



# Full wwPDB X-ray Structure Validation Report ⓘ

Feb 15, 2024 – 01:58 PM EST

PDB ID : 3PZG  
Title : I222 crystal form of the hyperthermostable endo-1,4-beta-D-mannanase from *Thermotoga petrophila* RKU-1  
Authors : Santos, C.R.; Meza, A.N.; Paiva, J.H.; Silva, J.C.; Ruller, R.; Prade, R.A.; Squina, F.M.; Murakami, M.T.  
Deposited on : 2010-12-14  
Resolution : 1.40 Å(reported)

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We welcome your comments at [validation@mail.wwpdb.org](mailto:validation@mail.wwpdb.org)

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<https://www.wwpdb.org/validation/2017/XrayValidationReportHelp>

with specific help available everywhere you see the ⓘ symbol.

The types of validation reports are described at

<http://www.wwpdb.org/validation/2017/FAQs#types>.

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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 : 2.36  
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) : 2.36

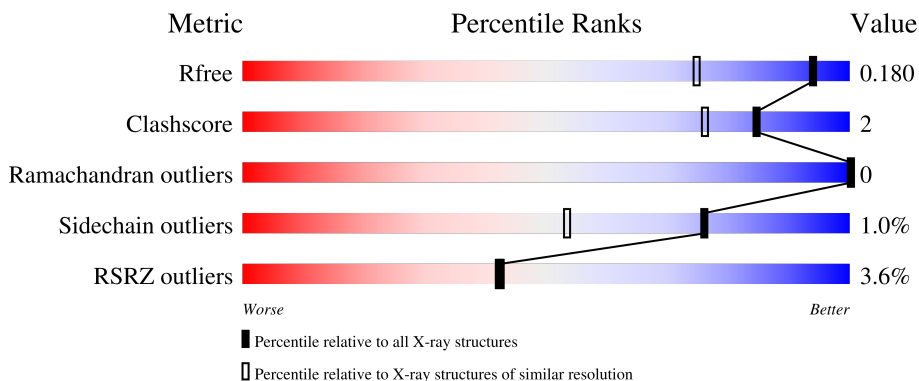
# 1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

*X-RAY DIFFRACTION*

The reported resolution of this entry is 1.40 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	1714 (1.40-1.40)
Clashscore	141614	1812 (1.40-1.40)
Ramachandran outliers	138981	1763 (1.40-1.40)
Sidechain outliers	138945	1762 (1.40-1.40)
RSRZ outliers	127900	1674 (1.40-1.40)

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 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	A	383	

## 2 Entry composition

There are 5 unique types of molecules in this entry. The entry contains 3288 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 Mannan endo-1,4-beta-mannosidase. Glycosyl Hydrolase family 5.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
1	A	357	2950	1901	485	553	11	0	5	0

There are 21 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	11	MET	-	expression tag	UNP A5IMX7
A	12	GLY	-	expression tag	UNP A5IMX7
A	13	SER	-	expression tag	UNP A5IMX7
A	14	SER	-	expression tag	UNP A5IMX7
A	15	HIS	-	expression tag	UNP A5IMX7
A	16	HIS	-	expression tag	UNP A5IMX7
A	17	HIS	-	expression tag	UNP A5IMX7
A	18	HIS	-	expression tag	UNP A5IMX7
A	19	HIS	-	expression tag	UNP A5IMX7
A	20	HIS	-	expression tag	UNP A5IMX7
A	21	SER	-	expression tag	UNP A5IMX7
A	22	SER	-	expression tag	UNP A5IMX7
A	23	GLY	-	expression tag	UNP A5IMX7
A	24	LEU	-	expression tag	UNP A5IMX7
A	25	VAL	-	expression tag	UNP A5IMX7
A	26	PRO	-	expression tag	UNP A5IMX7
A	27	ARG	-	expression tag	UNP A5IMX7
A	28	GLY	-	expression tag	UNP A5IMX7
A	29	SER	-	expression tag	UNP A5IMX7
A	30	HIS	-	expression tag	UNP A5IMX7
A	31	MET	-	expression tag	UNP A5IMX7

- Molecule 2 is 2-AMINO-2-HYDROXYMETHYL-PROPANE-1,3-DIOL (three-letter code: TRS) (formula: C<sub>4</sub>H<sub>12</sub>NO<sub>3</sub>).



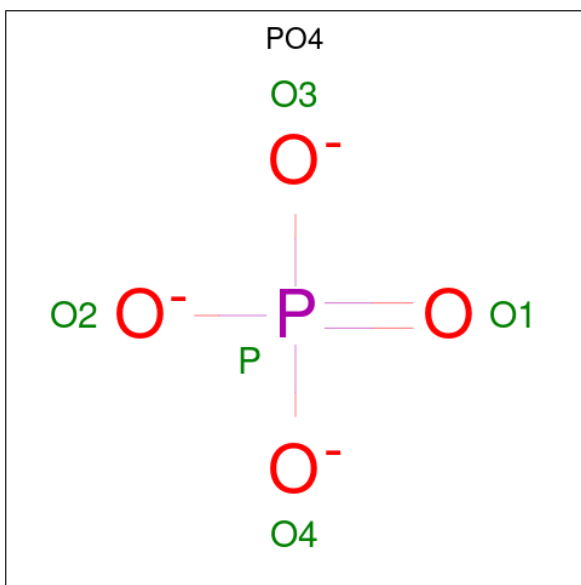
Mol	Chain	Residues	Atoms				ZeroOcc	AltConf
			Total	C	N	O		
2	A	1	8	4	1	3	0	0

- Molecule 3 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
			Total	C	O		
3	A	1	6	3	3	0	0

- Molecule 4 is PHOSPHATE ION (three-letter code: PO4) (formula: O<sub>4</sub>P).



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

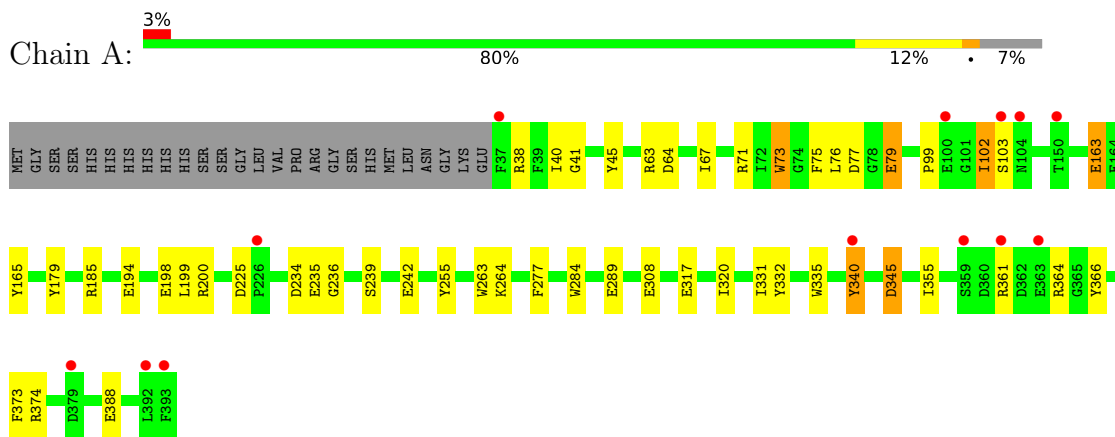
- Molecule 5 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
5	A	319	Total	O	0	0
			319	319		

### 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: Mannan endo-1,4-beta-mannosidase. Glycosyl Hydrolase family 5



## 4 Data and refinement statistics i

Property	Value	Source
Space group	I 2 2 2	Depositor
Cell constants a, b, c, $\alpha$ , $\beta$ , $\gamma$	91.03Å 89.97Å 97.89Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	37.30 – 1.40 37.29 – 1.40	Depositor EDS
% Data completeness (in resolution range)	95.2 (37.30-1.40) 95.2 (37.29-1.40)	Depositor EDS
$R_{merge}$	(Not available)	Depositor
$R_{sym}$	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ <sup>1</sup>	4.21 (at 1.40Å)	Xtrriage
Refinement program	REFMAC 5.5.0110	Depositor
R, $R_{free}$	0.154 , 0.184 0.147 , 0.180	Depositor DCC
$R_{free}$ test set	3778 reflections (5.01%)	wwPDB-VP
Wilson B-factor (Å <sup>2</sup> )	15.2	Xtrriage
Anisotropy	0.765	Xtrriage
Bulk solvent $k_{sol}$ (e/Å <sup>3</sup> ), $B_{sol}$ (Å <sup>2</sup> )	0.39 , 42.7	EDS
L-test for twinning <sup>2</sup>	$\langle  L  \rangle = 0.51$ , $\langle L^2 \rangle = 0.34$	Xtrriage
Estimated twinning fraction	0.005 for -k,-h,-l	Xtrriage
$F_o, F_c$ correlation	0.98	EDS
Total number of atoms	3288	wwPDB-VP
Average B, all atoms (Å <sup>2</sup> )	17.0	wwPDB-VP

Xtrriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 5.19% 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 [i](#)

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

Bond lengths and bond angles in the following residue types are not validated in this section: TRS, GOL, PO4

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	1.56	34/3069 (1.1%)	1.32	21/4157 (0.5%)

All (34) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	A	340[A]	TYR	CE1-CZ	13.04	1.55	1.38
1	A	340[B]	TYR	CE1-CZ	13.04	1.55	1.38
1	A	289	GLU	CD-OE1	9.71	1.36	1.25
1	A	165	TYR	CE2-CZ	8.41	1.49	1.38
1	A	335	TRP	CG-CD1	7.82	1.47	1.36
1	A	163	GLU	CD-OE1	7.72	1.34	1.25
1	A	79	GLU	CD-OE2	7.46	1.33	1.25
1	A	255	TYR	CE2-CZ	7.02	1.47	1.38
1	A	289	GLU	CG-CD	6.87	1.62	1.51
1	A	308	GLU	CG-CD	6.61	1.61	1.51
1	A	332	TYR	CE2-CZ	6.57	1.47	1.38
1	A	317	GLU	CD-OE1	6.08	1.32	1.25
1	A	388	GLU	CG-CD	5.87	1.60	1.51
1	A	242	GLU	CB-CG	5.86	1.63	1.52
1	A	340[A]	TYR	CD1-CE1	-5.69	1.30	1.39
1	A	340[B]	TYR	CD1-CE1	-5.69	1.30	1.39
1	A	73	TRP	CE3-CZ3	5.54	1.47	1.38
1	A	373	PHE	CE2-CZ	5.53	1.47	1.37
1	A	284	TRP	CZ3-CH2	5.49	1.48	1.40
1	A	345	ASP	CB-CG	5.46	1.63	1.51
1	A	364	ARG	CG-CD	5.35	1.65	1.51
1	A	198	GLU	CD-OE1	-5.27	1.19	1.25
1	A	179	TYR	CG-CD1	5.26	1.46	1.39
1	A	199	LEU	CA-CB	5.22	1.65	1.53
1	A	179	TYR	CE2-CZ	5.21	1.45	1.38
1	A	45	TYR	CE1-CZ	5.19	1.45	1.38

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Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	A	64	ASP	N-CA	5.13	1.56	1.46
1	A	345	ASP	CG-OD2	5.10	1.37	1.25
1	A	335	TRP	CD2-CE2	5.07	1.47	1.41
1	A	75	PHE	CB-CG	5.05	1.59	1.51
1	A	335	TRP	CZ3-CH2	5.05	1.48	1.40
1	A	277	PHE	CD1-CE1	5.04	1.49	1.39
1	A	340[A]	TYR	CD2-CE2	5.00	1.46	1.39
1	A	340[B]	TYR	CD2-CE2	5.00	1.46	1.39

All (21) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	185	ARG	NE-CZ-NH1	12.23	126.42	120.30
1	A	185	ARG	NE-CZ-NH2	-10.11	115.25	120.30
1	A	317	GLU	OE1-CD-OE2	-8.98	112.52	123.30
1	A	345	ASP	CB-CG-OD1	-8.22	110.90	118.30
1	A	77	ASP	CB-CG-OD2	7.60	125.14	118.30
1	A	345	ASP	CB-CG-OD2	7.31	124.88	118.30
1	A	194	GLU	OE1-CD-OE2	7.11	131.84	123.30
1	A	234	ASP	CB-CG-OD1	6.73	124.36	118.30
1	A	225	ASP	CB-CG-OD2	-6.58	112.37	118.30
1	A	71	ARG	NE-CZ-NH1	6.46	123.53	120.30
1	A	200	ARG	NE-CZ-NH2	-6.18	117.21	120.30
1	A	289	GLU	CG-CD-OE2	-5.89	106.53	118.30
1	A	374	ARG	NE-CZ-NH1	5.53	123.06	120.30
1	A	340[A]	TYR	CB-CA-C	5.48	121.36	110.40
1	A	340[B]	TYR	CB-CA-C	5.48	121.36	110.40
1	A	366	TYR	CD1-CE1-CZ	-5.44	114.90	119.80
1	A	264	LYS	CD-CE-NZ	5.30	123.88	111.70
1	A	63	ARG	NE-CZ-NH1	5.12	122.86	120.30
1	A	289	GLU	CG-CD-OE1	5.11	128.51	118.30
1	A	235	GLU	OE1-CD-OE2	-5.09	117.19	123.30
1	A	364	ARG	NE-CZ-NH1	5.06	122.83	120.30

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	2950	0	2768	13	0
2	A	8	0	12	0	0
3	A	6	0	8	0	0
4	A	5	0	0	0	0
5	A	319	0	0	6	1
All	All	3288	0	2788	13	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 2.

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:79:GLU:HG3	5:A:687:HOH:O	2.01	0.60
1:A:239:SER:O	5:A:423:HOH:O	2.16	0.59
1:A:163:GLU:HG3	5:A:688:HOH:O	2.02	0.59
1:A:99:PRO:HG2	1:A:102:ILE:HD11	1.93	0.50
1:A:361:ARG:NH2	5:A:656:HOH:O	2.15	0.49
1:A:355:ILE:C	1:A:355:ILE:HD12	2.33	0.48
1:A:236:GLY:HA2	1:A:263:TRP:CD1	2.49	0.48
1:A:102:ILE:HD11	5:A:607:HOH:O	2.15	0.46
1:A:103:SER:HA	5:A:583:HOH:O	2.16	0.45
1:A:38:ARG:HA	1:A:345:ASP:O	2.18	0.43
1:A:320:ILE:HD11	1:A:331:ILE:HG21	2.02	0.41
1:A:41:GLY:HA2	1:A:67:ILE:HG23	2.04	0.40
1:A:40:ILE:HD13	1:A:340[A]:TYR:OH	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)
5:A:423:HOH:O	5:A:583:HOH:O[8_555]	2.00	0.20

## 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	361/383 (94%)	350 (97%)	11 (3%)	0	100	100

There are no Ramachandran outliers to report.

### 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	310/326 (95%)	307 (99%)	3 (1%)	76	53

All (3) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	73	TRP
1	A	76	LEU
1	A	102	ILE

Sometimes 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 monosaccharides 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	$\# Z  > 2$
4	PO4	A	395	-	4,4,4	0.45	0	6,6,6	1.35	1 (16%)
2	TRS	A	1	-	7,7,7	1.05	1 (14%)	9,9,9	0.85	0
3	GOL	A	394	-	5,5,5	0.92	0	5,5,5	1.93	2 (40%)

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	TRS	A	1	-	-	0/9/9/9	-
3	GOL	A	394	-	-	1/4/4/4	-

All (1) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
2	A	1	TRS	C1-C	2.25	1.60	1.53

All (3) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
3	A	394	GOL	O3-C3-C2	-3.56	93.15	110.20
4	A	395	PO4	O4-P-O1	-2.32	102.41	110.89
3	A	394	GOL	O2-C2-C1	2.11	118.40	109.12

There are no chirality outliers.

All (1) torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
3	A	394	GOL	O1-C1-C2-O2

There are no ring outliers.

No monomer is involved in short contacts.

## 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	357/383 (93%)	0.12	13 (3%) 42 42	10, 14, 27, 35	6 (1%)

All (13) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	392	LEU	4.6
1	A	37	PHE	4.3
1	A	393	PHE	4.0
1	A	150	THR	3.6
1	A	226	PRO	3.0
1	A	363	GLU	2.9
1	A	103	SER	2.6
1	A	379	ASP	2.6
1	A	359	SER	2.1
1	A	340[A]	TYR	2.1
1	A	361	ARG	2.1
1	A	100	GLU	2.0
1	A	104	ASN	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 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(Å <sup>2</sup> )	Q<0.9
3	GOL	A	394	6/6	0.91	0.11	21,22,27,32	0
4	PO4	A	395	5/5	0.93	0.11	18,18,20,20	5
2	TRS	A	1	8/8	0.97	0.11	11,11,14,14	0

## 6.5 Other polymers [i](#)

There are no such residues in this entry.