wwPDB X-ray Structure Validation Summary Report (i)

Feb 1, 2016 – 04:26 PM GMT

PDB ID	:	4F08
Title	:	Discovery and Optimization of C-2 Methyl Imidazo-pyrrolopyridines as Potent and Orally Bioavailable JAK1 Inhibitors with Selectivity over JAK2
Authors	:	Murray, J.M.
Deposited on	:	2012-05-03
Resolution	:	2.82 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
A user guide is available at
http://wwpdb.org/validation/2016/XrayValidationReportHelp
with specific help available everywhere you see the (i) symbol.

The following versions of software and data (see references (1)) were used in the production of this report:

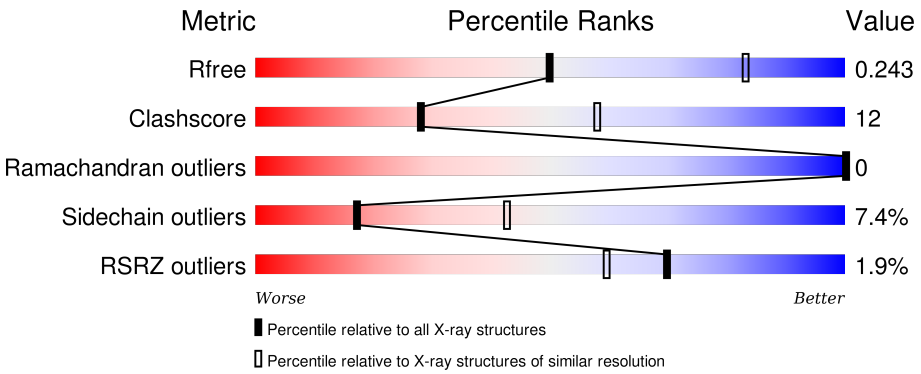
MolProbity	:	4.02b-467
Mogul	:	1.7 (RC4), CSD as536be (2015)
Xtriage (Phenix)	:	1.9-1692
EDS	:	rb-20026688
Percentile statistics	:	20151230.v01 (using entries in the PDB archive December 30th 2015)
Refmac	:	5.8.0135
CCP4	:	6.5.0
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, RNA)	:	Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP)	:	trunk26865

1 Overall quality at a glance (i)

The following experimental techniques were used to determine the structure:
X-RAY DIFFRACTION

The reported resolution of this entry is 2.82 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}	91344	2676 (2.84-2.80)
Clashscore	102246	3124 (2.84-2.80)
Ramachandran outliers	100387	3072 (2.84-2.80)
Sidechain outliers	100360	3074 (2.84-2.80)
RSRZ outliers	91569	2690 (2.84-2.80)

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 >=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 <=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	302	2% 70% 23% • •
1	B	302	2% 69% 24% • •

2 Entry composition (i)

There are 2 unique types of molecules in this entry. The entry contains 4804 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.

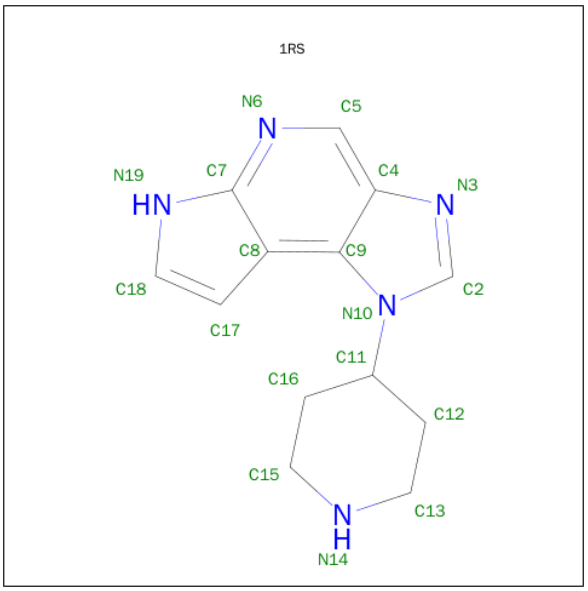
- Molecule 1 is a protein called Tyrosine-protein kinase JAK2.

Mol	Chain	Residues	Atoms						ZeroOcc	AltConf	Trace
			Total	C	N	O	P	S			
1	A	290	2392	1517	412	447	2	14	0	0	0
1	B	290	2376	1505	408	447	2	14	0	0	0

There are 4 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	831	GLY	-	EXPRESSION TAG	UNP O60674
A	832	SER	-	EXPRESSION TAG	UNP O60674
B	831	GLY	-	EXPRESSION TAG	UNP O60674
B	832	SER	-	EXPRESSION TAG	UNP O60674

- Molecule 2 is 1-(PIPERIDIN-4-YL)-1,6-DIHYDROIMIDAZO[4,5-D]PYRROLO[2,3-B]PYRIDINE (three-letter code: 1RS) (formula: $C_{13}H_{15}N_5$).



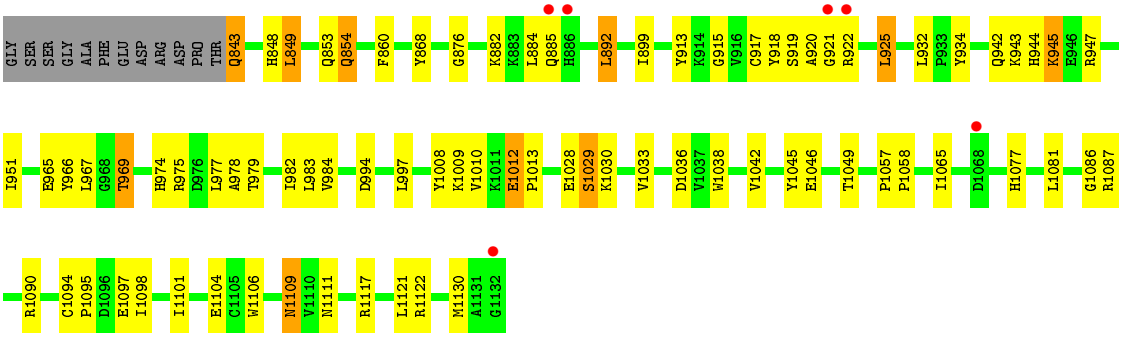
Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
			Total	C	N		
2	A	1	18	13	5	0	0
			Total	C	N		
2	B	1	18	13	5	0	0

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 errors 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.

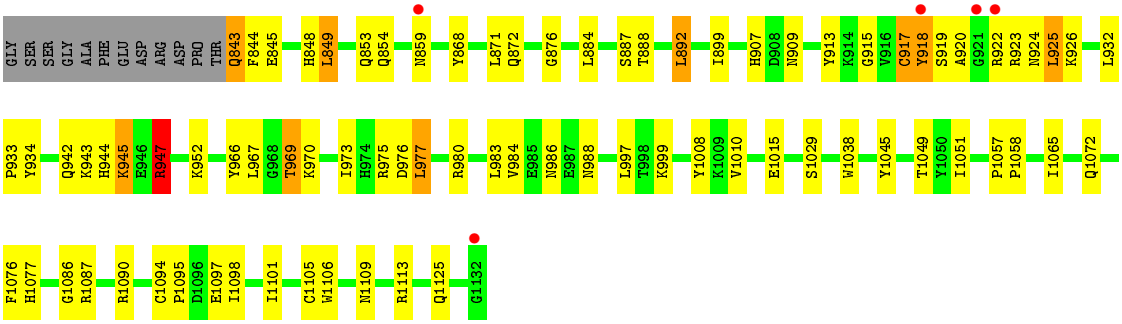
- Molecule 1: Tyrosine-protein kinase JAK2

Chain A:



- Molecule 1: Tyrosine-protein kinase JAK2

Chain B:



4 Data and refinement statistics (i)

Property	Value	Source
Space group	P 41	Depositor
Cell constants a, b, c, α, β, γ	110.92Å 110.92Å 70.73Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	49.61 – 2.82 49.61 – 2.82	Depositor EDS
% Data completeness (in resolution range)	99.6 (49.61-2.82) 99.7 (49.61-2.82)	Depositor EDS
R_{merge}	0.10	Depositor
R_{sym}	(Not available)	Depositor
$< I/\sigma(I) >$ [1]	3.17 (at 2.81Å)	Xtriage
Refinement program	BUSTER 2.11.2	Depositor
R, R_{free}	0.213 , 0.241 0.210 , 0.243	Depositor DCC
R_{free} test set	1034 reflections (5.22%)	DCC
Wilson B-factor (Å^2)	54.7	Xtriage
Anisotropy	0.038	Xtriage
Bulk solvent k_{sol}(e/Å^3), B_{sol}(Å^2)	0.34 , 47.1	EDS
Estimated twinning fraction	0.031 for h,-k,-l	Xtriage
L-test for twinning[2]	$< \|L\| > = 0.50$, $< L^2 > = 0.34$	Xtriage
Outliers	0 of 20852 reflections	Xtriage
F_o,F_c correlation	0.93	EDS
Total number of atoms	4804	wwPDB-VP
Average B, all atoms (Å^2)	58.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 3.68% of the height of the origin peak. No significant pseudotranslation is detected.*

[1] Intensities estimated from amplitudes.

[2] Theoretical values of $< |L| >$, $< L^2 >$ for acentric reflections are 0.5, 0.375 respectively for untwinned datasets, and 0.333, 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: 1RS, PTR

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	0.54	0/2409	0.64	2/3240 (0.1%)
1	B	0.56	0/2392	0.63	0/3220
All	All	0.55	0/4801	0.64	2/6460 (0.0%)

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	B	0	1

There are no bond length outliers.

All (2) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(^{o})	Ideal(^{o})
1	A	1090	ARG	NE-CZ-NH2	-5.48	117.56	120.30
1	A	922	ARG	CB-CA-C	-5.16	100.09	110.40

There are no chirality outliers.

All (1) planarity outliers are listed below:

Mol	Chain	Res	Type	Group
1	B	947	ARG	Sidechain

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	2392	0	2356	57	3
1	B	2376	0	2327	54	3
2	A	18	0	15	1	0
2	B	18	0	15	2	0
All	All	4804	0	4713	111	3

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 12.

The worst 5 of 111 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:920:ALA:H	1:B:923:ARG:HA	1.26	0.99
1:B:907:HIS:CD2	1:B:909:ASN:H	1.81	0.98
1:A:951:ILE:HD13	1:A:1130:MET:SD	2.05	0.96
1:A:1104:GLU:OE2	1:A:1122:ARG:NH1	2.01	0.93
1:B:907:HIS:HD2	1:B:909:ASN:H	1.10	0.93

All (3) 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)
1:A:853:GLN:OE1	1:B:947:ARG:NH2[1_554]	1.90	0.30
1:A:853:GLN:OE1	1:B:947:ARG:CZ[1_554]	2.05	0.15
1:A:853:GLN:OE1	1:B:947:ARG:NH1[1_554]	2.16	0.04

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	286/302 (95%)	275 (96%)	11 (4%)	0	100	100
1	B	286/302 (95%)	278 (97%)	8 (3%)	0	100	100
All	All	572/604 (95%)	553 (97%)	19 (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	260/271 (96%)	241 (93%)	19 (7%)	17	43
1	B	257/271 (95%)	238 (93%)	19 (7%)	17	43
All	All	517/542 (95%)	479 (93%)	38 (7%)	17	43

5 of 38 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	1097	GLU
1	B	849	LEU
1	B	1029	SER
1	B	843	GLN
1	B	853	GLN

Some sidechains can be flipped to improve hydrogen bonding and reduce clashes. 5 of 23 such sidechains are listed below:

Mol	Chain	Res	Type
1	A	1112	GLN
1	B	848	HIS
1	B	1077	HIS
1	B	843	GLN
1	B	854	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)

4 non-standard protein/DNA/RNA residues 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	$\#\|Z\| > 2$
1	PTR	A	1007	1	14,16,17	1.57	1 (7%)	18,22,24	0.66	0
1	PTR	A	1008	1	14,16,17	1.65	1 (7%)	18,22,24	1.25	3 (16%)
1	PTR	B	1007	1	14,16,17	1.41	1 (7%)	18,22,24	0.96	2 (11%)
1	PTR	B	1008	1	14,16,17	1.59	1 (7%)	18,22,24	0.78	1 (5%)

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
1	PTR	A	1007	1	-	0/9/11/13	0/1/1/1
1	PTR	A	1008	1	-	0/9/11/13	0/1/1/1
1	PTR	B	1007	1	-	0/9/11/13	0/1/1/1
1	PTR	B	1008	1	-	0/9/11/13	0/1/1/1

All (4) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	B	1008	PTR	OH-CZ	-5.58	1.27	1.40
1	A	1008	PTR	OH-CZ	-5.54	1.27	1.40
1	A	1007	PTR	OH-CZ	-5.48	1.27	1.40
1	B	1007	PTR	OH-CZ	-4.71	1.29	1.40

The worst 5 of 6 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(^{o})	Ideal(^{o})
1	B	1008	PTR	O-C-CA	-2.21	119.74	125.49
1	A	1008	PTR	OH-CZ-CE1	-2.10	112.75	119.22
1	B	1007	PTR	O-C-CA	-2.08	120.08	125.49
1	A	1008	PTR	P-OH-CZ	2.24	130.21	123.76
1	B	1007	PTR	O3P-P-OH	2.37	113.73	105.22

There are no chirality outliers.

There are no torsion outliers.

There are no ring outliers.

2 monomers are involved in 3 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
1	A	1008	PTR	1	0
1	B	1008	PTR	2	0

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	1RS	A	1201	-	14,21,21	4.85	7 (50%)	16,30,30	2.68	8 (50%)
2	1RS	B	1201	-	14,21,21	4.77	7 (50%)	16,30,30	2.64	8 (50%)

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	1RS	A	1201	-	-	0/4/12/12	0/4/4/4
2	1RS	B	1201	-	-	0/4/12/12	0/4/4/4

The worst 5 of 14 bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
2	A	1201	1RS	C5-N6	-10.70	1.29	1.47
2	B	1201	1RS	C5-N6	-10.63	1.29	1.47
2	A	1201	1RS	C8-C9	-10.08	1.39	1.54
2	B	1201	1RS	C8-C9	-9.97	1.39	1.54
2	A	1201	1RS	C9-N10	-6.15	1.36	1.49

The worst 5 of 16 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(^{o})	Ideal(^{o})
2	A	1201	1RS	C13-C12-C11	-3.93	104.82	110.80
2	B	1201	1RS	C15-C16-C11	-3.62	105.30	110.80
2	A	1201	1RS	C15-C16-C11	-3.29	105.81	110.80
2	B	1201	1RS	C13-C12-C11	-3.10	106.08	110.80
2	A	1201	1RS	C2-N10-C9	2.10	107.03	104.75

There are no chirality outliers.

There are no torsion outliers.

There are no ring outliers.

2 monomers are involved in 3 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
2	A	1201	1RS	1	0
2	B	1201	1RS	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, 95th 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^2)	Q<0.9
1	A	288/302 (95%)	-0.15	6 (2%)	67	56	30, 51, 109, 167	0
1	B	288/302 (95%)	-0.17	5 (1%)	73	63	32, 51, 107, 167	0
All	All	576/604 (95%)	-0.16	11 (1%)	70	59	30, 51, 108, 167	0

The worst 5 of 11 RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	921	GLY	7.9
1	B	859	ASN	4.7
1	B	921	GLY	4.5
1	B	922	ARG	3.8
1	A	1132	GLY	3.5

6.2 Non-standard residues in protein, DNA, RNA chains (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, 95th 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(Å^2)	Q<0.9
1	PTR	A	1008	16/17	0.94	0.17	-	34,61,77,79	0
1	PTR	A	1007	16/17	0.93	0.15	-	41,57,103,109	0
1	PTR	B	1007	16/17	0.92	0.18	-	54,59,99,104	0
1	PTR	B	1008	16/17	0.93	0.16	-	51,82,101,103	0

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, 95th 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(Å^2)	Q<0.9
2	1RS	A	1201	18/18	0.96	0.14	-0.59	20,20,20,20	0
2	1RS	B	1201	18/18	0.96	0.13	-1.13	20,20,20,20	0

6.5 Other polymers (i)

There are no such residues in this entry.