



Full wwPDB X-ray Structure Validation Report ⓘ

Oct 15, 2025 – 04:15 am BST

PDB ID : 9HJ2 / pdb_00009hj2
Title : Structure of P167S/D240G/D172A/S104G/H184R BlaC from Mycobacterium tuberculosis
Authors : Sun, J.; Bruenle, S.; Ubbink, M.
Deposited on : 2024-11-27
Resolution : 1.60 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

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>.

The following versions of software and data (see [references ⓘ](#)) were used in the production of this report:

MolProbity : 4-5-2 with Phenix2.0
Mogul : 1.8.4, CSD as541be (2020)
Xtriage (Phenix) : 2.0
EDS : 3.0
Percentile statistics : 20231227.v01 (using entries in the PDB archive December 27th 2023)
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) : 2.46

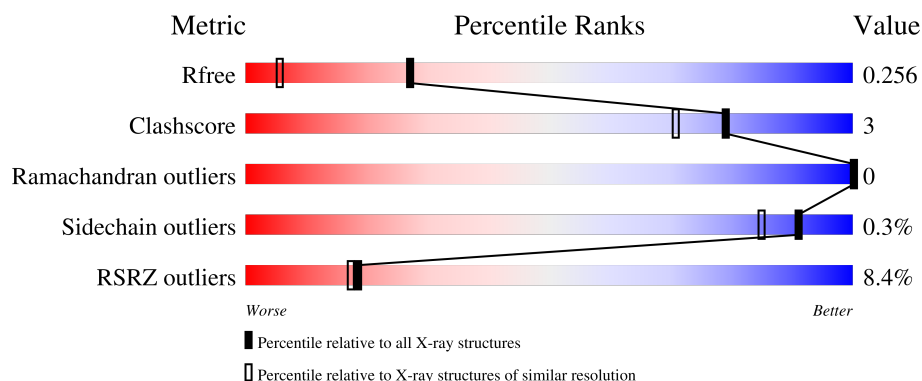
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 1.60 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}	164625	4274 (1.60-1.60)
Clashscore	180529	4682 (1.60-1.60)
Ramachandran outliers	177936	4583 (1.60-1.60)
Sidechain outliers	177891	4582 (1.60-1.60)
RSRZ outliers	164620	4272 (1.60-1.60)

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 ≥ 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	265	<div> <div>5%</div> <div> <div></div> <div>89%</div> <div>7%</div> <div></div> </div> </div>
1	C	265	<div> <div>12%</div> <div> <div></div> <div>89%</div> <div>6%</div> <div></div> </div> </div>

2 Entry composition [i](#)

There are 4 unique types of molecules in this entry. The entry contains 4145 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.

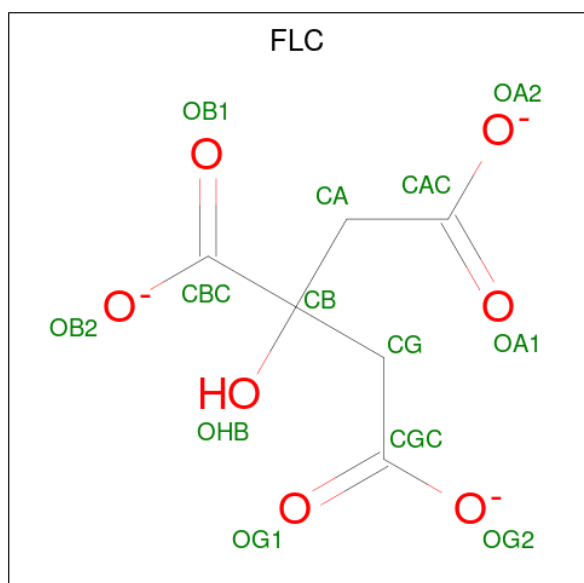
- Molecule 1 is a protein called Beta-lactamase.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	256	Total	C	N	O	S	0	1	0
			1916	1200	343	367	6			
1	C	255	Total	C	N	O	S	0	0	0
			1901	1190	339	366	6			

There are 6 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	104	GLY	SER	engineered mutation	UNP A0A045INV3
A	184	ARG	HIS	engineered mutation	UNP A0A045INV3
A	240	GLY	ASP	engineered mutation	UNP A0A045INV3
C	104	GLY	SER	engineered mutation	UNP A0A045INV3
C	184	ARG	HIS	engineered mutation	UNP A0A045INV3
C	240	GLY	ASP	engineered mutation	UNP A0A045INV3

- Molecule 2 is CITRATE ANION (CCD ID: FLC) (formula: $C_6H_5O_7$).



Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
2	A	1	Total	C	O	0	0
			13	6	7		
2	C	1	Total	C	O	0	0
			13	6	7		

- Molecule 3 is GLYCEROL (CCD ID: GOL) (formula: $C_3H_8O_3$).



Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
3	C	1	Total	C	O	0	0
			6	3	3		
3	C	1	Total	C	O	0	0
			6	3	3		

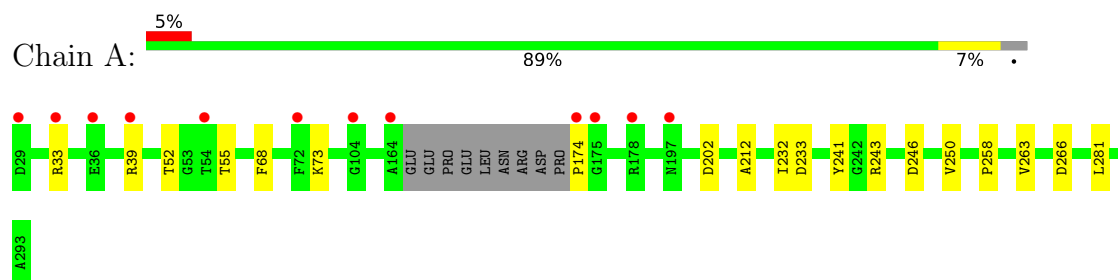
- Molecule 4 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
4	A	161	Total	O	0	0
			161	161		
4	C	129	Total	O	0	0
			129	129		

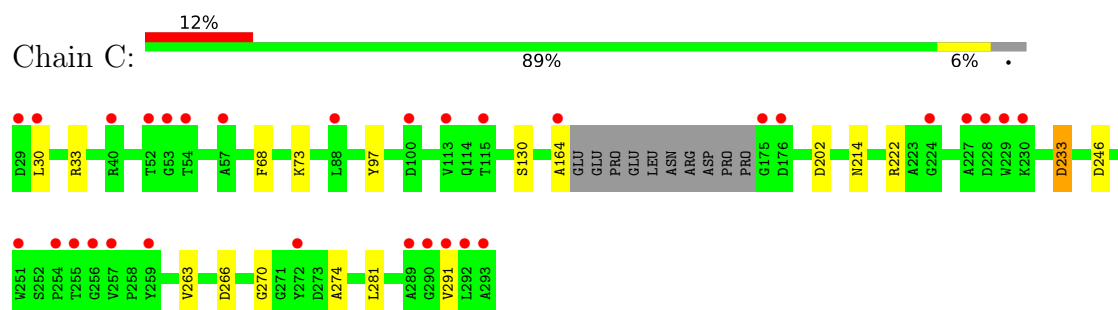
3 Residue-property plots [i](#)

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: Beta-lactamase



- Molecule 1: Beta-lactamase



4 Data and refinement statistics

Property	Value	Source
Space group	P 1 21 1	Depositor
Cell constants a, b, c, α , β , γ	53.83Å 57.27Å 76.93Å 90.00° 95.71° 90.00°	Depositor
Resolution (Å)	53.62 – 1.60 53.62 – 1.60	Depositor EDS
% Data completeness (in resolution range)	98.7 (53.62-1.60) 98.7 (53.62-1.60)	Depositor EDS
R_{merge}	(Not available)	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	2.10 (at 1.60Å)	Xtriage
Refinement program	REFMAC 1.0	Depositor
R, R_{free}	0.232 , 0.252 0.237 , 0.256	Depositor DCC
R_{free} test set	2980 reflections (4.84%)	wwPDB-VP
Wilson B-factor (Å ²)	12.2	Xtriage
Anisotropy	0.250	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.39 , 35.7	EDS
L-test for twinning ²	$\langle L \rangle = 0.46$, $\langle L^2 \rangle = 0.29$	Xtriage
Estimated twinning fraction	No twinning to report.	Xtriage
F_o, F_c correlation	0.92	EDS
Total number of atoms	4145	wwPDB-VP
Average B, all atoms (Å ²)	16.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The analyses of the Patterson function reveals a significant off-origin peak that is 61.87 % of the origin peak, indicating pseudo-translational symmetry. The chance of finding a peak of this or larger height randomly in a structure without pseudo-translational symmetry is equal to 1.2277e-05. The detected translational NCS is most likely also responsible for the elevated intensity ratio.*

¹Intensities estimated from amplitudes.

²Theoretical 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, FLC

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	0.57	0/1954	0.83	3/2660 (0.1%)
1	C	0.56	0/1935	0.83	3/2635 (0.1%)
All	All	0.57	0/3889	0.83	6/5295 (0.1%)

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	3
1	C	0	1
All	All	0	4

There are no bond length outliers.

All (6) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	C	266	ASP	CA-CB-CG	5.73	118.33	112.60
1	A	68	PHE	CA-CB-CG	5.52	119.32	113.80
1	C	68	PHE	CA-CB-CG	5.40	119.20	113.80
1	A	202	ASP	CA-CB-CG	5.35	117.95	112.60
1	A	266	ASP	CA-CB-CG	5.27	117.87	112.60
1	C	202	ASP	CA-CB-CG	5.15	117.75	112.60

There are no chirality outliers.

All (4) planarity outliers are listed below:

Mol	Chain	Res	Type	Group
1	A	243	ARG	Sidechain
1	A	33	ARG	Sidechain
1	A	39	ARG	Sidechain
1	C	33	ARG	Sidechain

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	1916	0	1906	9	0
1	C	1901	0	1885	11	0
2	A	13	0	5	0	0
2	C	13	0	5	0	0
3	C	12	0	16	3	0
4	A	161	0	0	3	0
4	C	129	0	0	4	0
All	All	4145	0	3817	20	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 3.

All (20) 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:73:LYS:NZ	4:A:401:HOH:O	2.03	0.92
1:C:233:ASP:OD1	3:C:303:GOL:O3	1.86	0.92
1:C:73:LYS:NZ	4:C:401:HOH:O	2.10	0.83
1:C:164:ALA:HA	4:C:508:HOH:O	1.87	0.74
1:C:130:SER:O	4:C:401:HOH:O	2.12	0.67
1:C:214:ASN:HB3	3:C:303:GOL:O3	2.10	0.51
1:C:30:LEU:HD22	1:C:291:VAL:HG21	1.92	0.51
1:A:52:THR:OG1	1:A:55:THR:HG22	2.11	0.51
1:A:55:THR:HG23	4:A:479:HOH:O	2.13	0.48
1:A:55:THR:CG2	4:A:479:HOH:O	2.64	0.45
1:C:222:ARG:HB2	3:C:303:GOL:H12	1.99	0.44
1:C:97:TYR:O	4:C:402:HOH:O	2.21	0.43
1:A:212:ALA:HA	1:A:232:ILE:HG22	2.01	0.42

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:233:ASP:OD2	1:A:246:ASP:OD1	2.37	0.42
1:C:270:GLY:HA3	1:C:274:ALA:HB2	2.02	0.41
1:A:174:PRO:HG3	1:A:241:TYR:CZ	2.56	0.41
1:C:233:ASP:OD2	1:C:246:ASP:OD1	2.38	0.41
1:A:263:VAL:HG12	1:A:281:LEU:HD22	2.02	0.40
1:C:263:VAL:HG12	1:C:281:LEU:HD22	2.04	0.40
1:A:250:VAL:O	1:A:258:PRO:HA	2.21	0.40

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	253/265 (96%)	250 (99%)	3 (1%)	0	100	100
1	C	251/265 (95%)	247 (98%)	4 (2%)	0	100	100
All	All	504/530 (95%)	497 (99%)	7 (1%)	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	192/200 (96%)	192 (100%)	0	100	100

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Mol	Chain	Analysed	Rotameric	Outliers	Percentiles	
1	C	190/200 (95%)	189 (100%)	1 (0%)	86	78
All	All	382/400 (96%)	381 (100%)	1 (0%)	91	85

All (1) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	C	233	ASP

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 oligosaccharides in this entry.

5.6 Ligand geometry [i](#)

4 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	C	303	-	5,5,5	0.11	0	5,5,5	0.24	0
3	GOL	C	301	-	5,5,5	0.09	0	5,5,5	0.28	0

Mol	Type	Chain	Res	Link	Bond lengths			Bond angles		
					Counts	RMSZ	# Z > 2	Counts	RMSZ	# Z > 2
2	FLC	C	302	-	12,12,12	1.28	1 (8%)	17,17,17	1.20	2 (11%)
2	FLC	A	301	-	12,12,12	1.22	1 (8%)	17,17,17	1.20	2 (11%)

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	C	303	-	-	2/4/4/4	-
3	GOL	C	301	-	-	0/4/4/4	-
2	FLC	C	302	-	-	3/16/16/16	-
2	FLC	A	301	-	-	3/16/16/16	-

All (2) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
2	C	302	FLC	CB-CBC	2.48	1.56	1.53
2	A	301	FLC	CB-CBC	2.48	1.56	1.53

All (4) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
2	A	301	FLC	OB1-CBC-CB	-3.21	117.71	122.25
2	C	302	FLC	OB1-CBC-CB	-3.02	117.98	122.25
2	A	301	FLC	OB2-CBC-CB	2.49	117.36	113.05
2	C	302	FLC	OB2-CBC-CB	2.35	117.13	113.05

There are no chirality outliers.

All (8) torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
2	A	301	FLC	CAC-CA-CB-CBC
2	A	301	FLC	CAC-CA-CB-CG
2	A	301	FLC	CAC-CA-CB-OHB
2	C	302	FLC	CAC-CA-CB-CBC
2	C	302	FLC	CAC-CA-CB-CG
2	C	302	FLC	CAC-CA-CB-OHB
3	C	303	GOL	O1-C1-C2-C3
3	C	303	GOL	O1-C1-C2-O2

There are no ring outliers.

1 monomer is involved in 3 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
3	C	303	GOL	3	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 ⓘ

6.1 Protein, DNA and RNA chains ⓘ

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	256/265 (96%)	0.61	12 (4%) 37 37	6, 12, 24, 47	1 (0%)
1	C	255/265 (96%)	1.01	31 (12%) 10 8	7, 15, 32, 63	0
All	All	511/530 (96%)	0.81	43 (8%) 18 17	6, 13, 29, 63	1 (0%)

All (43) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	C	293	ALA	7.6
1	C	164	ALA	5.9
1	C	175	GLY	5.4
1	A	174	PRO	4.9
1	C	292	LEU	4.8
1	C	254	PRO	4.6
1	C	54	THR	4.4
1	C	255	THR	4.4
1	C	291	VAL	4.3
1	C	176	ASP	3.5
1	C	227	ALA	3.3
1	A	178	ARG	3.2
1	A	36	GLU	3.2
1	A	175	GLY	3.1
1	C	30	LEU	3.1
1	C	251	TRP	3.0
1	C	53	GLY	3.0
1	C	289	ALA	2.9
1	C	115	THR	2.9
1	C	230	LYS	2.9
1	C	257	VAL	2.8
1	C	259	TYR	2.7
1	C	290	GLY	2.6
1	C	29	ASP	2.6

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Mol	Chain	Res	Type	RSRZ
1	C	272	TYR	2.5
1	C	113	VAL	2.5
1	C	88	LEU	2.4
1	C	52	THR	2.4
1	A	29	ASP	2.4
1	A	33	ARG	2.4
1	C	228	ASP	2.3
1	C	100	ASP	2.3
1	C	57	ALA	2.3
1	A	39	ARG	2.2
1	A	164	ALA	2.2
1	A	197	ASN	2.2
1	C	229	TRP	2.1
1	C	224	GLY	2.1
1	C	256	GLY	2.1
1	C	40	ARG	2.1
1	A	104	GLY	2.1
1	A	72	PHE	2.0
1	A	54	THR	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 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, 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	B-factors(\AA^2)	Q<0.9
2	FLC	A	301	13/13	0.83	0.16	16,27,42,45	0
2	FLC	C	302	13/13	0.85	0.16	15,26,44,50	0
3	GOL	C	303	6/6	0.86	0.12	15,19,22,25	0
3	GOL	C	301	6/6	0.91	0.10	17,18,20,21	0

6.5 Other polymers [i](#)

There are no such residues in this entry.