chirality outliers.

All (2) planarity outliers are listed below:

Mol	Chain	Res	Type	Group
1	A	86	GLU	Peptide
1	B	183	SER	Peptide

## 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	1852	0	1795	21	1
1	B	1875	0	1847	29	1
2	A	6	0	8	1	0
3	A	5	0	0	0	0
3	B	5	0	0	0	0
4	A	6	0	0	0	0
4	B	11	0	0	0	0
All	All	3760	0	3650	49	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 7.

All (49) 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:B:181:THR:HB	1:B:183:SER:HA	1.50	0.92
1:A:185:THR:HG23	1:A:188:ALA:H	1.45	0.82
1:B:185:THR:HG23	1:B:188:ALA:H	1.43	0.81
1:B:86:GLU:O	1:B:88:THR:N	2.16	0.78
1:B:183:SER:HB3	1:B:259:ILE:HG21	1.72	0.71
1:A:170:ILE:HG12	1:A:259:ILE:HB	1.76	0.67

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:306:LEU:HD13	1:A:311:GLU:HB3	1.75	0.66
1:B:152:LEU:HD13	1:B:160:MET:HE1	1.78	0.64
1:B:199:PHE:HA	1:B:204:ARG:HG2	1.81	0.63
1:B:306:LEU:HD13	1:B:311:GLU:HB3	1.80	0.63
1:A:199:PHE:HA	1:A:204:ARG:HG2	1.81	0.62
1:B:170:ILE:HG12	1:B:259:ILE:HB	1.81	0.62
1:B:249:ASP:OD2	1:B:252:ALA:N	2.30	0.57
1:A:308:SER:O	1:A:312:ILE:HG13	2.05	0.56
1:B:195:VAL:HG12	1:B:230:ILE:HG23	1.90	0.53
1:A:195:VAL:HG12	1:A:230:ILE:HG23	1.91	0.53
1:B:308:SER:O	1:B:312:ILE:HG13	2.09	0.52
1:A:131:PRO:HG2	1:A:150:GLU:HB2	1.91	0.52
1:B:92:LYS:O	1:B:281:ARG:NH2	2.44	0.51
1:B:131:PRO:HG2	1:B:150:GLU:HB2	1.93	0.51
1:B:152:LEU:HB3	1:B:160:MET:CE	2.42	0.50
1:B:276:ARG:NH2	1:B:306:LEU:O	2.45	0.50
1:A:249:ASP:OD2	1:A:252:ALA:N	2.36	0.50
1:A:92:LYS:O	1:A:281:ARG:NH2	2.45	0.49
1:A:276:ARG:NH2	1:A:306:LEU:O	2.46	0.49
1:A:189:LEU:HD23	1:A:211:PHE:HZ	1.79	0.46
1:B:189:LEU:HD23	1:B:211:PHE:HZ	1.80	0.46
1:A:152:LEU:HD23	1:A:160:MET:HE1	1.98	0.46
1:B:135:ALA:HB2	1:B:152:LEU:HD23	1.98	0.46
1:A:266:SER:HA	2:A:401:GOL:H32	1.99	0.45
1:A:101:HIS:CE1	1:A:105:ARG:HG3	2.52	0.45
1:B:101:HIS:CE1	1:B:105:ARG:HG3	2.51	0.45
1:B:232:THR:O	1:B:236:LEU:HD23	2.17	0.44
1:A:176:HIS:CG	1:A:177:PRO:HD2	2.53	0.44
1:B:300:VAL:O	1:B:304:VAL:HG23	2.18	0.44
1:B:176:HIS:CG	1:B:177:PRO:HD2	2.53	0.44
1:B:183:SER:HB3	1:B:259:ILE:CG2	2.46	0.43
1:A:167:ASN:OD1	1:A:168:ARG:N	2.42	0.43
1:B:153:HIS:CD2	1:B:154:LEU:HD13	2.53	0.43
1:A:292:ALA:HB1	1:A:294:HIS:CE1	2.54	0.42
1:B:292:ALA:HB1	1:B:294:HIS:CE1	2.55	0.42
1:A:97:ILE:O	1:A:126:MET:HA	2.18	0.42
1:B:168:ARG:NH2	1:B:266:SER:O	2.52	0.41
1:B:162:PRO:HB2	1:B:321:LEU:HD21	2.02	0.41
1:A:86:GLU:O	1:A:87:HIS:HB3	2.20	0.41
1:B:150:GLU:OE2	1:B:203:GLY:N	2.52	0.41
1:A:113:LYS:HB2	1:B:236:LEU:HD13	2.02	0.41

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:101:HIS:O	1:A:105:ARG:HB2	2.20	0.41
1:B:209:THR:O	1:B:213:ARG:HG3	2.21	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)
1:A:281:ARG:NH1	1:B:310:GLU:OE1[2_555]	2.09	0.11

## 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	237/330 (72%)	226 (95%)	10 (4%)	1 (0%)	38	54
1	B	237/330 (72%)	227 (96%)	8 (3%)	2 (1%)	22	33
All	All	474/660 (72%)	453 (96%)	18 (4%)	3 (1%)	28	41

All (3) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	B	87	HIS
1	B	183	SER
1	A	87	HIS

### 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	195/281 (69%)	175 (90%)	20 (10%)	8	12
1	B	200/281 (71%)	179 (90%)	21 (10%)	8	11
All	All	395/562 (70%)	354 (90%)	41 (10%)	8	12

All (41) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	105	ARG
1	A	118	ARG
1	A	152	LEU
1	A	156	ASP
1	A	158	LEU
1	A	159	VAL
1	A	161	LEU
1	A	171	VAL
1	A	181	THR
1	A	183	SER
1	A	213	ARG
1	A	222	PHE
1	A	246	MET
1	A	248	VAL
1	A	249	ASP
1	A	251	LEU
1	A	260	ASP
1	A	267	HIS
1	A	271	LYS
1	A	320	LYS
1	B	105	ARG
1	B	118	ARG
1	B	139	SER
1	B	154	LEU
1	B	156	ASP
1	B	159	VAL
1	B	161	LEU
1	B	181	THR
1	B	183	SER
1	B	184	VAL
1	B	213	ARG
1	B	222	PHE
1	B	246	MET
1	B	248	VAL

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Mol	Chain	Res	Type
1	B	249	ASP
1	B	251	LEU
1	B	260	ASP
1	B	267	HIS
1	B	271	LYS
1	B	290	ARG
1	B	320	LYS

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

### 5.3.3 RNA [i](#)

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 carbohydrates in this entry.

## 5.6 Ligand geometry [i](#)

3 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	GOL	A	401	-	5,5,5	0.27	0	5,5,5	0.32	0
3	SO4	A	402	-	4,4,4	0.25	0	6,6,6	0.21	0
3	SO4	B	401	-	4,4,4	0.33	0	6,6,6	0.54	0

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	GOL	A	401	-	-	0/4/4/4	0/0/0/0
3	SO4	A	402	-	-	0/0/0/0	0/0/0/0
3	SO4	B	401	-	-	0/0/0/0	0/0/0/0

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	401	GOL	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, 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	239/330 (72%)	0.51	15 (6%) 21 19	32, 44, 65, 79	0
1	B	239/330 (72%)	0.71	18 (7%) 15 13	32, 49, 77, 95	0
All	All	478/660 (72%)	0.61	33 (6%) 18 16	32, 47, 75, 95	0

All (33) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	B	89	TRP	5.4
1	B	184	VAL	5.0
1	B	87	HIS	4.9
1	A	182	SER	4.3
1	A	89	TRP	4.3
1	B	183	SER	4.1
1	A	157	ASP	3.5
1	B	158	LEU	3.4
1	B	236	LEU	3.3
1	A	184	VAL	3.3
1	A	160	MET	3.3
1	A	179	ALA	2.8
1	A	213	ARG	2.6
1	A	118	ARG	2.6
1	B	156	ASP	2.5
1	B	324	LYS	2.5
1	A	180	ALA	2.5
1	B	191	GLN	2.5
1	B	160	MET	2.4
1	B	157	ASP	2.4
1	A	87	HIS	2.4
1	B	257	VAL	2.4
1	B	181	THR	2.3
1	A	199	PHE	2.3

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Mol	Chain	Res	Type	RSRZ
1	A	290	ARG	2.2
1	A	262	HIS	2.2
1	A	158	LEU	2.1
1	B	306	LEU	2.1
1	B	186	ILE	2.1
1	B	178	LEU	2.1
1	B	215	GLY	2.1
1	A	321	LEU	2.1
1	B	318	ASP	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	402	5/5	0.99	0.13	-0.57	34,35,38,39	0
3	SO4	B	401	5/5	0.99	0.12	-1.64	32,32,35,39	0
2	GOL	A	401	6/6	0.80	0.16	-	54,55,56,57	0

## 6.5 Other polymers [i](#)

There are no such residues in this entry.