



# wwPDB X-ray Structure Validation Summary Report ⓘ

Mar 5, 2026 – 07:42 PM UTC

PDB ID : 4U7D / pdb\_00004u7d  
Title : Structure of human RECQ-like helicase in complex with an oligonucleotide  
Authors : Pike, A.C.W.; Zhang, Y.; Schnecke, C.; Cooper, C.D.O.; von Delft, F.; Arrowsmith, C.H.; Edwards, A.; Bountra, C.; Gileadi, O.; Structural Genomics Consortium (SGC)  
Deposited on : 2014-07-30  
Resolution : 3.40 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.

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 : 4-5-2 with Phenix2.0  
Xtriage (Phenix) : 2.0  
EDS : 3.0  
Percentile statistics : 20250101.v01 (using entries in the PDB archive January 1st 2025)  
CCP4 : 9.0.010 (Gargrove)  
Density-Fitness : 1.0.12  
Ideal geometry (proteins) : Engh & Huber (2001)  
Ideal geometry (DNA, RNA) : Parkinson et al. (1996)  
Validation Pipeline (wwPDB-VP) : 2.49

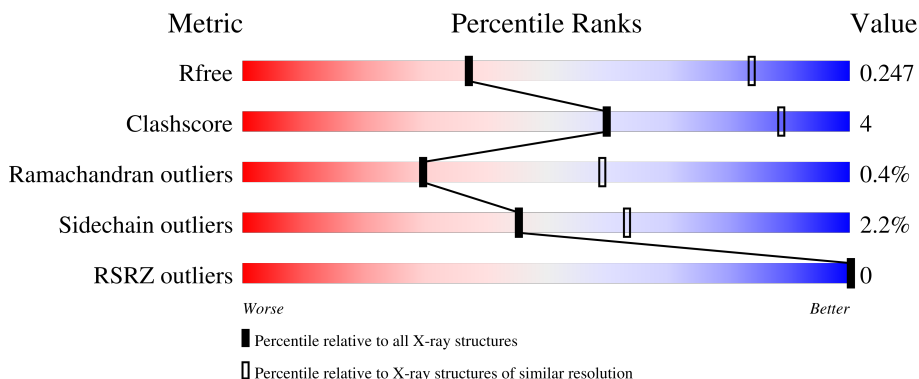
# 1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

*X-RAY DIFFRACTION*

The reported resolution of this entry is 3.40 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.





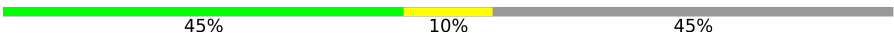
Metric	Whole archive (#Entries)	Similar resolution (#Entries, resolution range(Å))
$R_{free}$	180053	1001 (3.44-3.36)
Clashscore	190562	1022 (3.44-3.36)
Ramachandran outliers	187476	1012 (3.44-3.36)
Sidechain outliers	187428	1012 (3.44-3.36)
RSRZ outliers	180081	1001 (3.44-3.36)

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	591	 79% 10% • 11%
1	B	591	 78% 11% 11%
1	C	591	 80% 10% • 10%
1	D	591	 80% 9% 10%
2	P	20	 30% 55% 15%

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Mol	Chain	Length	Quality of chain
2	Q	20	
2	R	20	
2	S	20	

## 2 Entry composition [i](#)

There are 3 unique types of molecules in this entry. The entry contains 17224 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 ATP-dependent DNA helicase Q1.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
1	A	527	4056	2594	678	751	33	0	0	0
1	B	527	4052	2594	675	749	34	0	0	0
1	C	530	4062	2601	677	751	33	0	0	0
1	D	530	4070	2604	678	755	33	0	0	0

There are 96 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	48	MET	-	initiating methionine	UNP P46063
A	611	SER	GLY	conflict	UNP P46063
A	617	ALA	-	expression tag	UNP P46063
A	618	GLU	-	expression tag	UNP P46063
A	619	ASN	-	expression tag	UNP P46063
A	620	LEU	-	expression tag	UNP P46063
A	621	TYR	-	expression tag	UNP P46063
A	622	PHE	-	expression tag	UNP P46063
A	623	GLN	-	expression tag	UNP P46063
A	624	SER	-	expression tag	UNP P46063
A	625	HIS	-	expression tag	UNP P46063
A	626	HIS	-	expression tag	UNP P46063
A	627	HIS	-	expression tag	UNP P46063
A	628	HIS	-	expression tag	UNP P46063
A	629	HIS	-	expression tag	UNP P46063
A	630	HIS	-	expression tag	UNP P46063
A	631	ASP	-	expression tag	UNP P46063
A	632	TYR	-	expression tag	UNP P46063
A	633	LYS	-	expression tag	UNP P46063
A	634	ASP	-	expression tag	UNP P46063
A	635	ASP	-	expression tag	UNP P46063

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Chain	Residue	Modelled	Actual	Comment	Reference
A	636	ASP	-	expression tag	UNP P46063
A	637	ASP	-	expression tag	UNP P46063
A	638	LYS	-	expression tag	UNP P46063
B	48	MET	-	initiating methionine	UNP P46063
B	611	SER	GLY	conflict	UNP P46063
B	617	ALA	-	expression tag	UNP P46063
B	618	GLU	-	expression tag	UNP P46063
B	619	ASN	-	expression tag	UNP P46063
B	620	LEU	-	expression tag	UNP P46063
B	621	TYR	-	expression tag	UNP P46063
B	622	PHE	-	expression tag	UNP P46063
B	623	GLN	-	expression tag	UNP P46063
B	624	SER	-	expression tag	UNP P46063
B	625	HIS	-	expression tag	UNP P46063
B	626	HIS	-	expression tag	UNP P46063
B	627	HIS	-	expression tag	UNP P46063
B	628	HIS	-	expression tag	UNP P46063
B	629	HIS	-	expression tag	UNP P46063
B	630	HIS	-	expression tag	UNP P46063
B	631	ASP	-	expression tag	UNP P46063
B	632	TYR	-	expression tag	UNP P46063
B	633	LYS	-	expression tag	UNP P46063
B	634	ASP	-	expression tag	UNP P46063
B	635	ASP	-	expression tag	UNP P46063
B	636	ASP	-	expression tag	UNP P46063
B	637	ASP	-	expression tag	UNP P46063
B	638	LYS	-	expression tag	UNP P46063
C	48	MET	-	initiating methionine	UNP P46063
C	611	SER	GLY	conflict	UNP P46063
C	617	ALA	-	expression tag	UNP P46063
C	618	GLU	-	expression tag	UNP P46063
C	619	ASN	-	expression tag	UNP P46063
C	620	LEU	-	expression tag	UNP P46063
C	621	TYR	-	expression tag	UNP P46063
C	622	PHE	-	expression tag	UNP P46063
C	623	GLN	-	expression tag	UNP P46063
C	624	SER	-	expression tag	UNP P46063
C	625	HIS	-	expression tag	UNP P46063
C	626	HIS	-	expression tag	UNP P46063
C	627	HIS	-	expression tag	UNP P46063
C	628	HIS	-	expression tag	UNP P46063
C	629	HIS	-	expression tag	UNP P46063

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Chain	Residue	Modelled	Actual	Comment	Reference
C	630	HIS	-	expression tag	UNP P46063
C	631	ASP	-	expression tag	UNP P46063
C	632	TYR	-	expression tag	UNP P46063
C	633	LYS	-	expression tag	UNP P46063
C	634	ASP	-	expression tag	UNP P46063
C	635	ASP	-	expression tag	UNP P46063
C	636	ASP	-	expression tag	UNP P46063
C	637	ASP	-	expression tag	UNP P46063
C	638	LYS	-	expression tag	UNP P46063
D	48	MET	-	initiating methionine	UNP P46063
D	611	SER	GLY	conflict	UNP P46063
D	617	ALA	-	expression tag	UNP P46063
D	618	GLU	-	expression tag	UNP P46063
D	619	ASN	-	expression tag	UNP P46063
D	620	LEU	-	expression tag	UNP P46063
D	621	TYR	-	expression tag	UNP P46063
D	622	PHE	-	expression tag	UNP P46063
D	623	GLN	-	expression tag	UNP P46063
D	624	SER	-	expression tag	UNP P46063
D	625	HIS	-	expression tag	UNP P46063
D	626	HIS	-	expression tag	UNP P46063
D	627	HIS	-	expression tag	UNP P46063
D	628	HIS	-	expression tag	UNP P46063
D	629	HIS	-	expression tag	UNP P46063
D	630	HIS	-	expression tag	UNP P46063
D	631	ASP	-	expression tag	UNP P46063
D	632	TYR	-	expression tag	UNP P46063
D	633	LYS	-	expression tag	UNP P46063
D	634	ASP	-	expression tag	UNP P46063
D	635	ASP	-	expression tag	UNP P46063
D	636	ASP	-	expression tag	UNP P46063
D	637	ASP	-	expression tag	UNP P46063
D	638	LYS	-	expression tag	UNP P46063

- Molecule 2 is a DNA chain called DNA oligonucleotide.

Mol	Chain	Residues	Atoms				ZeroOcc	AltConf	Trace	
2	P	17	Total	C	N	O	P	0	0	0
			323	154	54	99	16			
2	Q	16	Total	C	N	O	P	0	0	0
			311	149	54	93	15			
2	R	9	Total	C	N	O	P	0	0	0
			156	74	24	50	8			

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Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
2	S	11	Total	C	N	O	P	0	0	0
			190	89	27	63	11			

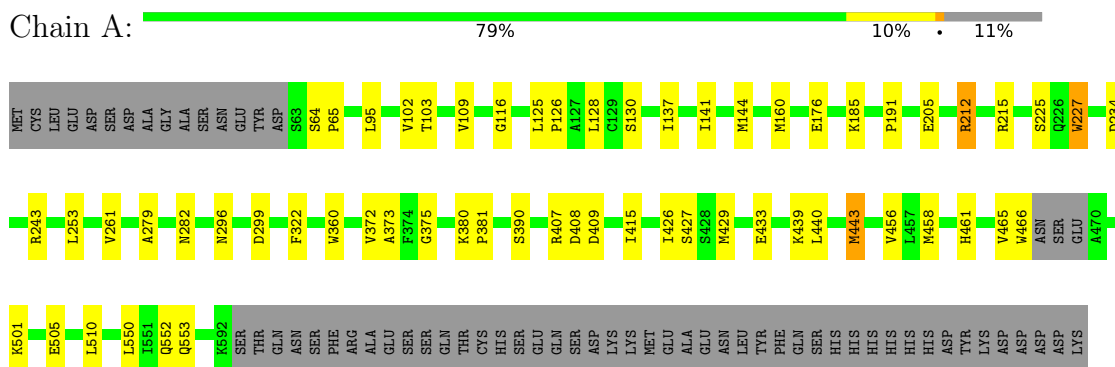
- Molecule 3 is ZINC ION (CCD ID: ZN) (formula: Zn).

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

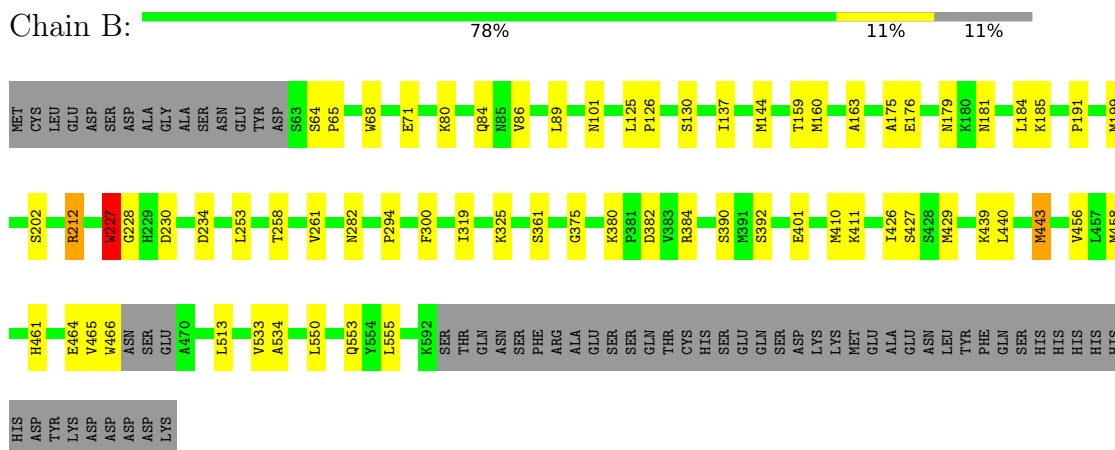
### 3 Residue-property plots [i](#)

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: ATP-dependent DNA helicase Q1



- Molecule 1: ATP-dependent DNA helicase Q1



- Molecule 1: ATP-dependent DNA helicase Q1





## 4 Data and refinement statistics i

Property	Value	Source
Space group	P 1 21 1	Depositor
Cell constants a, b, c, $\alpha$ , $\beta$ , $\gamma$	55.38Å 138.22Å 207.58Å 90.00° 90.02° 90.00°	Depositor
Resolution (Å)	39.90 – 3.40 39.90 – 3.40	Depositor EDS
% Data completeness (in resolution range)	94.9 (39.90-3.40) 94.9 (39.90-3.40)	Depositor EDS
$R_{merge}$	0.10	Depositor
$R_{sym}$	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ <sup>1</sup>	1.93 (at 3.41Å)	Xtrriage
Refinement program	PHENIX (phenix.refine: 1.9_1682)	Depositor
R, $R_{free}$	0.205 , 0.249 0.209 , 0.247	Depositor DCC
$R_{free}$ test set	1888 reflections (4.38%)	wwPDB-VP
Wilson B-factor (Å <sup>2</sup> )	78.3	Xtrriage
Anisotropy	0.315	Xtrriage
Bulk solvent $k_{sol}$ (e/Å <sup>3</sup> ), $B_{sol}$ (Å <sup>2</sup> )	0.34 , 78.3	EDS
L-test for twinning <sup>2</sup>	$\langle  L  \rangle = 0.39$ , $\langle L^2 \rangle = 0.22$	Xtrriage
Estimated twinning fraction	0.337 for h,-k,-l	Xtrriage
$F_o, F_c$ correlation	0.95	EDS
Total number of atoms	17224	wwPDB-VP
Average B, all atoms (Å <sup>2</sup> )	94.0	wwPDB-VP

Xtrriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 9.67% 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:  
ZN

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	0.53	0/4137	0.90	3/5606 (0.1%)
1	B	0.53	0/4133	0.94	8/5601 (0.1%)
1	C	0.49	0/4144	0.89	4/5619 (0.1%)
1	D	0.46	0/4152	0.87	4/5629 (0.1%)
2	P	0.44	0/360	0.60	0/552
2	Q	0.45	0/346	0.57	0/529
2	R	0.34	0/172	0.47	0/262
2	S	0.32	0/211	0.52	0/322
All	All	0.50	0/17655	0.88	19/24120 (0.1%)

There are no bond length outliers.

The worst 5 of 19 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	B	227	TRP	N-CA-C	-7.75	104.31	114.31
1	B	80	LYS	N-CA-C	-7.61	102.99	111.28
1	B	282	ASN	N-CA-C	6.11	119.21	110.24
1	A	415	ILE	N-CA-C	5.87	116.32	107.75
1	C	282	ASN	N-CA-C	5.84	118.83	110.24

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	4056	0	3918	35	0
1	B	4052	0	3919	34	0
1	C	4062	0	3917	30	0
1	D	4070	0	3928	28	0
2	P	323	0	182	13	0
2	Q	311	0	174	10	0
2	R	156	0	88	3	0
2	S	190	0	104	2	0
3	A	1	0	0	0	0
3	B	1	0	0	0	0
3	C	1	0	0	0	0
3	D	1	0	0	0	0
All	All	17224	0	16230	141	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 4.

The worst 5 of 141 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:130:SER:O	1:B:185:LYS:NZ	2.15	0.78
1:D:130:SER:O	1:D:185:LYS:NZ	2.22	0.72
1:A:130:SER:O	1:A:185:LYS:NZ	2.23	0.70
2:P:4:DT:O2	2:Q:18:DG:N2	2.30	0.64
1:A:243:ARG:NH2	1:D:431:VAL:O	2.26	0.64

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	523/591 (88%)	499 (95%)	22 (4%)	2 (0%)	30 59

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Mol	Chain	Analysed	Favoured	Allowed	Outliers	Percentiles	
1	B	523/591 (88%)	500 (96%)	21 (4%)	2 (0%)	30	59
1	C	528/591 (89%)	504 (96%)	22 (4%)	2 (0%)	30	59
1	D	528/591 (89%)	503 (95%)	22 (4%)	3 (1%)	21	50
All	All	2102/2364 (89%)	2006 (95%)	87 (4%)	9 (0%)	30	59

5 of 9 Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	C	465	VAL
1	A	375	GLY
1	A	465	VAL
1	B	375	GLY
1	B	465	VAL

### 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	416/521 (80%)	407 (98%)	9 (2%)	45	63
1	B	416/521 (80%)	407 (98%)	9 (2%)	45	63
1	C	414/521 (80%)	405 (98%)	9 (2%)	45	63
1	D	417/521 (80%)	408 (98%)	9 (2%)	45	63
All	All	1663/2084 (80%)	1627 (98%)	36 (2%)	45	63

5 of 36 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	D	227	TRP
1	D	461	HIS
1	D	253	LEU
1	D	439	LYS
1	B	390	SER

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. 5 of 8 such sidechains are listed below:

Mol	Chain	Res	Type
1	C	315	GLN
1	B	389	HIS
1	B	222	HIS
1	B	169	HIS
1	B	315	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 oligosaccharides in this entry.

### 5.6 Ligand geometry [i](#)

Of 4 ligands modelled in this entry, 4 are monoatomic - leaving 0 for Mogul analysis.

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.

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

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	527/591 (89%)	-1.42	0 100 100	42, 82, 133, 160	0
1	B	527/591 (89%)	-1.48	0 100 100	52, 78, 110, 131	0
1	C	530/591 (89%)	-1.36	0 100 100	66, 96, 134, 158	0
1	D	530/591 (89%)	-1.24	0 100 100	60, 116, 153, 168	0
2	P	17/20 (85%)	-1.48	0 100 100	78, 99, 108, 111	0
2	Q	16/20 (80%)	-1.40	0 100 100	71, 92, 107, 108	0
2	R	9/20 (45%)	-1.37	0 100 100	127, 134, 136, 139	0
2	S	11/20 (55%)	-1.38	0 100 100	109, 131, 137, 140	0
All	All	2167/2444 (88%)	-1.38	0 100 100	42, 89, 140, 168	0

There are no RSRZ outliers to report.

### 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 oligosaccharides 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	ZN	D	701	1/1	0.99	0.05	131,131,131,131	0
3	ZN	B	701	1/1	1.00	0.01	91,91,91,91	0
3	ZN	C	701	1/1	1.00	0.02	94,94,94,94	0
3	ZN	A	701	1/1	1.00	0.01	75,75,75,75	0

## 6.5 Other polymers [i](#)

There are no such residues in this entry.