



# Full wwPDB X-ray Structure Validation Report ⓘ

May 21, 2020 – 10:28 pm BST

PDB ID : 1UOQ  
Title : PROLYL OLIGOPEPTIDASE FROM PORCINE BRAIN, S554A MUTANT  
WITH BOUND PEPTIDE LIGAND GLU-PHE-SER-PRO  
Authors : Rea, D.; Fulop, V.  
Deposited on : 2003-09-22  
Resolution : 2.10 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

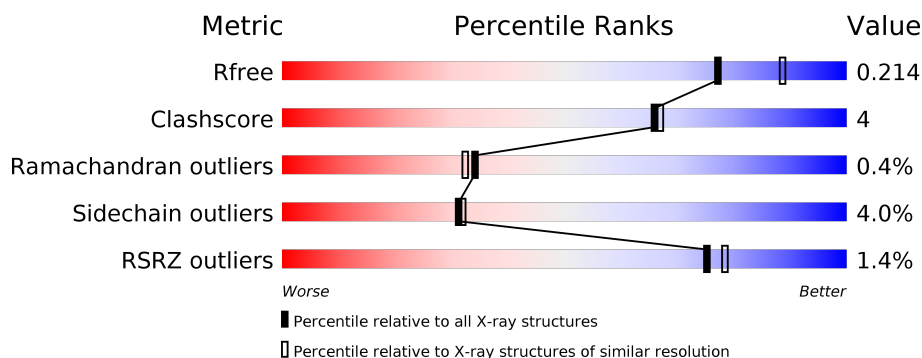
# 1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

## *X-RAY DIFFRACTION*

The reported resolution of this entry is 2.10 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	5197 (2.10-2.10)
Clashscore	141614	5710 (2.10-2.10)
Ramachandran outliers	138981	5647 (2.10-2.10)
Sidechain outliers	138945	5648 (2.10-2.10)
RSRZ outliers	127900	5083 (2.10-2.10)

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	710	<div> <div style="width: 100%; height: 10px; background-color: red; position: relative;"> <span style="position: absolute; top: -10px; left: 0;">%</span> </div> <div style="display: flex; justify-content: space-between; margin-top: 5px;"> <span>86%</span> <span>12%</span> </div> </div>
2	B	4	<div> <div style="width: 100%; height: 10px; background-color: green; position: relative;"> <span style="position: absolute; top: -10px; left: 0;">25%</span> <span style="position: absolute; top: -10px; right: 0;">75%</span> </div> </div>

## 2 Entry composition [i](#)

There are 4 unique types of molecules in this entry. The entry contains 6278 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 PROLYL ENDOPEPTIDASE.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
1	A	710	5700	3659	944	1069	28	0	0	0

There is a discrepancy between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	554	ALA	SER	engineered mutation	UNP P23687

- Molecule 2 is a protein called PEPTIDE LIGAND GLU-PHE-SER-PRO.

Mol	Chain	Residues	Atoms				ZeroOcc	AltConf	Trace
			Total	C	N	O			
2	B	4	34	22	4	8	0	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
3	A	1	Total	C	O	0	0
			6	3	3		
3	A	1	Total	C	O	0	0
			6	3	3		

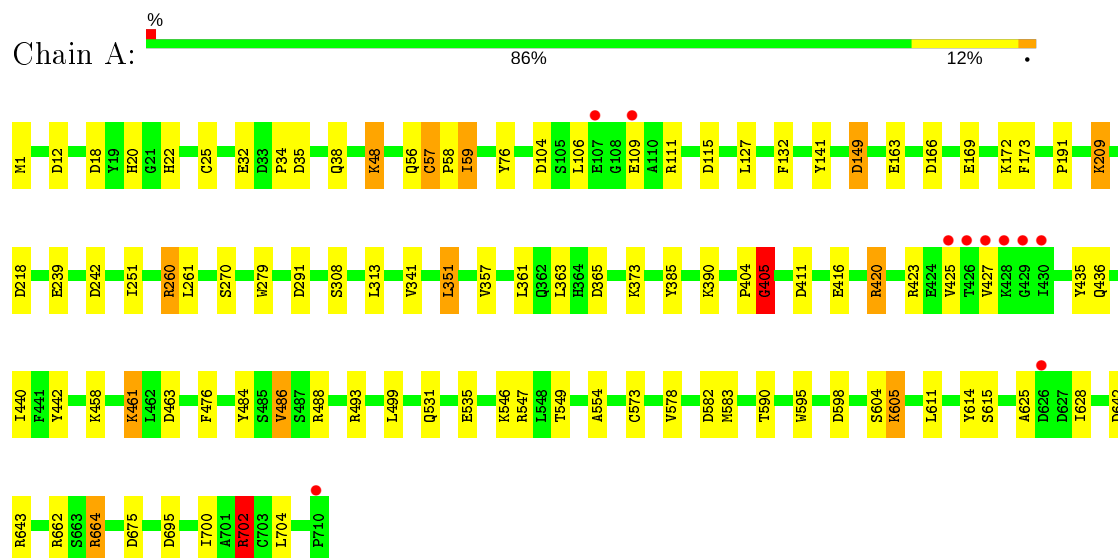
- Molecule 4 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
4	A	530	Total	O	0	0
			530	530		
4	B	2	Total	O	0	0
			2	2		

### 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: PROLYL ENDOPEPTIDASE



#### • Molecule 2: PEPTIDE LIGAND GLU-PHE-SER-PRO



## 4 Data and refinement statistics

Property	Value	Source
Space group	P 21 21 21	Depositor
Cell constants a, b, c, $\alpha$ , $\beta$ , $\gamma$	70.30 Å 99.10 Å 109.80 Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	36.00 – 2.10 35.15 – 2.10	Depositor EDS
% Data completeness (in resolution range)	95.1 (36.00-2.10) 95.1 (35.15-2.10)	Depositor EDS
$R_{merge}$	0.09	Depositor
$R_{sym}$	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ <sup>1</sup>	3.07 (at 2.10 Å)	Xtriage
Refinement program	REFMAC	Depositor
R, $R_{free}$	0.147 , 0.205 0.161 , 0.214	Depositor DCC
$R_{free}$ test set	1827 reflections (4.23%)	wwPDB-VP
Wilson B-factor (Å <sup>2</sup> )	29.8	Xtriage
Anisotropy	0.385	Xtriage
Bulk solvent $k_{sol}$ (e/Å <sup>3</sup> ), $B_{sol}$ (Å <sup>2</sup> )	0.38 , 56.8	EDS
L-test for twinning <sup>2</sup>	$\langle  L  \rangle = 0.47$ , $\langle L^2 \rangle = 0.30$	Xtriage
Estimated twinning fraction	No twinning to report.	Xtriage
$F_o, F_c$ correlation	0.96	EDS
Total number of atoms	6278	wwPDB-VP
Average B, all atoms (Å <sup>2</sup> )	26.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 3.97% 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

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	1.21	9/5854 (0.2%)	1.04	22/7938 (0.3%)
2	B	1.79	0/35	1.01	0/45
All	All	1.21	9/5889 (0.2%)	1.04	22/7983 (0.3%)

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

All (9) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	A	573	CYS	CB-SG	-5.84	1.72	1.81
1	A	239	GLU	CD-OE2	5.66	1.31	1.25
1	A	173	PHE	CE2-CZ	5.55	1.47	1.37
1	A	132	PHE	CE2-CZ	5.45	1.47	1.37
1	A	614	TYR	CD2-CE2	5.40	1.47	1.39
1	A	476	PHE	CD1-CE1	5.22	1.49	1.39
1	A	279	TRP	CB-CG	5.13	1.59	1.50
1	A	385	TYR	CE2-CZ	5.09	1.45	1.38
1	A	442	TYR	CD2-CE2	5.04	1.47	1.39

All (22) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	242	ASP	CB-CG-OD2	8.22	125.70	118.30
1	A	642	ASP	CB-CG-OD1	7.37	124.93	118.30

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Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	463	ASP	CB-CG-OD2	7.15	124.73	118.30
1	A	104	ASP	CB-CG-OD2	7.06	124.65	118.30
1	A	351	LEU	CB-CG-CD2	6.86	122.66	111.00
1	A	18	ASP	CB-CG-OD2	6.26	123.94	118.30
1	A	695	ASP	CB-CG-OD2	6.21	123.89	118.30
1	A	57	CYS	CA-CB-SG	-6.18	102.87	114.00
1	A	291	ASP	CB-CG-OD2	6.01	123.71	118.30
1	A	209	LYS	CD-CE-NZ	-5.98	97.95	111.70
1	A	582	ASP	CB-CG-OD2	5.94	123.64	118.30
1	A	420	ARG	NE-CZ-NH2	-5.92	117.34	120.30
1	A	115	ASP	CB-CG-OD2	5.86	123.57	118.30
1	A	149	ASP	CB-CG-OD2	5.86	123.58	118.30
1	A	702	ARG	CG-CD-NE	-5.81	99.60	111.80
1	A	166	ASP	CB-CG-OD2	5.58	123.32	118.30
1	A	365	ASP	CB-CG-OD2	5.51	123.26	118.30
1	A	643	ARG	NE-CZ-NH2	-5.46	117.57	120.30
1	A	675	ASP	CB-CG-OD2	5.35	123.11	118.30
1	A	260	ARG	NE-CZ-NH1	-5.33	117.64	120.30
1	A	411	ASP	CB-CG-OD1	5.23	123.01	118.30
1	A	35	ASP	CB-CG-OD2	5.06	122.86	118.30

There are no chirality outliers.

All (1) planarity outliers are listed below:

Mol	Chain	Res	Type	Group
1	A	405	GLY	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	5700	0	5516	44	0
2	B	34	0	26	2	0
3	A	12	0	16	0	0
4	A	530	0	0	8	1
4	B	2	0	0	0	0
All	All	6278	0	5558	45	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 4.

All (45) 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:25:CYS:HB3	4:A:2030:HOH:O	1.73	0.87
1:A:625:ALA:HB3	1:A:628:ILE:HD12	1.60	0.83
1:A:48:LYS:HE2	4:A:2070:HOH:O	1.86	0.75
1:A:20:HIS:HB3	1:A:605:LYS:HD3	1.73	0.70
1:A:313:LEU:HD21	1:A:341:VAL:HG21	1.73	0.69
1:A:57:CYS:SG	1:A:59:ILE:HG22	2.32	0.68
1:A:38:GLN:HG2	4:A:2028:HOH:O	1.96	0.65
1:A:22:HIS:HB2	4:A:2465:HOH:O	2.00	0.61
1:A:531:GLN:O	1:A:535:GLU:HG3	2.04	0.57
1:A:163:GLU:HG2	4:A:2153:HOH:O	2.04	0.57
1:A:59:ILE:C	1:A:59:ILE:HD13	2.25	0.57
1:A:341:VAL:HG13	1:A:351:LEU:HD22	1.87	0.56
1:A:486:VAL:HG13	4:A:2406:HOH:O	2.05	0.56
1:A:404:PRO:HG3	1:A:427:VAL:HG23	1.88	0.55
1:A:583:MET:HB2	1:A:615:SER:HB2	1.89	0.54
1:A:484:TYR:CE2	1:A:486:VAL:HG12	2.43	0.53
1:A:59:ILE:HD13	1:A:59:ILE:O	2.09	0.52
1:A:436:GLN:HE21	1:A:458:LYS:HG2	1.75	0.52
1:A:404:PRO:O	1:A:405:GLY:C	2.47	0.52
1:A:57:CYS:SG	1:A:58:PRO:HD2	2.50	0.52
1:A:20:HIS:CB	1:A:605:LYS:HD3	2.41	0.49
1:A:554:ALA:HA	1:A:578:VAL:O	2.13	0.49
1:A:664:ARG:HD3	1:A:664:ARG:HA	1.56	0.48
1:A:595:TRP:CD1	2:B:726:PRO:HD3	2.50	0.47
1:A:488:ARG:HD3	1:A:499:LEU:CD1	2.45	0.46
1:A:488:ARG:HD3	1:A:499:LEU:HD13	1.97	0.46
1:A:191:PRO:HG3	1:A:209:LYS:NZ	2.32	0.45
1:A:625:ALA:CB	1:A:628:ILE:HD12	2.39	0.45
1:A:363:LEU:HB3	1:A:373:LYS:HB3	1.99	0.44
1:A:662:ARG:NH2	4:A:2495:HOH:O	2.49	0.44
1:A:32:GLU:O	1:A:34:PRO:HD3	2.18	0.43
1:A:440:ILE:C	1:A:440:ILE:HD12	2.38	0.43
1:A:127:LEU:CD1	1:A:141:TYR:HB2	2.49	0.43
1:A:191:PRO:HG3	1:A:209:LYS:HZ3	1.85	0.42
1:A:76:TYR:CE1	1:A:423:ARG:HD2	2.54	0.42
1:A:461:LYS:HE2	4:A:2394:HOH:O	2.19	0.42
1:A:57:CYS:HB2	1:A:702:ARG:HD2	2.02	0.42

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:583:MET:HB3	1:A:611:LEU:HD22	2.02	0.42
1:A:435:TYR:OH	1:A:493:ARG:HD3	2.19	0.42
1:A:149:ASP:HB2	1:A:172:LYS:HE2	2.01	0.41
1:A:547:ARG:HA	1:A:704:LEU:HD13	2.01	0.41
1:A:251:ILE:HB	1:A:260:ARG:HB2	2.02	0.41
2:B:723:GLU:HG3	2:B:725:SER:H	1.85	0.41
1:A:12:ASP:C	1:A:12:ASP:OD1	2.59	0.41
1:A:549:THR:HG21	1:A:700:ILE:HD11	2.03	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)
4:A:2136:HOH:O	4:A:2417:HOH:O[3_656]	2.17	0.03

## 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	
1	A	708/710 (100%)	685 (97%)	20 (3%)	3 (0%)	34	32
2	B	2/4 (50%)	2 (100%)	0	0	100	100
All	All	710/714 (99%)	687 (97%)	20 (3%)	3 (0%)	34	32

All (3) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	405	GLY
1	A	590	THR
1	A	357	VAL

### 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	616/616 (100%)	591 (96%)	25 (4%)	30	31
2	B	4/4 (100%)	4 (100%)	0	100	100
All	All	620/620 (100%)	595 (96%)	25 (4%)	31	32

All (25) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	1	MET
1	A	48	LYS
1	A	56	GLN
1	A	59	ILE
1	A	106	LEU
1	A	109	GLU
1	A	111	ARG
1	A	169	GLU
1	A	218	ASP
1	A	261	LEU
1	A	270	SER
1	A	308	SER
1	A	361	LEU
1	A	390	LYS
1	A	416	GLU
1	A	420	ARG
1	A	425	VAL
1	A	461	LYS
1	A	486	VAL
1	A	546	LYS
1	A	598	ASP
1	A	604	SER
1	A	605	LYS
1	A	664	ARG
1	A	702	ARG

Some sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (4) such

sidechains are listed below:

Mol	Chain	Res	Type
1	A	56	GLN
1	A	192	GLN
1	A	397	GLN
1	A	436	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](#)

2 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	$\# Z  > 2$
3	GOL	A	1712	-	5,5,5	0.55	0	5,5,5	0.75	0
3	GOL	A	1711	-	5,5,5	0.61	0	5,5,5	1.33	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
3	GOL	A	1712	-	-	0/4/4/4	-
3	GOL	A	1711	-	-	2/4/4/4	-

There are no bond length outliers.

There are no bond angle outliers.

There are no chirality outliers.

All (2) torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
3	A	1711	GOL	O1-C1-C2-C3
3	A	1711	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	710/710 (100%)	-0.40	10 (1%) 75 78	17, 23, 37, 59	0
2	B	4/4 (100%)	-0.05	0 100 100	25, 27, 29, 36	0
All	All	714/714 (100%)	-0.40	10 (1%) 75 78	17, 23, 37, 59	0

All (10) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	426	THR	4.6
1	A	430	ILE	4.2
1	A	428	LYS	3.9
1	A	427	VAL	3.2
1	A	107	GLU	2.9
1	A	626	ASP	2.9
1	A	710	PRO	2.8
1	A	429	GLY	2.6
1	A	109	GLU	2.4
1	A	425	VAL	2.1

### 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
3	GOL	A	1711	6/6	0.83	0.14	40,42,43,45	0
3	GOL	A	1712	6/6	0.97	0.07	27,32,35,35	0

## 6.5 Other polymers [i](#)

There are no such residues in this entry.