



# Full wwPDB X-ray Structure Validation Report ⓘ

Aug 15, 2017 – 12:04 AM EDT

PDB ID : 3KRL  
Title : cFMS Tyrosine kinase in complex with 5-Cyano-furan-2-carboxylic acid [4-(4-methyl-piperazin-1-yl)-2-piperidin-1-yl-phenyl]-amide  
Authors : Schubert, C.  
Deposited on : unknown  
Resolution : 2.40 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

<http://wwpdb.org/validation/2016/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 : 1.7.2 (RC1), CSD as538be (2017)  
Xtriage (Phenix) : 1.9-1692  
EDS : rb-20029824  
Percentile statistics : 20161228.v01 (using entries in the PDB archive December 28th 2016)  
Refmac : 5.8.0135  
CCP4 : 6.5.0  
Ideal geometry (proteins) : Engh & Huber (2001)  
Ideal geometry (DNA, RNA) : Parkinson et al. (1996)  
Validation Pipeline (wwPDB-VP) : rb-20029824

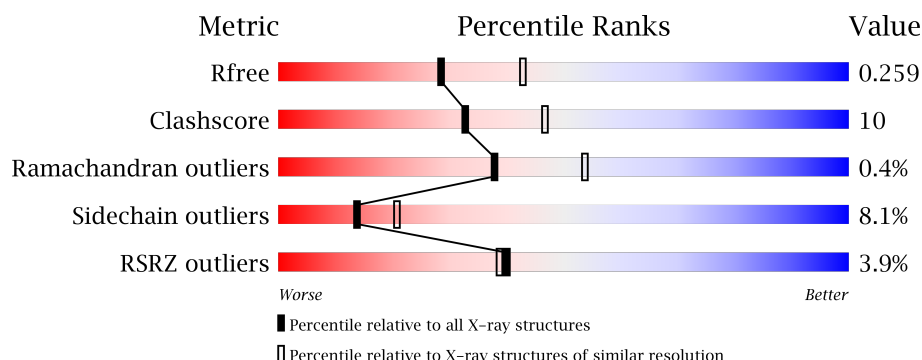
# 1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

## *X-RAY DIFFRACTION*

The reported resolution of this entry is 2.40 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))
$R_{free}$	100719	3166 (2.40-2.40)
Clashscore	112137	3674 (2.40-2.40)
Ramachandran outliers	110173	3616 (2.40-2.40)
Sidechain outliers	110143	3617 (2.40-2.40)
RSRZ outliers	101464	3195 (2.40-2.40)

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 on the lower bar indicate the fraction of residues that contain outliers for  $\geq 3$ , 2, 1 and 0 types of geometric quality criteria. 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	335	

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 criteria:

Mol	Type	Chain	Res	Chirality	Geometry	Clashes	Electron density
3	SO4	A	923	-	X	X	-

## 2 Entry composition [i](#)

There are 4 unique types of molecules in this entry. The entry contains 4574 atoms, of which 2271 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.

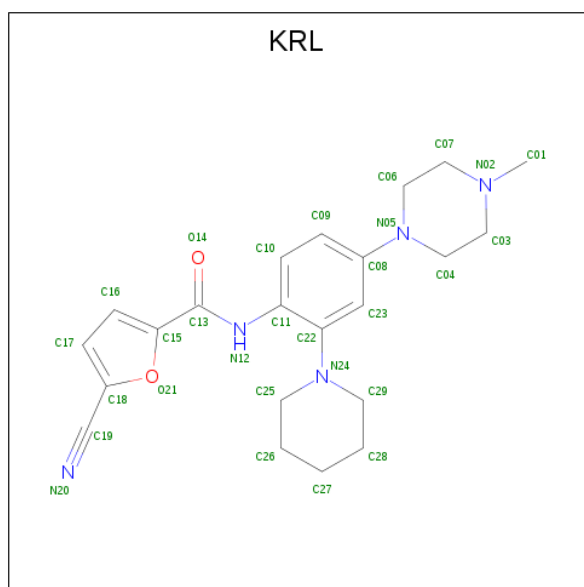
- Molecule 1 is a protein called Macrophage colony-stimulating factor 1 receptor, Basic fibroblast growth factor receptor 1.

Mol	Chain	Residues	Atoms						ZeroOcc	AltConf	Trace
1	A	281	Total	C	H	N	O	S	0	2	0
			4476	1442	2244	381	393	16			

There are 4 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	535	GLY	-	EXPRESSION TAG	UNP P07333
A	536	VAL	-	EXPRESSION TAG	UNP P07333
A	537	ASP	-	EXPRESSION TAG	UNP P07333
A	686	SER	CYS	ENGINEERED	UNP P11362

- Molecule 2 is 5-cyano-N-[4-(4-methylpiperazin-1-yl)-2-piperidin-1-ylphenyl]furan-2-carboxamide (three-letter code: KRL) (formula: C<sub>22</sub>H<sub>27</sub>N<sub>5</sub>O<sub>2</sub>).



Mol	Chain	Residues	Atoms					ZeroOcc	AltConf
2	A	1	Total	C	H	N	O	0	0
			56	22	27	5	2		

- Molecule 3 is SULFATE ION (three-letter code: SO4) (formula: O<sub>4</sub>S).



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

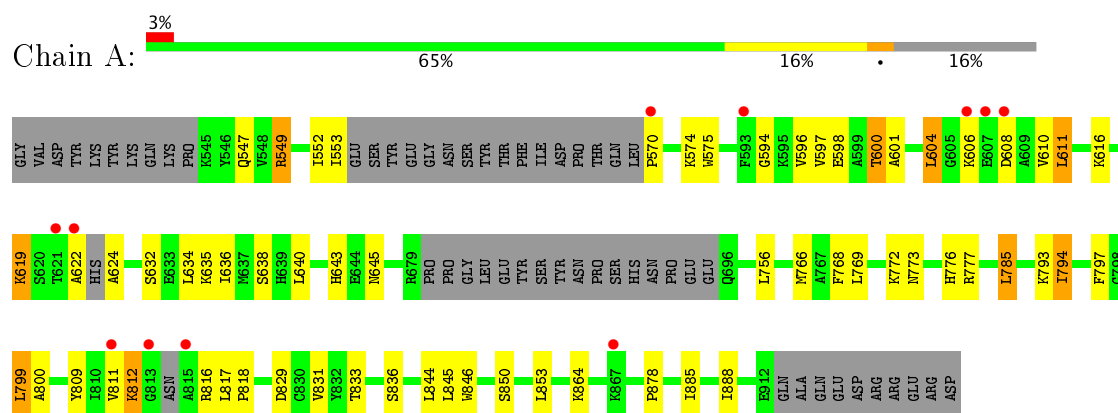
- Molecule 4 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
4	A	37	Total	O	0	0
			37	37		

### 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: Macrophage colony-stimulating factor 1 receptor, Basic fibroblast growth factor receptor 1



## 4 Data and refinement statistics

Property	Value	Source
Space group	H 3	Depositor
Cell constants a, b, c, $\alpha$ , $\beta$ , $\gamma$	81.11Å 81.11Å 142.57Å 90.00° 90.00° 120.00°	Depositor
Resolution (Å)	16.16 – 2.40 16.16 – 2.40	Depositor EDS
% Data completeness (in resolution range)	94.5 (16.16-2.40) 94.5 (16.16-2.40)	Depositor EDS
$R_{merge}$	0.06	Depositor
$R_{sym}$	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ <sup>1</sup>	4.86 (at 2.40Å)	Xtriage
Refinement program	PHENIX	Depositor
R, $R_{free}$	0.209 , 0.264 0.200 , 0.259	Depositor DCC
$R_{free}$ test set	638 reflections (4.96%)	DCC
Wilson B-factor (Å <sup>2</sup> )	48.0	Xtriage
Anisotropy	0.486	Xtriage
Bulk solvent $k_{sol}$ (e/Å <sup>3</sup> ), $B_{sol}$ (Å <sup>2</sup> )	0.41 , 47.0	EDS
L-test for twinning <sup>2</sup>	$\langle  L  \rangle = 0.46$ , $\langle L^2 \rangle = 0.29$	Xtriage
Estimated twinning fraction	0.069 for h,-h-k,-l	Xtriage
$F_o, F_c$ correlation	0.94	EDS
Total number of atoms	4574	wwPDB-VP
Average B, all atoms (Å <sup>2</sup> )	66.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 5.68% 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: SO4, KRL

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	0.23	0/2288	0.42	0/3088

There are no bond length outliers.

There are no bond angle outliers.

There are no chirality outliers.

There are no planarity outliers.

### 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	2232	2244	2242	42	0
2	A	29	27	27	6	0
3	A	5	0	0	0	9
4	A	37	0	0	0	0
All	All	2303	2271	2269	45	9

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 10.

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:622:ALA:HB1	1:A:624:ALA:HA	1.78	0.66
1:A:811:VAL:HG22	1:A:816:ARG:CZ	2.26	0.66
1:A:785:LEU:HD13	1:A:797:PHE:CE1	2.34	0.63
1:A:769:LEU:HD11	1:A:794:ILE:HD11	1.82	0.60
1:A:616:LYS:HE3	2:A:1:KRL:C19	2.32	0.59
1:A:811:VAL:HG22	1:A:816:ARG:NH2	2.20	0.56
1:A:570:PRO:HA	1:A:635:LYS:HE2	1.89	0.55
1:A:645:ASN:O	1:A:793:LYS:HA	2.13	0.49
1:A:632:SER:O	1:A:636:ILE:HG13	2.13	0.49
1:A:604:LEU:HB3	1:A:611:LEU:HD11	1.94	0.48
1:A:844:LEU:O	1:A:844:LEU:HD23	2.13	0.48
1:A:766:MET:SD	1:A:794:ILE:CD1	3.02	0.48
1:A:812:LYS:HD2	1:A:812:LYS:O	2.14	0.47
2:A:1:KRL:H29	2:A:1:KRL:N12	2.29	0.47
1:A:549:ARG:HH12	1:A:818:PRO:HD3	1.78	0.47
1:A:850:SER:HB2	1:A:853:LEU:HD12	1.98	0.46
1:A:552:ILE:HD11	1:A:640:LEU:HD21	1.97	0.45
1:A:570:PRO:HA	1:A:635:LYS:CE	2.46	0.45
1:A:846:TRP:CD1	1:A:878:PRO:HG3	2.51	0.45
1:A:785:LEU:HD22	1:A:797:PHE:CZ	2.52	0.45
2:A:1:KRL:H29	2:A:1:KRL:HN12	1.82	0.45
1:A:616:LYS:CE	2:A:1:KRL:N20	2.80	0.44
1:A:600:THR:HG22	1:A:610:VAL:HG13	1.98	0.44
1:A:549:ARG:HB3	1:A:777:ARG:NH2	2.33	0.44
1:A:776:HIS:O	1:A:777:ARG:HB2	2.17	0.44
1:A:596:VAL:HG12	1:A:800:ALA:CB	2.48	0.44
1:A:829:ASP:HB2	1:A:831:VAL:HG23	1.99	0.44
1:A:643:HIS:HD2	1:A:768:PHE:CD1	2.36	0.43
1:A:643:HIS:CD2	1:A:768:PHE:HB2	2.53	0.43
1:A:885:ILE:HA	1:A:888:ILE:HD12	1.99	0.43
1:A:600:THR:HG22	1:A:610:VAL:CG1	2.49	0.42
1:A:549:ARG:NH2	1:A:809:TYR:HE2	2.17	0.42
1:A:601:ALA:HB3	1:A:611:LEU:CD1	2.50	0.42
1:A:575:TRP:NE1	1:A:638:SER:HB2	2.34	0.42
1:A:616:LYS:HE2	2:A:1:KRL:N20	2.35	0.42
1:A:596:VAL:HG12	1:A:800:ALA:HB2	2.00	0.41
1:A:844:LEU:C	1:A:844:LEU:HD23	2.40	0.41
1:A:553:ILE:HG12	1:A:773:ASN:HB3	2.03	0.41
1:A:594:GLY:HA3	1:A:799:LEU:CD2	2.51	0.41
1:A:570:PRO:HA	1:A:635:LYS:CD	2.51	0.41
1:A:845:LEU:HD11	1:A:888:ILE:HG21	2.01	0.41
1:A:817:LEU:HA	1:A:818:PRO:HD3	1.93	0.40

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:833:THR:O	1:A:836:SER:HB2	2.21	0.40
1:A:604:LEU:C	1:A:604:LEU:CD2	2.89	0.40
2:A:1:KRL:HN12	2:A:1:KRL:C29	2.34	0.40

All (9) 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)
3:A:923:SO4:O1	3:A:923:SO4:O4[3_655]	0.81	1.39
3:A:923:SO4:O2	3:A:923:SO4:O3[2_545]	1.10	1.10
3:A:923:SO4:O1	3:A:923:SO4:O3[2_545]	1.26	0.94
3:A:923:SO4:S	3:A:923:SO4:O3[2_545]	1.46	0.74
3:A:923:SO4:S	3:A:923:SO4:O4[2_545]	1.46	0.74
3:A:923:SO4:S	3:A:923:SO4:O1[2_545]	1.46	0.74
3:A:923:SO4:O3	3:A:923:SO4:O3[2_545]	1.77	0.43
3:A:923:SO4:O3	3:A:923:SO4:O4[2_545]	1.77	0.43
3:A:923:SO4:O1	3:A:923:SO4:O2[2_545]	2.02	0.18

## 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	273/335 (82%)	264 (97%)	8 (3%)	1 (0%)	38 54

All (1) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	619	LYS

### 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	238 / 287 (83%)	219 (92%)	19 (8%)	14	21

All (19) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	547	GLN
1	A	549	ARG
1	A	574	LYS
1	A	597	VAL
1	A	598	GLU
1	A	600	THR
1	A	604	LEU
1	A	606	LYS
1	A	608	ASP
1	A	611	LEU
1	A	619	LYS
1	A	634	LEU
1	A	756	LEU
1	A	772	LYS
1	A	785	LEU
1	A	794	ILE
1	A	799	LEU
1	A	812	LYS
1	A	864	LYS

Some sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (1) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	899	HIS

### 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	$\# Z  > 2$
2	KRL	A	1	-	28,32,32	1.77	5 (17%)	34,44,44	3.79	21 (61%)
3	SO4	A	923	-	4,4,4	0.15	0	6,6,6	6.21	5 (83%)

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	KRL	A	1	-	-	0/13/36/36	0/3/4/4
3	SO4	A	923	-	-	0/0/0/0	0/0/0/0

All (5) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
2	A	1	KRL	C23-C22	2.04	1.43	1.39
2	A	1	KRL	C13-N12	2.09	1.41	1.35
2	A	1	KRL	C11-C22	2.87	1.43	1.40
2	A	1	KRL	C22-N24	3.16	1.48	1.41
2	A	1	KRL	C08-N05	4.75	1.51	1.38

All (26) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
3	A	923	SO4	O3-S-O2	-11.79	44.26	109.26
2	A	1	KRL	C10-C11-C22	-3.98	113.86	118.77
3	A	923	SO4	O3-S-O1	-3.88	87.88	109.26
2	A	1	KRL	C09-C08-C23	-3.50	112.04	119.05
2	A	1	KRL	O14-C13-C15	-3.26	114.15	121.13
3	A	923	SO4	O2-S-O1	-3.16	87.57	109.64
2	A	1	KRL	C11-C22-N24	-3.10	114.28	120.17
2	A	1	KRL	C09-C10-C11	2.05	123.70	119.72
2	A	1	KRL	C28-C29-N24	2.18	115.39	111.09
2	A	1	KRL	C11-N12-C13	2.36	133.54	126.99
2	A	1	KRL	C09-C08-N05	2.52	124.93	121.39
2	A	1	KRL	C08-C23-C22	2.63	125.08	119.26
2	A	1	KRL	C10-C09-C08	2.95	124.35	120.34
2	A	1	KRL	C26-C25-N24	3.32	117.62	111.09
3	A	923	SO4	O4-S-O1	3.55	128.82	109.26
2	A	1	KRL	C29-N24-C25	3.88	119.79	111.57
2	A	1	KRL	C29-N24-C22	3.94	125.42	116.33
2	A	1	KRL	C15-C13-N12	5.27	121.26	113.69
2	A	1	KRL	C01-N02-C07	5.28	118.63	110.67
2	A	1	KRL	C03-C04-N05	6.01	122.51	110.68
2	A	1	KRL	C07-C06-N05	6.04	122.57	110.68
2	A	1	KRL	C01-N02-C03	6.23	120.06	110.67
3	A	923	SO4	O4-S-O3	7.25	141.60	108.96
2	A	1	KRL	C03-N02-C07	7.30	119.21	109.47
2	A	1	KRL	C06-C07-N02	7.55	119.45	110.79
2	A	1	KRL	C04-C03-N02	7.58	119.49	110.79

There are no chirality outliers.

There are no torsion outliers.

There are no ring outliers.

2 monomers are involved in 15 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
2	A	1	KRL	6	0
3	A	923	SO4	0	9

## 5.7 Other polymers ⓘ

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	281/335 (83%)	0.20	11 (3%) 40 39	28, 57, 94, 136	0

All (11) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	813	GLY	7.6
1	A	811	VAL	7.1
1	A	621	THR	4.6
1	A	606	LYS	3.8
1	A	622	ALA	3.4
1	A	608	ASP	3.1
1	A	570	PRO	2.5
1	A	607	GLU	2.4
1	A	815	ALA	2.1
1	A	867	LYS	2.1
1	A	593	PHE	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 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. LLDF column lists the quality of electron density of the group with respect to its neighbouring residues in protein, DNA or RNA chains.

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	LLDF	B-factors( $\text{\AA}^2$ )	Q<0.9
2	KRL	A	1	29/29	0.96	0.17	0.41	28,45,85,86	0
3	SO4	A	923	5/5	0.97	0.09	-	69,70,74,75	2

## 6.5 Other polymers [i](#)

There are no such residues in this entry.