



# wwPDB X-ray Structure Validation Summary Report ⓘ

Oct 12, 2021 – 03:04 PM EDT

PDB ID : 2FK6  
Title : Crystal Structure of RNase Z/tRNA(Thr) complex  
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Deposited on : 2006-01-04  
Resolution : 2.90 Å(reported)

This is a wwPDB X-ray Structure Validation Summary 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	:	2.23.2
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)	:	2.23.2

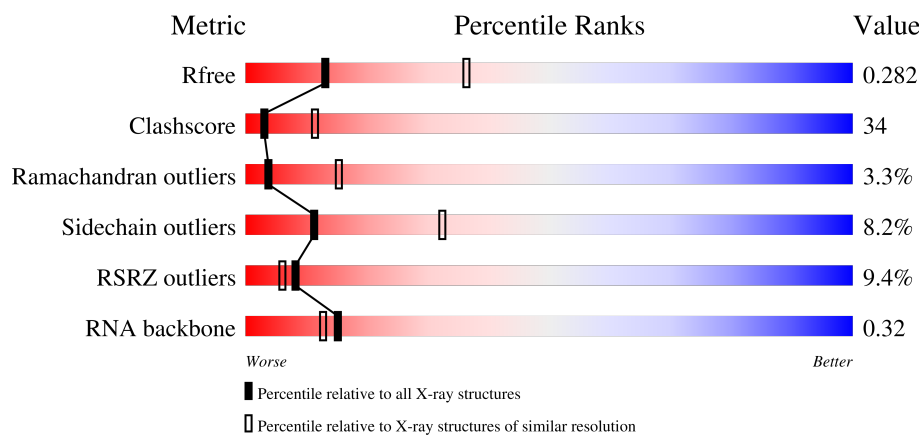
# 1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

## *X-RAY DIFFRACTION*

The reported resolution of this entry is 2.90 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	1957 (2.90-2.90)
Clashscore	141614	2172 (2.90-2.90)
Ramachandran outliers	138981	2115 (2.90-2.90)
Sidechain outliers	138945	2117 (2.90-2.90)
RSRZ outliers	127900	1906 (2.90-2.90)
RNA backbone	3102	1007 (3.16-2.64)

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 of 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	R	79	
2	A	320	

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 crite-

ria:

Mol	Type	Chain	Res	Chirality	Geometry	Clashes	Electron density
5	GOL	A	501	-	X	-	-

## 2 Entry composition

There are 6 unique types of molecules in this entry. The entry contains 3550 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 RNA chain called TRNA(THR).

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	R	53	Total	C	N	O	P	0	0	0
			1125	504	202	368	51			

- Molecule 2 is a protein called RIBONUCLEASE Z.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
2	A	307	Total	C	N	O	S	0	0	0
			2395	1524	408	456	7			

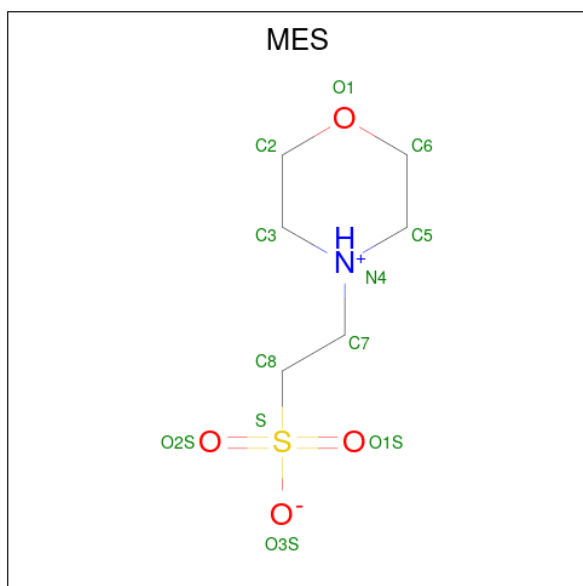
There are 16 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	46	MET	ILE	engineered mutation	UNP P54548
A	65	ALA	HIS	engineered mutation	UNP P54548
A	228	MET	LEU	engineered mutation	UNP P54548
A	308	LYS	-	expression tag	UNP P54548
A	309	LEU	-	expression tag	UNP P54548
A	310	ALA	-	expression tag	UNP P54548
A	311	ALA	-	expression tag	UNP P54548
A	312	ALA	-	expression tag	UNP P54548
A	313	LEU	-	expression tag	UNP P54548
A	314	GLU	-	expression tag	UNP P54548
A	315	HIS	-	expression tag	UNP P54548
A	316	HIS	-	expression tag	UNP P54548
A	317	HIS	-	expression tag	UNP P54548
A	318	HIS	-	expression tag	UNP P54548
A	319	HIS	-	expression tag	UNP P54548
A	320	HIS	-	expression tag	UNP P54548

- Molecule 3 is ZINC ION (three-letter code: ZN) (formula: Zn).

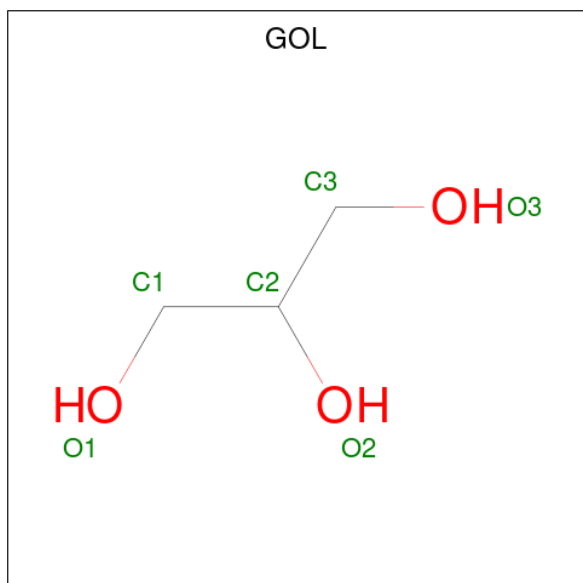
Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
3	A	1	Total	Zn	0	0
			1	1		

- Molecule 4 is 2-(N-MORPHOLINO)-ETHANESULFONIC ACID (three-letter code: MES) (formula:  $C_6H_{13}NO_4S$ ).



Mol	Chain	Residues	Atoms					ZeroOcc	AltConf
4	A	1	Total	C	N	O	S	0	0
			12	6	1	4	1		

- Molecule 5 is GLYCEROL (three-letter code: GOL) (formula:  $C_3H_8O_3$ ).



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

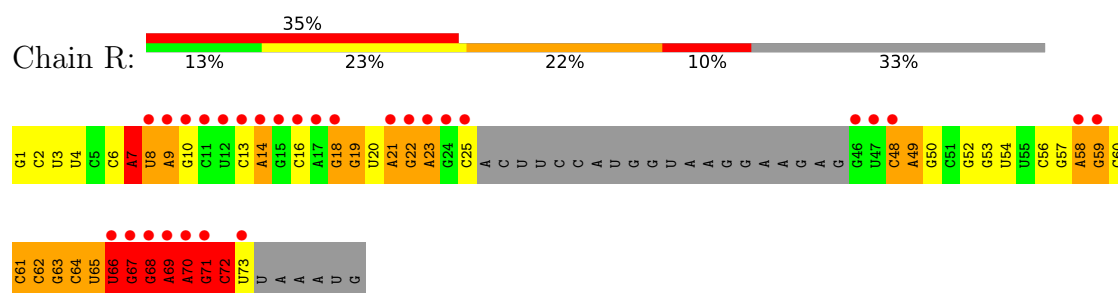
- Molecule 6 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
6	R	1	Total	O	0	0
			1	1		
6	A	10	Total	O	0	0
			10	10		

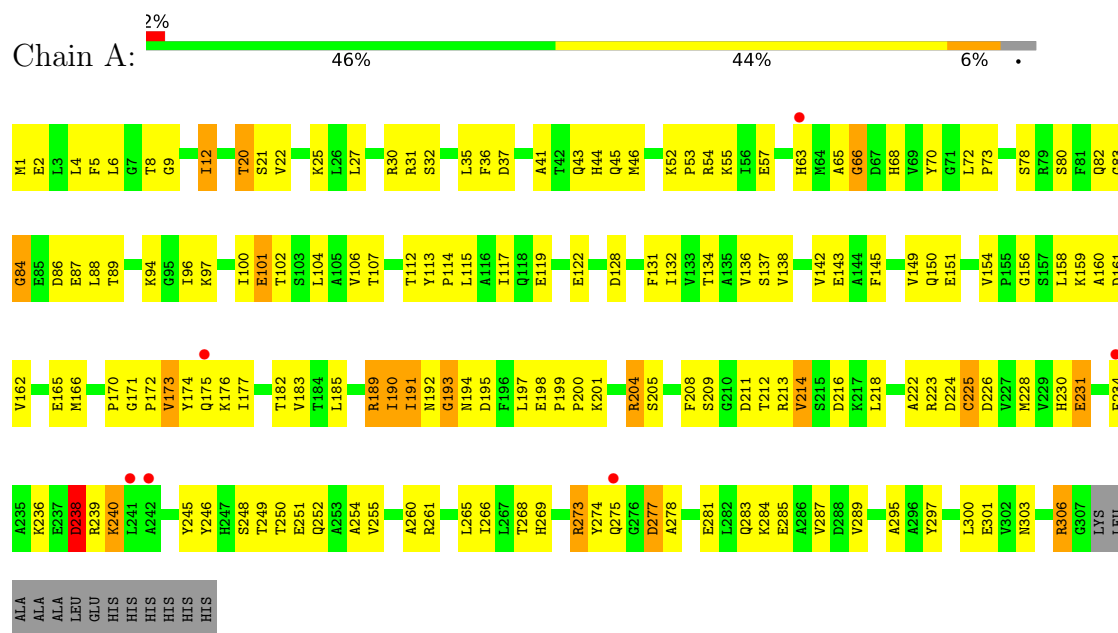
### 3 Residue-property plots

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: TRNA(THR)



#### • Molecule 2: RIBONUCLEASE Z



## 4 Data and refinement statistics

Property	Value	Source
Space group	C 1 2 1	Depositor
Cell constants a, b, c, $\alpha$ , $\beta$ , $\gamma$	173.54Å 42.40Å 110.43Å 90.00° 121.42° 90.00°	Depositor
Resolution (Å)	47.12 – 2.90 82.88 – 2.90	Depositor EDS
% Data completeness (in resolution range)	95.9 (47.12-2.90) 96.0 (82.88-2.90)	Depositor EDS
$R_{merge}$	0.07	Depositor
$R_{sym}$	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ <sup>1</sup>	2.53 (at 2.91Å)	Xtriage
Refinement program	CNS	Depositor
R, $R_{free}$	0.250 , 0.299 0.235 , 0.282	Depositor DCC
$R_{free}$ test set	747 reflections (4.97%)	wwPDB-VP
Wilson B-factor (Å <sup>2</sup> )	57.6	Xtriage
Anisotropy	0.726	Xtriage
Bulk solvent $k_{sol}$ (e/Å <sup>3</sup> ), $B_{sol}$ (Å <sup>2</sup> )	0.39 , 64.9	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	0.90	EDS
Total number of atoms	3550	wwPDB-VP
Average B, all atoms (Å <sup>2</sup> )	70.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 5.88% 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: MES, ZN, GOL

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	R	0.46	0/1256	1.13	27/1955 (1.4%)
2	A	0.48	0/2441	0.70	0/3301
All	All	0.48	0/3697	0.89	27/5256 (0.5%)

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	R	0	1

There are no bond length outliers.

The worst 5 of 27 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	R	66	U	C2'-C3'-O3'	7.05	125.01	109.50
1	R	72	C	C4'-C3'-O3'	6.98	126.97	113.00
1	R	67	G	C4'-C3'-O3'	6.18	125.37	113.00
1	R	68	G	C4'-C3'-O3'	6.18	125.35	113.00
1	R	69	A	C2'-C3'-O3'	6.16	123.56	113.70

There are no chirality outliers.

All (1) planarity outliers are listed below:

Mol	Chain	Res	Type	Group
1	R	71	G	Sidechain

## 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	R	1125	0	576	66	0
2	A	2395	0	2411	161	0
3	A	1	0	0	0	0
4	A	12	0	13	2	0
5	A	6	0	4	0	0
6	A	10	0	0	0	0
6	R	1	0	0	0	0
All	All	3550	0	3004	221	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 34.

The worst 5 of 221 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)
2:A:240:LYS:H	2:A:240:LYS:HD3	1.24	0.99
1:R:9:A:H62	1:R:23:A:H62	1.19	0.89
2:A:177:ILE:HG23	2:A:193:GLY:HA2	1.54	0.88
2:A:190:ILE:HD13	2:A:190:ILE:H	1.40	0.81
2:A:249:THR:H	2:A:252:GLN:HE21	1.28	0.81

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	
2	A	305/320 (95%)	258 (85%)	37 (12%)	10 (3%)	4	15

5 of 10 Ramachandran outliers are listed below:

Mol	Chain	Res	Type
2	A	21	SER
2	A	84	GLY
2	A	20	THR
2	A	66	GLY
2	A	122	GLU

### 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	
2	A	257/267 (96%)	236 (92%)	21 (8%)	11	32

5 of 21 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
2	A	231	GLU
2	A	273	ARG
2	A	306	ARG
2	A	277	ASP
2	A	240	LYS

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. 5 of 7 such sidechains are listed below:

Mol	Chain	Res	Type
2	A	252	GLN
2	A	283	GLN
2	A	303	ASN
2	A	292	ASN
2	A	194	ASN

### 5.3.3 RNA ⓘ

Mol	Chain	Analysed	Backbone Outliers	Pucker Outliers
1	R	51/79 (64%)	23 (45%)	10 (19%)

5 of 23 RNA backbone outliers are listed below:

Mol	Chain	Res	Type
1	R	7	A
1	R	8	U
1	R	9	A
1	R	10	G
1	R	14	A

5 of 10 RNA pucker outliers are listed below:

Mol	Chain	Res	Type
1	R	70	A
1	R	71	G
1	R	72	C
1	R	22	G
1	R	58	A

## 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 monosaccharides in this entry.

## 5.6 Ligand geometry ⓘ

Of 3 ligands modelled in this entry, 1 is monoatomic - leaving 2 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	MES	A	801	-	12,12,12	9.13	8 (66%)	14,16,16	2.61	5 (35%)
5	GOL	A	501	-	5,5,5	4.49	5 (100%)	5,5,5	5.79	3 (60%)

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	MES	A	801	-	-	0/6/14/14	0/1/1/1
5	GOL	A	501	-	-	2/4/4/4	-

The worst 5 of 13 bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
4	A	801	MES	C8-S	-24.07	1.43	1.77
4	A	801	MES	O2S-S	12.14	1.80	1.45
4	A	801	MES	O1S-S	11.93	1.80	1.45
4	A	801	MES	O3S-S	9.24	1.80	1.47
5	A	501	GOL	C3-C2	-7.38	1.21	1.51

The worst 5 of 8 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
5	A	501	GOL	O3-C3-C2	10.49	160.50	110.20
5	A	501	GOL	O2-C2-C3	6.81	139.10	109.12
4	A	801	MES	O3S-S-C8	6.40	116.11	105.77
4	A	801	MES	O1S-S-C8	4.59	112.44	106.92
5	A	501	GOL	O1-C1-C2	3.26	125.84	110.20

There are no chirality outliers.

All (2) torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
5	A	501	GOL	C1-C2-C3-O3
5	A	501	GOL	O1-C1-C2-O2

There are no ring outliers.

1 monomer is involved in 2 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
4	A	801	MES	2	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	R	53/79 (67%)	2.72	28 (52%) <b>0</b> <b>0</b>	53, 97, 156, 179	0
2	A	307/320 (95%)	0.55	6 (1%) 65 63	33, 50, 84, 98	0
All	All	360/399 (90%)	0.87	34 (9%) <b>8</b> <b>6</b>	33, 52, 113, 179	0

The worst 5 of 34 RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	R	17	A	9.1
1	R	9	A	7.2
1	R	16	C	7.1
1	R	24	G	6.5
1	R	46	G	5.6

### 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 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
5	GOL	A	501	6/6	0.72	0.30	69,71,72,73	0
4	MES	A	801	12/12	0.89	0.21	84,86,89,89	0
3	ZN	A	401	1/1	0.93	0.09	99,99,99,99	0

## 6.5 Other polymers [i](#)

There are no such residues in this entry.