



# Full wwPDB X-ray Structure Validation Report ⓘ

May 16, 2020 – 07:06 am BST

PDB ID : 2PWU  
Title : tRNA guanine transglycosylase in complex with guanine  
Authors : Tidten, N.; Heine, A.; Reuter, K.; Klebe, G.  
Deposited on : 2007-05-13  
Resolution : 1.77 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.

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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 : 1.8.5 (274361), CSD as541be (2020)  
Xtriage (Phenix) : 1.13  
EDS : 2.11  
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) : 2.11

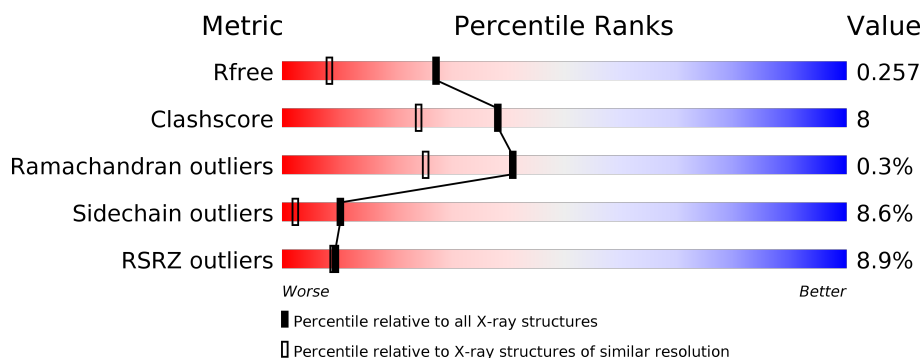
# 1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

## *X-RAY DIFFRACTION*

The reported resolution of this entry is 1.77 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	9185 (1.80-1.76)
Clashscore	141614	10184 (1.80-1.76)
Ramachandran outliers	138981	10051 (1.80-1.76)
Sidechain outliers	138945	10050 (1.80-1.76)
RSRZ outliers	127900	9032 (1.80-1.76)

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	386	<div> <div>8%</div> <div>70%</div> <div>19%</div> <div>7%</div> </div>

## 2 Entry composition [i](#)

There are 5 unique types of molecules in this entry. The entry contains 2870 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 Queuine tRNA-ribosyltransferase.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	358	Total	C	N	O	S	0	7	0
			2736	1719	492	507	18			

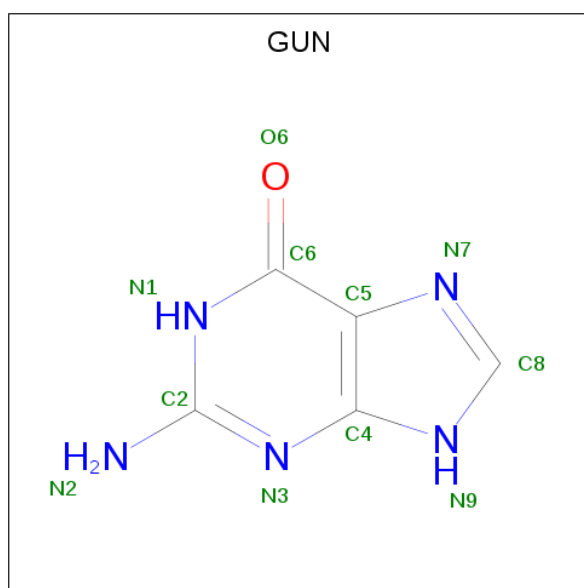
There is a discrepancy between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	312	LYS	THR	SEE REMARK 999	UNP P28720

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

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

- Molecule 3 is GUANINE (three-letter code: GUN) (formula: C<sub>5</sub>H<sub>5</sub>N<sub>5</sub>O).



Mol	Chain	Residues	Atoms				ZeroOcc	AltConf
3	A	1	Total	C	N	O	0	0
			11	5	5	1		

- Molecule 4 is GLYCEROL (three-letter code: GOL) (formula:  $C_3H_8O_3$ ).



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

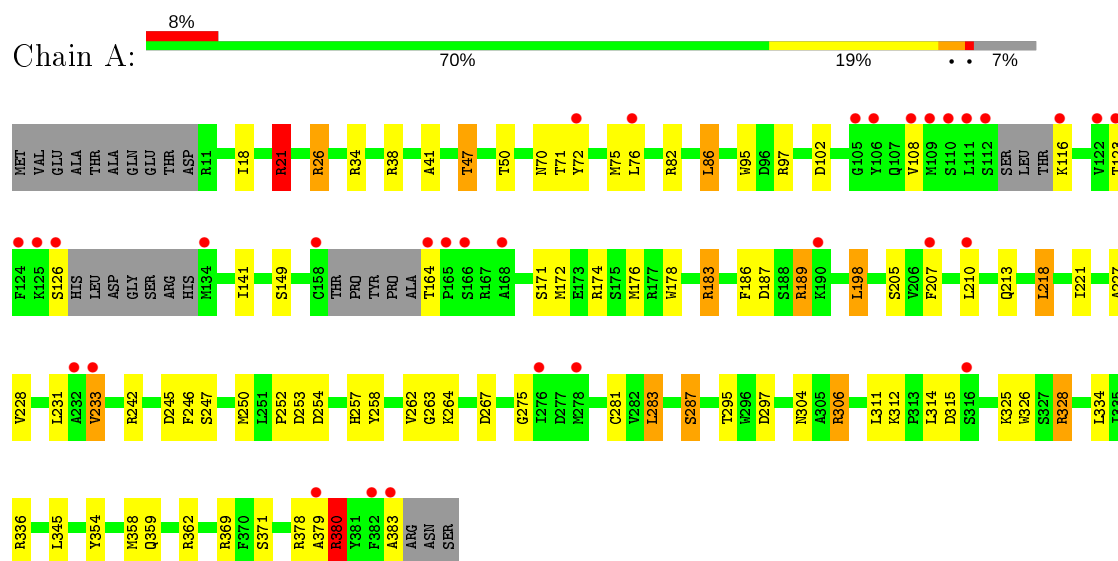
- Molecule 5 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
5	A	104	Total	O	0	0
			104	104		

### 3 Residue-property plots [i](#)

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: Queuine tRNA-ribosyltransferase



## 4 Data and refinement statistics

Property	Value	Source
Space group	C 1 2 1	Depositor
Cell constants a, b, c, $\alpha$ , $\beta$ , $\gamma$	90.15Å 64.50Å 70.77Å 90.00° 92.79° 90.00°	Depositor
Resolution (Å)	10.00 – 1.77 35.34 – 1.77	Depositor EDS
% Data completeness (in resolution range)	87.4 (10.00-1.77) 92.0 (35.34-1.77)	Depositor EDS
$R_{merge}$	0.04	Depositor
$R_{sym}$	0.04	Depositor
$\langle I/\sigma(I) \rangle$ <sup>1</sup>	2.12 (at 1.77Å)	Xtriage
Refinement program	SHELXL-97, CNS	Depositor
R, $R_{free}$	0.200 , (Not available) 0.203 , 0.257	Depositor DCC
$R_{free}$ test set	1821 reflections (5.00%)	wwPDB-VP
Wilson B-factor (Å <sup>2</sup> )	25.7	Xtriage
Anisotropy	0.271	Xtriage
Bulk solvent $k_{sol}$ (e/Å <sup>3</sup> ), $B_{sol}$ (Å <sup>2</sup> )	0.35 , 57.9	EDS
L-test for twinning <sup>2</sup>	$\langle  L  \rangle = 0.48$ , $\langle L^2 \rangle = 0.31$	Xtriage
Estimated twinning fraction	0.028 for -h,-k,l	Xtriage
$F_o, F_c$ correlation	0.95	EDS
Total number of atoms	2870	wwPDB-VP
Average B, all atoms (Å <sup>2</sup> )	33.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 8.35% 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, ZN, GUN

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	0.38	0/2810	1.15	19/3788 (0.5%)

There are no bond length outliers.

All (19) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	380	ARG	CD-NE-CZ	11.34	139.47	123.60
1	A	183	ARG	NE-CZ-NH1	10.93	125.76	120.30
1	A	378	ARG	CD-NE-CZ	10.70	138.59	123.60
1	A	183	ARG	NE-CZ-NH2	-9.91	115.35	120.30
1	A	34	ARG	NE-CZ-NH2	-7.28	116.66	120.30
1	A	380	ARG	NE-CZ-NH1	6.58	123.59	120.30
1	A	21[A]	ARG	NE-CZ-NH1	6.13	123.36	120.30
1	A	21[B]	ARG	NE-CZ-NH1	6.13	123.36	120.30
1	A	26	ARG	CD-NE-CZ	6.01	132.02	123.60
1	A	378	ARG	NE-CZ-NH2	-5.68	117.46	120.30
1	A	26	ARG	NE-CZ-NH1	5.65	123.13	120.30
1	A	336	ARG	NE-CZ-NH2	-5.38	117.61	120.30
1	A	26	ARG	NE-CZ-NH2	-5.36	117.62	120.30
1	A	336	ARG	NE-CZ-NH1	5.28	122.94	120.30
1	A	369	ARG	NE-CZ-NH1	5.27	122.93	120.30
1	A	336	ARG	CD-NE-CZ	5.19	130.87	123.60
1	A	34	ARG	NE-CZ-NH1	5.19	122.89	120.30
1	A	328	ARG	NE-CZ-NH1	5.12	122.86	120.30
1	A	189	ARG	CD-NE-CZ	5.02	130.63	123.60

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	2736	0	2624	41	0
2	A	1	0	0	0	0
3	A	11	0	5	0	0
4	A	18	0	24	1	0
5	A	104	0	0	1	0
All	All	2870	0	2653	41	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 8.

All (41) 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:283:LEU:O	1:A:287:SER:HB2	1.86	0.75
1:A:47:THR:HB	5:A:736:HOH:O	1.87	0.74
1:A:70:ASN:HA	1:A:102[B]:ASP:OD2	1.89	0.73
1:A:176:MET:SD	1:A:218:LEU:HD13	2.33	0.68
1:A:76:LEU:HD13	1:A:126:SER:OG	1.97	0.64
1:A:379:ALA:O	1:A:383:ALA:HB2	2.01	0.61
1:A:281:CYS:SG	1:A:283:LEU:HB2	2.42	0.59
1:A:297:ASP:OD1	1:A:380:ARG:HD3	2.04	0.58
1:A:186:PHE:CD2	1:A:198:LEU:HG	2.38	0.58
1:A:72:TYR:O	1:A:75:MET:HG2	2.05	0.56
1:A:252:PRO:O	1:A:257:HIS:HE1	1.89	0.55
1:A:71:THR:HG22	1:A:75:MET:CE	2.39	0.52
1:A:172:MET:HE1	1:A:213:GLN:HB3	1.92	0.51
1:A:38:ARG:O	1:A:41:ALA:HB2	2.10	0.50
1:A:174:ARG:HD3	1:A:178:TRP:CZ2	2.47	0.50
1:A:82:ARG:O	1:A:86:LEU:HD22	2.13	0.49
1:A:247:SER:O	1:A:250:MET:HB2	2.13	0.48
1:A:227:ALA:HA	1:A:258:TYR:O	2.14	0.47
1:A:254:ASP:HA	4:A:714:GOL:O1	2.15	0.47
1:A:246:PHE:HD1	1:A:250:MET:HE3	1.79	0.47
1:A:325:LYS:HB2	1:A:326:TRP:CE3	2.50	0.47
1:A:257:HIS:HD2	1:A:275:GLY:O	1.98	0.46

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:21[B]:ARG:NH2	1:A:253:ASP:OD1	2.49	0.46
1:A:358:MET:O	1:A:362:ARG:HG3	2.16	0.45
1:A:116:LYS:N	1:A:123:THR:O	2.50	0.45
1:A:183:ARG:HG2	1:A:221:ILE:CG2	2.47	0.45
1:A:95:TRP:CE2	1:A:97:ARG:HB2	2.51	0.45
1:A:295:THR:HB	1:A:315:ASP:OD2	2.16	0.44
1:A:354:TYR:O	1:A:358:MET:HG2	2.18	0.44
1:A:304:ASN:OD1	1:A:306:ARG:HG2	2.18	0.44
1:A:71:THR:O	1:A:75:MET:HE2	2.18	0.43
1:A:233:VAL:O	1:A:233:VAL:HG13	2.18	0.43
1:A:264:LYS:NZ	1:A:267:ASP:OD1	2.50	0.43
1:A:359:GLN:NE2	1:A:362:ARG:HH21	2.17	0.43
1:A:312:LYS:O	1:A:328:ARG:HG3	2.19	0.42
1:A:228:VAL:CG1	1:A:231:LEU:HD12	2.49	0.42
1:A:205:SER:HB3	1:A:207:PHE:CE2	2.55	0.42
1:A:183:ARG:HD2	1:A:187:ASP:OD2	2.20	0.42
1:A:262:VAL:HG13	1:A:263:GLY:HA3	2.03	0.41
1:A:18:ILE:HD13	1:A:21[B]:ARG:NH2	2.36	0.40
1:A:242:ARG:O	1:A:245:ASP:HB2	2.21	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	357/386 (92%)	346 (97%)	10 (3%)	1 (0%)	41 25

All (1) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	47	THR

### 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	273 / 315 (87%)	249 (91%)	24 (9%)	10 2

All (24) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	21[A]	ARG
1	A	21[B]	ARG
1	A	26	ARG
1	A	50	THR
1	A	86	LEU
1	A	108	VAL
1	A	141	ILE
1	A	149	SER
1	A	164	THR
1	A	171	SER
1	A	189	ARG
1	A	198	LEU
1	A	210	LEU
1	A	218	LEU
1	A	233	VAL
1	A	283	LEU
1	A	287	SER
1	A	306	ARG
1	A	311	LEU
1	A	314	LEU
1	A	334	LEU
1	A	345	LEU
1	A	371	SER
1	A	380	ARG

Some sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (6) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	202	GLN

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Mol	Chain	Res	Type
1	A	237	GLN
1	A	257	HIS
1	A	356	GLN
1	A	359	GLN
1	A	372	GLN

### 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](#)

Of 5 ligands modelled in this entry, 1 is monoatomic - leaving 4 for Mogul analysis.

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	$\# Z  > 2$
4	GOL	A	702	-	5,5,5	0.28	0	5,5,5	0.35	0
4	GOL	A	714	-	5,5,5	0.29	0	5,5,5	0.36	0
3	GUN	A	600	-	9,12,12	2.21	3 (33%)	8,17,17	4.25	5 (62%)
4	GOL	A	703	-	5,5,5	0.30	0	5,5,5	0.46	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
4	GOL	A	702	-	-	2/4/4/4	-
4	GOL	A	714	-	-	4/4/4/4	-
3	GUN	A	600	-	-	-	0/2/2/2
4	GOL	A	703	-	-	4/4/4/4	-

All (3) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
3	A	600	GUN	C4-N3	3.93	1.44	1.36
3	A	600	GUN	C6-C5	3.16	1.46	1.41
3	A	600	GUN	C5-C4	-2.95	1.33	1.40

All (5) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
3	A	600	GUN	C4-C5-N7	-8.09	100.97	109.40
3	A	600	GUN	C2-N3-C4	4.59	120.60	115.36
3	A	600	GUN	C5-C6-N1	-4.51	117.26	123.43
3	A	600	GUN	C6-N1-C2	4.32	122.80	115.93
3	A	600	GUN	N3-C2-N1	-3.89	122.04	127.22

There are no chirality outliers.

All (10) torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
4	A	702	GOL	O1-C1-C2-O2
4	A	702	GOL	O1-C1-C2-C3
4	A	703	GOL	O1-C1-C2-O2
4	A	703	GOL	O1-C1-C2-C3
4	A	703	GOL	C1-C2-C3-O3
4	A	703	GOL	O2-C2-C3-O3
4	A	714	GOL	O1-C1-C2-C3
4	A	714	GOL	C1-C2-C3-O3
4	A	714	GOL	O1-C1-C2-O2
4	A	714	GOL	O2-C2-C3-O3

There are no ring outliers.

1 monomer is involved in 1 short contact:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
4	A	714	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	358/386 (92%)	0.70	32 (8%) 9 9	19, 30, 55, 93	0

All (32) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	111	LEU	11.1
1	A	108	VAL	8.9
1	A	109	MET	8.3
1	A	110	SER	6.8
1	A	124	PHE	6.5
1	A	382	PHE	6.4
1	A	105	GLY	5.5
1	A	383	ALA	4.4
1	A	168	ALA	4.3
1	A	134	MET	4.2
1	A	158	CYS	4.1
1	A	125	LYS	3.8
1	A	112	SER	3.8
1	A	123	THR	3.7
1	A	165	PRO	3.7
1	A	76	LEU	3.3
1	A	166	SER	3.3
1	A	126	SER	3.2
1	A	72	TYR	3.2
1	A	116	LYS	3.1
1	A	207	PHE	2.8
1	A	316[A]	SER	2.6
1	A	233	VAL	2.6
1	A	210	LEU	2.5
1	A	278	MET	2.4
1	A	164	THR	2.4
1	A	122	VAL	2.3

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Mol	Chain	Res	Type	RSRZ
1	A	106	TYR	2.3
1	A	232	ALA	2.3
1	A	379	ALA	2.3
1	A	190	LYS	2.3
1	A	276	ILE	2.2

## 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. 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
4	GOL	A	703	6/6	0.73	0.25	39,66,80,107	0
3	GUN	A	600	11/11	0.74	0.19	35,45,51,53	11
4	GOL	A	714	6/6	0.85	0.26	42,46,62,62	0
4	GOL	A	702	6/6	0.88	0.17	30,36,40,48	0
2	ZN	A	500	1/1	1.00	0.04	23,23,23,23	0

## 6.5 Other polymers [i](#)

There are no such residues in this entry.