



# Full wwPDB X-ray Structure Validation Report

Feb 28, 2014 – 09:13 AM GMT

PDB ID : 3I3R  
Title : X-ray structure dihydrofolate reductase/thymidylatesynthase from babesia  
bovis at 2.35Å resolution  
Authors : Seattle Structural Genomics Center for Infectious Disease (SSGSID)  
Deposited on : 2009-06-30  
Resolution : 2.35 Å(reported)

This is a full wwPDB 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/ValidationPDFNotes.html>

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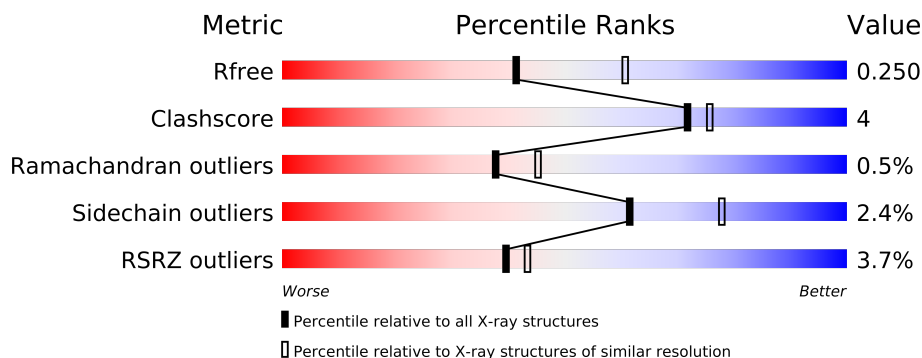
The following versions of software and data (see [references](#)) were used in the production of this report:

MolProbity : 4.02b-467  
Mogul : 1.15 2013  
Xtriage (Phenix) : dev-1323  
EDS : stable22639  
Percentile statistics : 21963  
Refmac : 5.8.0049  
CCP4 : 6.3.0 (Settle)  
Ideal geometry (proteins) : Engh & Huber (2001)  
Ideal geometry (DNA, RNA) : Parkinson et. al. (1996)  
Validation Pipeline (wwPDB-VP) : stable22683

# 1 Overall quality at a glance

The reported resolution of this entry is 2.35 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))
$R_{free}$	66092	3327 (2.40-2.32)
Clashscore	79885	1064 (2.38-2.34)
Ramachandran outliers	78287	1048 (2.38-2.34)
Sidechain outliers	78261	1049 (2.38-2.34)
RSRZ outliers	66119	3330 (2.40-2.32)

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. The upper red bar (where present) indicates the fraction of residues that have poor fit to the electron density.

Mol	Chain	Length	Quality of chain
1	A	511	
1	B	511	

## 2 Entry composition

There are 3 unique types of molecules in this entry. The entry contains 7862 atoms, of which 0 are hydrogen and 0 are deuterium.

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 Dihydrofolate reductase/thymidylatesynthase.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	489	Total	C	N	O	S	0	0	0
			3851	2477	652	703	19			
1	B	477	Total	C	N	O	S	0	0	0
			3756	2416	637	686	17			

- Molecule 2 is CHLORIDE ION (three-letter code: CL) (formula: Cl).

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
2	B	1	Total	Cl	0	0
			1	1		
2	A	1	Total	Cl	0	0
			1	1		

- Molecule 3 is water.

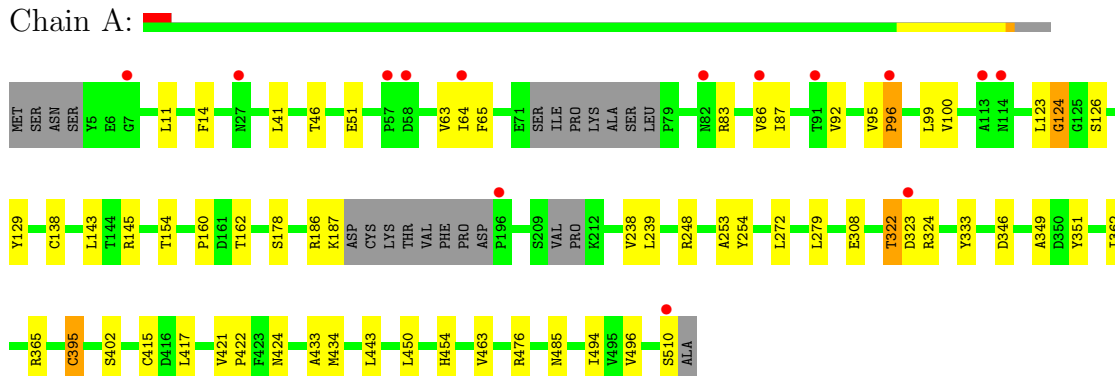
Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
3	A	153	Total	O	0	0
			153	153		
3	B	100	Total	O	0	0
			100	100		

### 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 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.

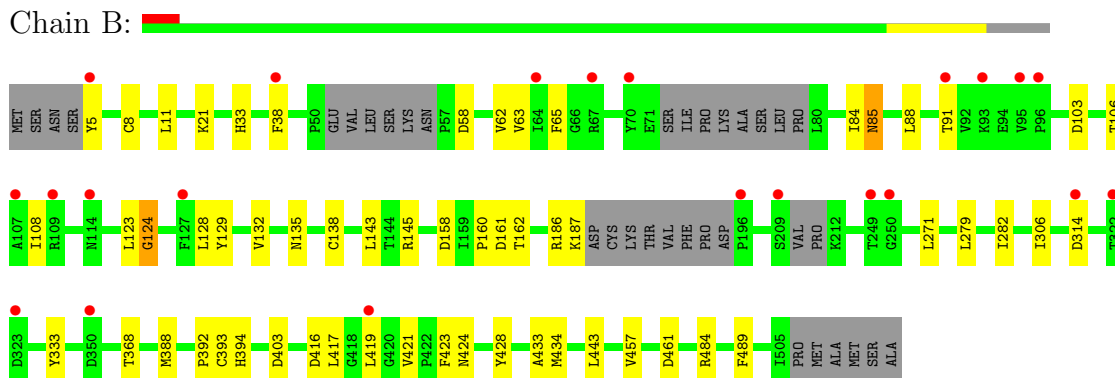
- Molecule 1: Dihydrofolate reductase/thymidylatesynthase

Chain A:



- Molecule 1: Dihydrofolate reductase/thymidylatesynthase

Chain B:



## 4 Data and refinement statistics

Property	Value	Source
Space group	P 1	Depositor
Cell constants a, b, c, $\alpha$ , $\beta$ , $\gamma$	52.54Å 83.48Å 84.19Å 119.00° 97.99° 100.69°	Depositor
Resolution (Å)	19.69 – 2.35 19.69 – 2.35	Depositor EDS
% Data completeness (in resolution range)	97.2 (19.69-2.35) 97.4 (19.69-2.35)	Depositor EDS
$R_{merge}$	0.10	Depositor
$R_{sym}$	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ <sup>1</sup>	2.32 (at 2.35Å)	Xtriage
Refinement program	REFMAC 5.5.0088	Depositor
R, $R_{free}$	0.202 , 0.251 0.205 , 0.250	Depositor DCC
$R_{free}$ test set	2440 reflections (5.36%)	DCC
Wilson B-factor (Å <sup>2</sup> )	29.5	Xtriage
Anisotropy	0.029	Xtriage
Bulk solvent $k_{sol}$ (e/Å <sup>3</sup> ), $B_{sol}$ (Å <sup>2</sup> )	0.40 , 32.5	EDS
Estimated twinning fraction	0.012 for -h,-l,-k	Xtriage
L-test for twinning	$\langle  L  \rangle = 0.49$ , $\langle L^2 \rangle = 0.32$	Xtriage
Outliers	0 of 47995 reflections	Xtriage
$F_o, F_c$ correlation	0.93	EDS
Total number of atoms	7862	wwPDB-VP
Average B, all atoms (Å <sup>2</sup> )	28.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 4.95% of the height of the origin peak. No significant pseudotranslation is detected.*

<sup>1</sup>Intensities estimated from amplitudes.

## 5 Model quality

### 5.1 Standard geometry

Bond lengths and bond angles in the following residue types are not validated in this section:  
CL

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	0.47	1/3951 (0.0%)	0.61	0/5381
1	B	0.47	1/3853 (0.0%)	0.61	0/5250
All	All	0.47	2/7804 (0.0%)	0.61	0/10631

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	2
1	B	0	1
All	All	0	3

All (2) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	B	393	CYS	CB-SG	-6.71	1.70	1.82
1	A	395	CYS	CB-SG	-5.94	1.72	1.81

There are no bond angle outliers.

There are no chirality outliers.

All (3) planarity outliers are listed below:

Mol	Chain	Res	Type	Group
1	A	124	GLY	Peptide
1	A	395	CYS	Peptide
1	B	124	GLY	Peptide

## 5.2 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 hydrogens added by MolProbity. The Clashes column lists the number of clashes within the asymmetric unit, and the number in parentheses is this value normalized per 1000 atoms of the molecule in the chain. The Symm-Clashes column gives symmetry related clashes, in the same way as for the Clashes column.

Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
1	A	3851	0	3714	36	0
1	B	3756	0	3598	30	0
2	A	1	0	0	0	0
2	B	1	0	0	0	0
3	A	153	0	0	0	0
3	B	100	0	0	0	0
All	All	7862	0	7312	66	0

Clashscore is defined as the number of clashes calculated for the entry per 1000 atoms (including hydrogens) of the entry. The overall clashscore for this entry is 4.

All (66) close contacts within the same asymmetric unit are listed below.

Atom-1	Atom-2	Distance(Å)	Clash(Å)
1:A:160:PRO:HB2	1:A:162:THR:HG22	1.47	0.94
1:B:33:HIS:CE1	1:B:38:PHE:CE2	2.70	0.79
1:B:271:LEU:HD13	1:B:279:LEU:HD11	1.66	0.76
1:B:88:LEU:HD12	1:B:128:LEU:HD13	1.74	0.69
1:A:126:SER:OG	1:A:154:THR:HG22	1.93	0.69
1:B:33:HIS:CE1	1:B:38:PHE:CD2	2.81	0.69
1:B:91:THR:O	1:B:91:THR:HG22	1.93	0.69
1:B:8:CYS:HA	1:B:108:ILE:HG21	1.74	0.68
1:B:394:HIS:ND1	1:B:428:TYR:OH	2.23	0.66
1:B:282:ILE:HD11	1:B:423:PHE:HB3	1.80	0.64
1:B:85:ASN:N	1:B:85:ASN:HD22	1.95	0.64
1:A:95:VAL:HG13	1:A:96:PRO:HD2	1.79	0.64
1:B:88:LEU:HD12	1:B:128:LEU:CD1	2.31	0.61
1:B:103:ASP:O	1:B:106:THR:HG22	2.03	0.57
1:B:434:MET:HE2	1:B:489:PHE:CD2	2.41	0.55
1:A:279:LEU:HD21	1:A:496:VAL:CG2	2.36	0.55
1:B:421:VAL:HA	1:B:424:ASN:HD22	1.72	0.54
1:A:87:ILE:CG2	1:A:100:VAL:HG22	2.38	0.54
1:B:143:LEU:CD2	1:B:145:ARG:HG2	2.38	0.53
1:A:272:LEU:HD12	1:A:422:PRO:HB3	1.90	0.53
1:A:433:ALA:HA	1:A:443:LEU:HD21	1.91	0.53

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Atom-1	Atom-2	Distance(Å)	Clash(Å)
1:A:239:LEU:HD11	1:A:463:VAL:HG23	1.91	0.53
1:B:282:ILE:CD1	1:B:423:PHE:HB3	2.39	0.52
1:B:63:VAL:HG13	1:B:123:LEU:HG	1.91	0.51
1:A:126:SER:OG	1:A:154:THR:CG2	2.57	0.51
1:A:63:VAL:CG1	1:A:123:LEU:HD12	2.40	0.51
1:B:91:THR:O	1:B:91:THR:CG2	2.59	0.50
1:A:87:ILE:HG22	1:A:99:LEU:O	2.11	0.50
1:A:322:THR:HG23	1:A:323:ASP:OD1	2.11	0.49
1:A:92:VAL:O	1:A:100:VAL:HG11	2.12	0.49
1:A:63:VAL:HG13	1:A:123:LEU:HG	1.95	0.49
1:B:417:LEU:HD23	1:B:421:VAL:HG21	1.96	0.47
1:B:124:GLY:HA2	1:B:129:TYR:CZ	2.49	0.47
1:B:5:TYR:CE2	1:B:135:ASN:ND2	2.83	0.47
1:A:362:ILE:HD13	1:A:365:ARG:HH11	1.80	0.46
1:A:421:VAL:HA	1:A:424:ASN:HD22	1.80	0.46
1:A:46:THR:HG22	1:A:83:ARG:HG3	1.97	0.46
1:B:11:LEU:O	1:B:138:CYS:HA	2.15	0.46
1:B:160:PRO:C	1:B:162:THR:H	2.19	0.46
1:A:14:PHE:CD2	1:A:41:LEU:HD13	2.50	0.46
1:B:128:LEU:O	1:B:132:VAL:HG23	2.16	0.45
1:A:63:VAL:CG1	1:A:123:LEU:CD1	2.94	0.45
1:A:434:MET:CE	1:A:494:ILE:HD11	2.46	0.45
1:B:388:MET:SD	1:B:392:PRO:HD3	2.57	0.45
1:A:279:LEU:HD21	1:A:496:VAL:HG23	1.99	0.45
1:A:11:LEU:O	1:A:138:CYS:HA	2.17	0.44
1:A:63:VAL:HG11	1:A:123:LEU:HD12	1.99	0.44
1:A:186:ARG:O	1:A:187:LYS:HB2	2.17	0.44
1:B:416:ASP:O	1:B:421:VAL:HG23	2.17	0.44
1:A:143:LEU:CD2	1:A:145:ARG:HG2	2.48	0.43
1:B:433:ALA:HA	1:B:443:LEU:HD21	1.99	0.43
1:A:63:VAL:HG13	1:A:123:LEU:CD1	2.49	0.43
1:B:186:ARG:O	1:B:187:LYS:HB2	2.18	0.43
1:A:124:GLY:HA2	1:A:129:TYR:CZ	2.53	0.43
1:A:64:ILE:HG12	1:A:86:VAL:HB	2.01	0.42
1:A:87:ILE:O	1:A:87:ILE:HG23	2.18	0.42
1:B:85:ASN:N	1:B:85:ASN:ND2	2.65	0.42
1:A:253:ALA:HB1	1:A:454:HIS:HB2	2.01	0.42
1:B:62:VAL:HG22	1:B:84:ILE:HB	2.02	0.41
1:A:415:CYS:SG	1:A:450:LEU:HD22	2.60	0.41
1:B:21:LYS:NZ	1:B:158:ASP:OD1	2.47	0.41
1:A:186:ARG:O	1:A:187:LYS:CB	2.69	0.41
1:A:178:SER:HB3	1:A:476:ARG:HG2	2.03	0.40

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Atom-1	Atom-2	Distance(Å)	Clash(Å)
1:A:254:TYR:O	1:A:454:HIS:HA	2.21	0.40
1:A:238:VAL:HG21	1:A:417:LEU:HD11	2.04	0.40
1:A:349:ALA:HB3	1:A:351:TYR:CZ	2.56	0.40

There are no symmetry-related clashes.

## 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	481/511 (94%)	458 (95%)	21 (4%)	2 (0%)	43	52
1	B	467/511 (91%)	449 (96%)	15 (3%)	3 (1%)	33	39
All	All	948/1022 (93%)	907 (96%)	36 (4%)	5 (0%)	38	45

All (5) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	333	TYR
1	B	333	TYR
1	A	96	PRO
1	B	161	ASP
1	B	306	ILE

### 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	415/458 (91%)	405 (98%)	10 (2%)	61	78
1	B	402/458 (88%)	392 (98%)	10 (2%)	60	76

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Mol	Chain	Analysed	Rotameric	Outliers	Percentiles	
All	All	817/916 (89%)	797 (98%)	20 (2%)	61	78

All (20) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	51	GLU
1	A	65	PHE
1	A	248	ARG
1	A	308	GLU
1	A	322	THR
1	A	324	ARG
1	A	346	ASP
1	A	402	SER
1	A	485	ASN
1	A	510	SER
1	B	58	ASP
1	B	65	PHE
1	B	85	ASN
1	B	314	ASP
1	B	368	THR
1	B	403	ASP
1	B	419	LEU
1	B	457	VAL
1	B	461	ASP
1	B	484	ARG

Some sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (10) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	339	HIS
1	A	424	ASN
1	A	485	ASN
1	B	33	HIS
1	B	85	ASN
1	B	135	ASN
1	B	225	ASN
1	B	404	ASN
1	B	424	ASN
1	B	466	GLN

### 5.3.3 RNA ⓘ

There are no RNA chains in this entry.

## 5.4 Non-standard residues in protein, DNA, RNA chains ⓘ

There are no non-standard protein/DNA/RNA residues in this entry.

## 5.5 Carbohydrates ⓘ

There are no carbohydrates in this entry.

## 5.6 Ligand geometry ⓘ

Of 2 ligands modelled in this entry, 2 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.

## 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 ⓘ

### 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, 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	489/511 (95%)	0.03	14 (2%)	49 53	13, 26, 51, 57	0
1	B	477/511 (93%)	0.06	22 (4%)	31 35	14, 26, 51, 57	0
All	All	966/1022 (94%)	0.04	36 (3%)	39 43	13, 26, 51, 57	0

All (36) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	B	209	SER	3.9
1	A	113	ALA	3.6
1	B	64	ILE	3.6
1	B	249	THR	3.3
1	A	323	ASP	3.2
1	B	96	PRO	3.1
1	B	196	PRO	3.0
1	B	67	ARG	2.9
1	B	70	TYR	2.9
1	A	196	PRO	2.9
1	A	57	PRO	2.8
1	B	322	THR	2.8
1	B	93	LYS	2.7
1	B	38	PHE	2.7
1	A	96	PRO	2.7
1	B	323	ASP	2.7
1	B	250	GLY	2.7
1	B	5	TYR	2.7
1	B	114	ASN	2.7
1	B	314	ASP	2.6
1	A	64	ILE	2.6
1	A	58	ASP	2.5
1	A	7	GLY	2.5
1	B	91	THR	2.5

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Mol	Chain	Res	Type	RSRZ
1	B	127	PHE	2.4
1	A	82	ASN	2.4
1	B	350	ASP	2.3
1	B	107	ALA	2.3
1	A	91	THR	2.3
1	A	27	ASN	2.3
1	B	419	LEU	2.3
1	B	109	ARG	2.2
1	B	95	VAL	2.2
1	A	510	SER	2.1
1	A	86	VAL	2.0
1	A	114	ASN	2.0

## 6.2 Non-standard residues in protein, DNA, RNA chains ⓘ

There are no non-standard protein/DNA/RNA residues in this entry.

## 6.3 Carbohydrates ⓘ

There are no carbohydrates in this entry.

## 6.4 Ligands ⓘ

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	RSR	LLDF	B-factors(Å <sup>2</sup> )	Q<0.9
2	CL	A	601	1/1	0.12	-0.45	33,33,33,33	0
2	CL	B	601	1/1	0.08	-1.41	42,42,42,42	0

## 6.5 Other polymers ⓘ

There are no such residues in this entry.