Full wwPDB X-ray Structure Validation Report (i)

Feb 1, 2016 – 05:07 PM GMT

PDB ID	:	4H98
Title	:	Candida glabrata dihydrofolate reductase complexed with NADPH and 5-{3-[3-(2,3-dihydro-1,4-benzodioxin-6-yl)-5-methoxyphenyl]prop-1-yn-1-yl}-6-ethylpyrimidine-2,4-diamine (UCP1018)
Authors	:	Paulsen, J.L.; Anderson, A.C.
Deposited on	:	2012-09-24
Resolution	:	2.90 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
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:

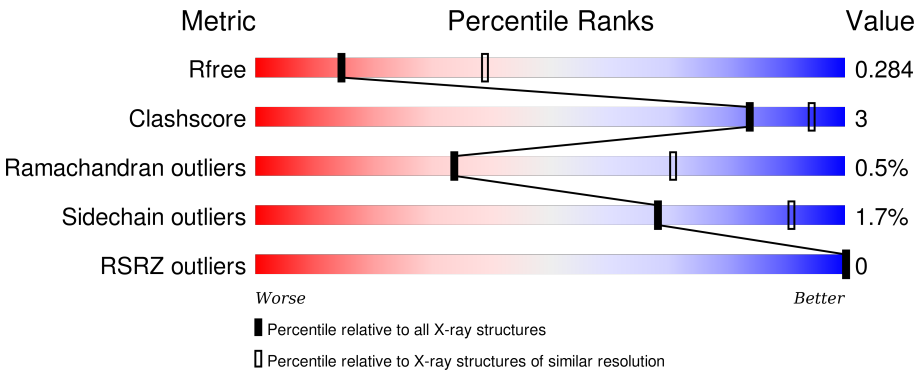
MolProbity	:	4.02b-467
Mogul	:	1.7 (RC4), CSD as536be (2015)
Xtriage (Phenix)	:	1.9-1692
EDS	:	rb-20026688
Percentile statistics	:	20151230.v01 (using entries in the PDB archive December 30th 2015)
Refmac	:	5.8.0135
CCP4	:	6.5.0
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, RNA)	:	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 2.90 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	1451 (2.90-2.90)
Clashscore	102246	1668 (2.90-2.90)
Ramachandran outliers	100387	1630 (2.90-2.90)
Sidechain outliers	100360	1632 (2.90-2.90)
RSRZ outliers	91569	1456 (2.90-2.90)

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	224	90% 10%
1	B	224	89% 11%

2 Entry composition (i)

There are 4 unique types of molecules in this entry. The entry contains 3856 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.

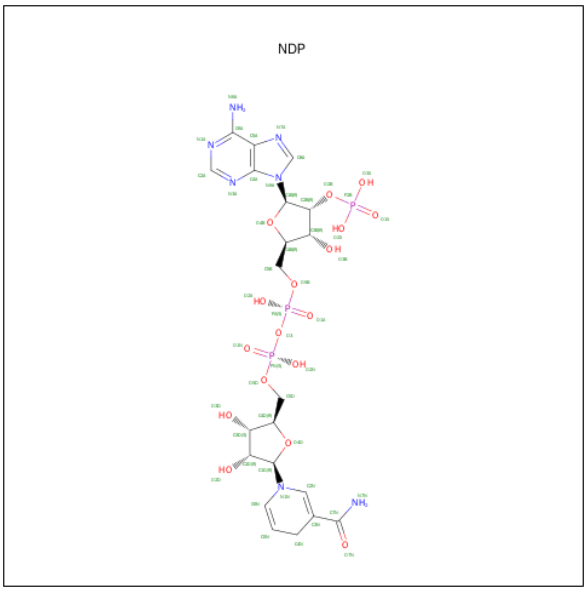
- Molecule 1 is a protein called Dihydrofolate Reductase.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
1	A	224	1837	1174	323	333	7	0	0	0
1	B	224	1837	1174	323	333	7	0	0	0

There are 20 discrepancies between the modelled and reference sequences:

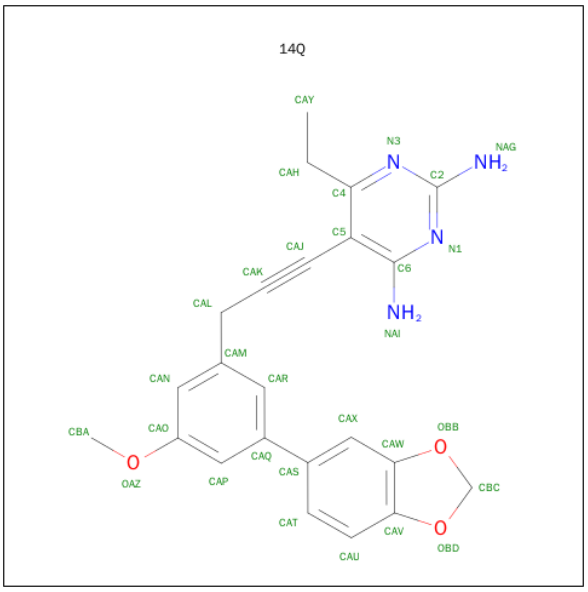
Chain	Residue	Modelled	Actual	Comment	Reference
A	218	LEU	-	EXPRESSION TAG	UNP Q6FPH0
A	219	GLU	-	EXPRESSION TAG	UNP Q6FPH0
A	220	HIS	-	EXPRESSION TAG	UNP Q6FPH0
A	221	HIS	-	EXPRESSION TAG	UNP Q6FPH0
A	222	HIS	-	EXPRESSION TAG	UNP Q6FPH0
A	223	HIS	-	EXPRESSION TAG	UNP Q6FPH0
A	224	HIS	-	EXPRESSION TAG	UNP Q6FPH0
A	225	HIS	-	EXPRESSION TAG	UNP Q6FPH0
A	226	HIS	-	EXPRESSION TAG	UNP Q6FPH0
A	227	HIS	-	EXPRESSION TAG	UNP Q6FPH0
B	218	LEU	-	EXPRESSION TAG	UNP Q6FPH0
B	219	GLU	-	EXPRESSION TAG	UNP Q6FPH0
B	220	HIS	-	EXPRESSION TAG	UNP Q6FPH0
B	221	HIS	-	EXPRESSION TAG	UNP Q6FPH0
B	222	HIS	-	EXPRESSION TAG	UNP Q6FPH0
B	223	HIS	-	EXPRESSION TAG	UNP Q6FPH0
B	224	HIS	-	EXPRESSION TAG	UNP Q6FPH0
B	225	HIS	-	EXPRESSION TAG	UNP Q6FPH0
B	226	HIS	-	EXPRESSION TAG	UNP Q6FPH0
B	227	HIS	-	EXPRESSION TAG	UNP Q6FPH0

- Molecule 2 is NADPH DIHYDRO-NICOTINAMIDE-ADENINE-DINUCLEOTIDE PHOSPHATE (three-letter code: NDP) (formula: $C_{21}H_{30}N_7O_{17}P_3$).



Mol	Chain	Residues	Atoms					ZeroOcc	AltConf
			Total	C	N	O	P		
2	A	1	48	21	7	17	3	0	0
			Total	C	N	O	P		
2	B	1	48	21	7	17	3	0	0

- Molecule 3 is 5-{3-[3-(1,3-BENZODIOXOL-5-YL)-5-METHOXYPHENYL]PROP-1-YN-1-YL}-6-ETHYLPYRIMIDINE-2,4-DIAMINE (three-letter code: 14Q) (formula: $C_{23}H_{22}N_4O_3$).



Mol	Chain	Residues	Atoms				ZeroOcc	AltConf
			Total	C	N	O		
3	A	1	30	23	4	3	0	0

Continued on next page...

Continued from previous page...

Mol	Chain	Residues	Atoms				ZeroOcc	AltConf
			Total	C	N	O		
3	B	1	30	23	4	3	0	0

- Molecule 4 is water.

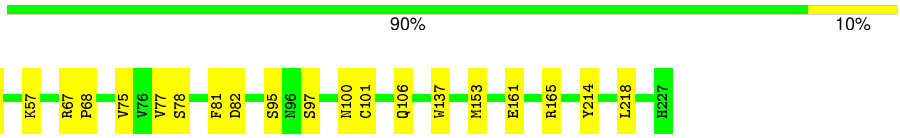
Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
			Total	O		
4	A	15	15	15	0	0
			Total	O		
4	B	11	11	11	0	0

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.

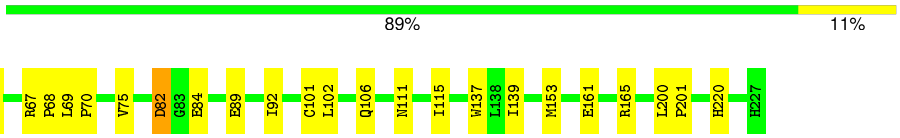
- Molecule 1: Dihydrofolate Reductase

Chain A:



- Molecule 1: Dihydrofolate Reductase

Chain B:



4 Data and refinement statistics (i)

Property	Value	Source
Space group	P 41	Depositor
Cell constants a, b, c, α, β, γ	42.71Å 42.71Å 230.46Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	42.71 – 2.90 41.99 – 2.90	Depositor EDS
% Data completeness (in resolution range)	88.1 (42.71-2.90) 88.0 (41.99-2.90)	Depositor EDS
R_{merge}	0.15	Depositor
R_{sym}	(Not available)	Depositor
$< I/\sigma(I) >$ [1]	2.66 (at 2.90Å)	Xtriage
Refinement program	REFMAC 5.6.0117	Depositor
R, R_{free}	0.223 , 0.285 0.223 , 0.284	Depositor DCC
R_{free} test set	434 reflections (5.69%)	DCC
Wilson B-factor (Å^2)	43.1	Xtriage
Anisotropy	0.010	Xtriage
Bulk solvent k_{sol}(e/Å^3), B_{sol}(Å^2)	0.38 , 7.4	EDS
Estimated twinning fraction	0.439 for h,-k,-l	Xtriage
L-test for twinning[2]	$< \|L\| > = 0.51$, $< L^2 > = 0.34$	Xtriage
Outliers	0 of 8010 reflections	Xtriage
F_o,F_c correlation	0.92	EDS
Total number of atoms	3856	wwPDB-VP
Average B, all atoms (Å^2)	38.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 7.51% 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: NDP, 14Q

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	0.48	0/1882	0.48	0/2545
1	B	0.48	0/1882	0.49	0/2545
All	All	0.48	0/3764	0.49	0/5090

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	1837	0	1833	10	0
1	B	1837	0	1833	13	0
2	A	48	0	26	1	0
2	B	48	0	26	0	0
3	A	30	0	22	1	0
3	B	30	0	22	1	0
4	A	15	0	0	0	0
4	B	11	0	0	0	0
All	All	3856	0	3762	23	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 (23) 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:25:LEU:HG	3:B:302:14Q:H15	1.71	0.72
1:B:161:GLU:HG3	1:B:165:ARG:HH12	1.58	0.68
1:A:25:LEU:HG	3:A:302:14Q:H15	1.77	0.65
1:A:77:VAL:HG12	1:A:95:SER:HB3	1.82	0.61
1:B:161:GLU:HG3	1:B:165:ARG:NH1	2.18	0.57
1:B:102:LEU:O	1:B:106:GLN:HG2	2.09	0.52
1:B:21:PHE:HB2	1:B:153:MET:HA	1.93	0.50
1:A:21:PHE:HB2	1:A:153:MET:HA	1.93	0.50
1:B:68:PRO:HD3	1:B:92:ILE:HD11	1.95	0.48
1:B:67:ARG:HA	1:B:68:PRO:C	2.35	0.47
1:B:137:TRP:HB3	1:B:139:ILE:HD11	1.98	0.46
1:A:97:SER:HB3	1:A:100:ASN:HB2	1.97	0.46
1:B:111:ASN:HB2	1:B:115:ILE:HG12	1.98	0.44
1:B:200:LEU:HA	1:B:201:PRO:HD3	1.90	0.44
1:A:137:TRP:HB2	1:A:214:TYR:HB2	2.00	0.43
1:A:75:VAL:HG11	1:A:101:CYS:SG	2.58	0.43
1:A:78:SER:HB3	1:A:81:PHE:CE2	2.55	0.42
1:B:89:GLU:HB2	1:B:92:ILE:HB	2.01	0.42
1:A:57:LYS:HD2	2:A:301:NDP:O1N	2.20	0.41
1:A:161:GLU:HG3	1:A:165:ARG:HH12	1.86	0.41
1:A:67:ARG:HA	1:A:68:PRO:C	2.41	0.40
1:B:53:ILE:HG12	1:B:75:VAL:HB	2.01	0.40
1:B:69:LEU:HA	1:B:70:PRO:HD3	1.84	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	222/224 (99%)	213 (96%)	8 (4%)	1 (0%)	34 71

Continued on next page...

Continued from previous page...

Mol	Chain	Analysed	Favoured	Allowed	Outliers	Percentiles	
1	B	222/224 (99%)	213 (96%)	8 (4%)	1 (0%)	34	71
All	All	444/448 (99%)	426 (96%)	16 (4%)	2 (0%)	34	71

All (2) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	82	ASP
1	B	82	ASP

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	204/204 (100%)	201 (98%)	3 (2%)	72	92
1	B	204/204 (100%)	200 (98%)	4 (2%)	63	88
All	All	408/408 (100%)	401 (98%)	7 (2%)	68	91

All (7) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	33	MET
1	A	106	GLN
1	A	218	LEU
1	B	82	ASP
1	B	84	GLU
1	B	101	CYS
1	B	220	HIS

Some sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (2) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	136	HIS
1	A	169	ASN

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)

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	$\#\|Z\| > 2$
2	NDP	A	301	-	42,52,52	1.24	5 (11%)	55,80,80	1.49	6 (10%)
3	14Q	A	302	-	31,33,33	1.59	6 (19%)	39,46,46	1.28	5 (12%)
2	NDP	B	301	-	42,52,52	1.23	5 (11%)	55,80,80	1.54	4 (7%)
3	14Q	B	302	-	31,33,33	1.65	6 (19%)	39,46,46	1.31	6 (15%)

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	NDP	A	301	-	-	0/30/77/77	0/5/5/5
3	14Q	A	302	-	-	0/13/20/20	0/4/4/4
2	NDP	B	301	-	-	0/30/77/77	0/5/5/5
3	14Q	B	302	-	-	0/13/20/20	0/4/4/4

All (22) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
2	B	301	NDP	C4N-C5N	-4.22	1.40	1.49
2	A	301	NDP	C4N-C5N	-4.21	1.40	1.49
3	A	302	14Q	CAS-CAQ	-3.14	1.40	1.49
3	B	302	14Q	CAS-CAQ	-3.08	1.41	1.49
2	B	301	NDP	O4B-C1B	2.08	1.43	1.41
2	B	301	NDP	C2N-C3N	2.09	1.39	1.34
2	A	301	NDP	O4B-C1B	2.18	1.44	1.41
2	A	301	NDP	C2N-C3N	2.20	1.40	1.34
3	B	302	14Q	C2-N1	2.87	1.40	1.35
3	A	302	14Q	C2-N1	2.93	1.40	1.35
3	A	302	14Q	CAJ-CAK	2.96	1.22	1.19
3	A	302	14Q	C2-N3	3.18	1.41	1.35
3	B	302	14Q	C2-N3	3.20	1.41	1.35
2	B	301	NDP	C5A-C4A	3.26	1.47	1.40
2	A	301	NDP	C5A-C4A	3.27	1.47	1.40
2	B	301	NDP	C6N-C5N	3.49	1.40	1.33
3	B	302	14Q	C6-N1	3.51	1.40	1.35
2	A	301	NDP	C6N-C5N	3.52	1.40	1.33
3	A	302	14Q	C6-N1	3.69	1.40	1.35
3	B	302	14Q	CAJ-CAK	3.76	1.23	1.19
3	A	302	14Q	C4-N3	4.09	1.41	1.34
3	B	302	14Q	C4-N3	4.19	1.41	1.34

All (21) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(^{o})	Ideal(^{o})
2	B	301	NDP	N3A-C2A-N1A	-7.25	123.34	128.89
2	A	301	NDP	N3A-C2A-N1A	-7.12	123.44	128.89
2	B	301	NDP	PN-O3-PA	-3.81	122.02	132.73
3	B	302	14Q	N3-C2-N1	-3.70	119.47	125.53
3	A	302	14Q	N3-C2-N1	-3.62	119.60	125.53
2	A	301	NDP	PN-O3-PA	-3.42	123.14	132.73
2	A	301	NDP	C4A-C5A-N7A	-3.09	106.63	109.48
2	B	301	NDP	C4A-C5A-N7A	-3.03	106.69	109.48
3	B	302	14Q	OBD-CBC-OBB	-2.41	104.04	108.12
3	A	302	14Q	OBD-CBC-OBB	-2.40	104.06	108.12
2	A	301	NDP	C1D-N1N-C2N	-2.07	117.29	120.91
3	B	302	14Q	NAG-C2-N3	2.00	120.51	117.20
3	A	302	14Q	OBD-CAV-CAU	2.21	131.47	127.96
3	B	302	14Q	OBD-CAV-CAU	2.22	131.49	127.96
3	A	302	14Q	C2-N1-C6	2.32	119.68	117.04
2	A	301	NDP	C5N-C4N-C3N	2.33	118.93	112.52

Continued on next page...

Continued from previous page...

Mol	Chain	Res	Type	Atoms	Z	Observed(^{o})	Ideal(^{o})
2	B	301	NDP	C5N-C4N-C3N	2.38	119.06	112.52
2	A	301	NDP	O4D-C1D-N1N	2.42	113.17	108.07
3	B	302	14Q	C2-N1-C6	2.47	119.86	117.04
3	A	302	14Q	OBB-CAW-CAX	2.68	131.72	127.88
3	B	302	14Q	OBB-CAW-CAX	2.78	131.87	127.88

There are no chirality outliers.

There are no torsion outliers.

There are no ring outliers.

3 monomers are involved in 3 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
2	A	301	NDP	1	0
3	A	302	14Q	1	0
3	B	302	14Q	1	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	224/224 (100%)	-0.31	0	100	100	29, 37, 54, 60	1 (0%)
1	B	224/224 (100%)	-0.31	0	100	100	30, 38, 57, 69	1 (0%)
All	All	448/448 (100%)	-0.31	0	100	100	29, 38, 56, 69	2 (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 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
3	14Q	B	302	30/30	0.94	0.19	0.71	32,34,35,35	0
3	14Q	A	302	30/30	0.95	0.19	0.57	35,38,39,40	0
2	NDP	A	301	48/48	0.97	0.12	-1.38	32,33,34,34	0
2	NDP	B	301	48/48	0.97	0.12	-1.53	31,32,32,33	0

6.5 Other polymers (i)

There are no such residues in this entry.