



Full wwPDB X-ray Structure Validation Report ⓘ

Feb 1, 2016 – 04:38 AM GMT

PDB ID : 2NO9
Title : The structure of deoxycytidine kinase complexed with troxacitabine and ADP.
Authors : Sabini, E.; Lavie, A.
Deposited on : 2006-10-25
Resolution : 2.15 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 ⓘ symbol.

The following versions of software and data (see [references ⓘ](#)) 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

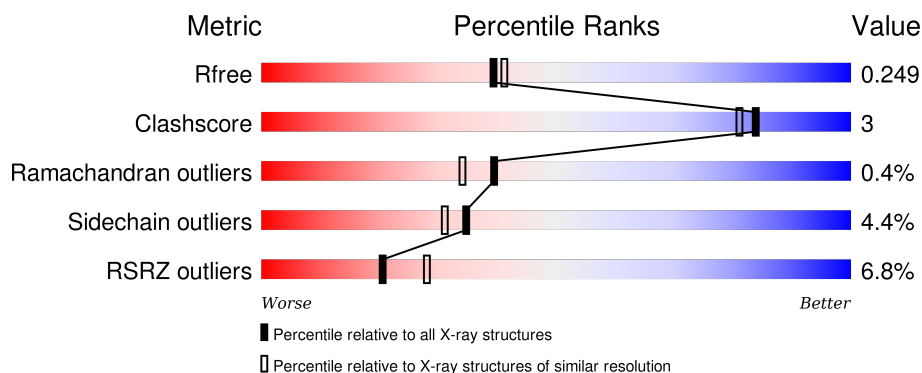
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 2.15 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	1045 (2.16-2.16)
Clashscore	102246	1152 (2.16-2.16)
Ramachandran outliers	100387	1131 (2.16-2.16)
Sidechain outliers	100360	1131 (2.16-2.16)
RSRZ outliers	91569	1050 (2.16-2.16)

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 $\leq 5\%$. 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	280	<div> <div>6%</div> <div>78%</div> <div>8%</div> <div>14%</div> </div>
1	B	280	<div> <div>6%</div> <div>71%</div> <div>9%</div> <div>19%</div> </div>

2 Entry composition [i](#)

There are 4 unique types of molecules in this entry. The entry contains 4013 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 deoxycytidine kinase.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	242	Total	C	N	O	S	0	0	0
			1978	1267	329	375	7			
1	B	227	Total	C	N	O	S	0	0	0
			1872	1203	311	352	6			

There are 48 discrepancies between the modelled and reference sequences:

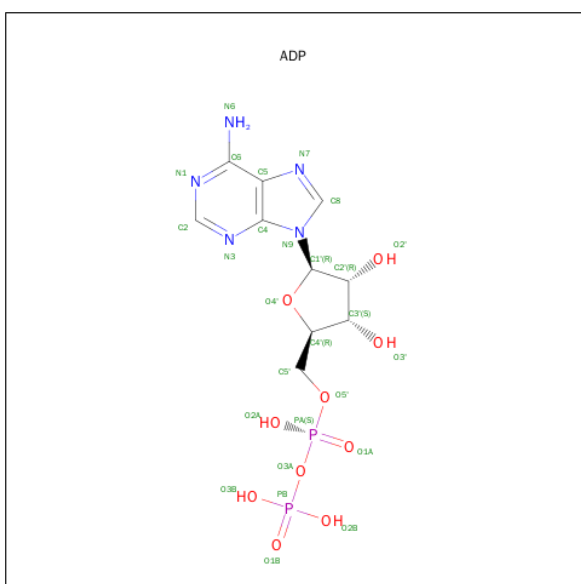
Chain	Residue	Modelled	Actual	Comment	Reference
A	-19	MET	-	cloning artifact	UNP P27707
A	-18	GLY	-	cloning artifact	UNP P27707
A	-17	SER	-	cloning artifact	UNP P27707
A	-16	SER	-	cloning artifact	UNP P27707
A	-15	HIS	-	cloning artifact	UNP P27707
A	-14	HIS	-	cloning artifact	UNP P27707
A	-13	HIS	-	cloning artifact	UNP P27707
A	-12	HIS	-	cloning artifact	UNP P27707
A	-11	HIS	-	cloning artifact	UNP P27707
A	-10	HIS	-	cloning artifact	UNP P27707
A	-9	SER	-	cloning artifact	UNP P27707
A	-8	SER	-	cloning artifact	UNP P27707
A	-7	GLY	-	cloning artifact	UNP P27707
A	-6	LEU	-	cloning artifact	UNP P27707
A	-5	VAL	-	cloning artifact	UNP P27707
A	-4	PRO	-	cloning artifact	UNP P27707
A	-3	ARG	-	cloning artifact	UNP P27707
A	-2	GLY	-	cloning artifact	UNP P27707
A	-1	SER	-	cloning artifact	UNP P27707
A	0	HIS	-	cloning artifact	UNP P27707
A	9	SER	CYS	engineered	UNP P27707
A	45	SER	CYS	engineered	UNP P27707
A	59	SER	CYS	engineered	UNP P27707
A	146	SER	CYS	engineered	UNP P27707
B	-19	MET	-	cloning artifact	UNP P27707

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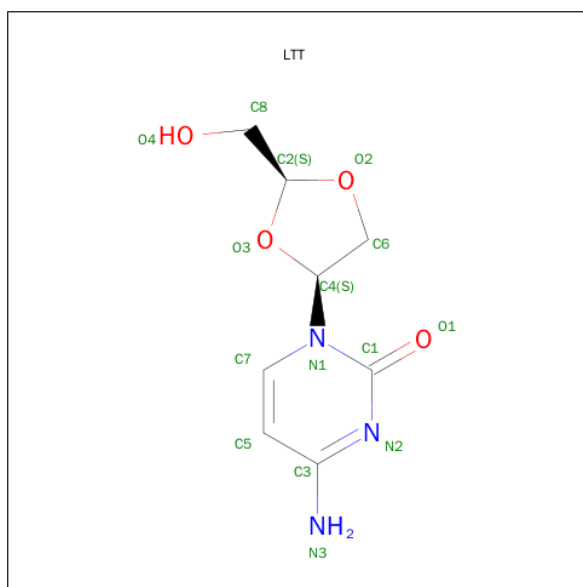
Chain	Residue	Modelled	Actual	Comment	Reference
B	-18	GLY	-	cloning artifact	UNP P27707
B	-17	SER	-	cloning artifact	UNP P27707
B	-16	SER	-	cloning artifact	UNP P27707
B	-15	HIS	-	cloning artifact	UNP P27707
B	-14	HIS	-	cloning artifact	UNP P27707
B	-13	HIS	-	cloning artifact	UNP P27707
B	-12	HIS	-	cloning artifact	UNP P27707
B	-11	HIS	-	cloning artifact	UNP P27707
B	-10	HIS	-	cloning artifact	UNP P27707
B	-9	SER	-	cloning artifact	UNP P27707
B	-8	SER	-	cloning artifact	UNP P27707
B	-7	GLY	-	cloning artifact	UNP P27707
B	-6	LEU	-	cloning artifact	UNP P27707
B	-5	VAL	-	cloning artifact	UNP P27707
B	-4	PRO	-	cloning artifact	UNP P27707
B	-3	ARG	-	cloning artifact	UNP P27707
B	-2	GLY	-	cloning artifact	UNP P27707
B	-1	SER	-	cloning artifact	UNP P27707
B	0	HIS	-	cloning artifact	UNP P27707
B	9	SER	CYS	engineered	UNP P27707
B	45	SER	CYS	engineered	UNP P27707
B	59	SER	CYS	engineered	UNP P27707
B	146	SER	CYS	engineered	UNP P27707

- Molecule 2 is ADENOSINE-5'-DIPHOSPHATE (three-letter code: ADP) (formula: $C_{10}H_{15}N_5O_{10}P_2$).



Mol	Chain	Residues	Atoms					ZeroOcc	AltConf
2	A	1	Total	C	N	O	P	0	0
			27	10	5	10	2		
2	B	1	Total	C	N	O	P	0	0
			27	10	5	10	2		

- Molecule 3 is 4-AMINO-1-[(2S,4S)-2-(HYDROXYMETHYL)-1,3-DIOXOLAN-4-YL]PYRIMIDIN-2(1H)-ONE (three-letter code: LTT) (formula: C₈H₁₁N₃O₄).



Mol	Chain	Residues	Atoms				ZeroOcc	AltConf
3	A	1	Total	C	N	O	0	0
			15	8	3	4		
3	B	1	Total	C	N	O	0	0
			15	8	3	4		

- Molecule 4 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
4	A	49	Total	O	0	0
			49	49		
4	B	30	Total	O	0	0
			30	30		

4 Data and refinement statistics

Property	Value	Source
Space group	C 2 2 21	Depositor
Cell constants a, b, c, α , β , γ	52.85Å 134.46Å 155.34Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	30.00 – 2.15 28.53 – 2.15	Depositor EDS
% Data completeness (in resolution range)	99.8 (30.00-2.15) 99.8 (28.53-2.15)	Depositor EDS
R_{merge}	(Not available)	Depositor
R_{sym}	0.10	Depositor
$\langle I/\sigma(I) \rangle$ ¹	4.05 (at 2.16Å)	Xtriage
Refinement program	REFMAC 5.2.0019	Depositor
R, R_{free}	0.195 , 0.255 0.193 , 0.249	Depositor DCC
R_{free} test set	3070 reflections (11.18%)	DCC
Wilson B-factor (Å ²)	35.1	Xtriage
Anisotropy	0.231	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.36 , 44.7	EDS
Estimated twinning fraction	No twinning to report.	Xtriage
L-test for twinning ²	$\langle L \rangle = 0.44$, $\langle L^2 \rangle = 0.27$	Xtriage
Outliers	1 of 30536 reflections (0.003%)	Xtriage
F_o, F_c correlation	0.95	EDS
Total number of atoms	4013	wwPDB-VP
Average B, all atoms (Å ²)	36.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 5.01% of the height of the origin peak. No significant pseudotranslation is detected.*

¹Intensities estimated from amplitudes.

²Theoretical values of $\langle |L| \rangle$, $\langle L^2 \rangle$ 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: ADP, LTT

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	0.79	0/2025	0.74	0/2744
1	B	0.80	1/1918 (0.1%)	0.80	1/2601 (0.0%)
All	All	0.80	1/3943 (0.0%)	0.77	1/5345 (0.0%)

All (1) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	B	210	TYR	CD1-CE1	5.19	1.47	1.39

All (1) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	B	41	LEU	CB-CG-CD2	-5.66	101.39	111.00

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	1978	0	1893	15	0
1	B	1872	0	1788	9	0
2	A	27	0	12	0	0
2	B	27	0	12	0	0

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Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
3	A	15	0	11	0	0
3	B	15	0	11	0	0
4	A	49	0	0	2	0
4	B	30	0	0	1	0
All	All	4013	0	3727	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:A:82:LEU:HD23	1:A:196:GLU:HG3	1.68	0.76
1:B:57:ARG:HH11	1:B:57:ARG:HB3	1.53	0.73
1:A:245:LYS:HB2	4:A:337:HOH:O	1.91	0.70
1:A:166:PHE:HB3	1:A:169:SER:HB2	1.78	0.65
1:A:88:LYS:HD2	1:A:91:ARG:HB2	1.80	0.64
1:A:143:GLU:OE2	1:A:211:LYS:NZ	2.28	0.63
1:A:45:SER:O	4:A:345:HOH:O	2.17	0.60
1:A:246:TYR:CZ	1:A:250:VAL:HG21	2.37	0.59
1:B:152:TRP:O	1:B:156:GLN:HG3	2.12	0.49
1:B:232:PRO:HG2	1:B:260:LEU:CD2	2.45	0.46
1:A:20:ARG:NH2	1:A:119:ALA:O	2.38	0.46
1:A:66:ASP:OD2	1:A:69:GLU:HG3	2.15	0.46
1:B:116:LEU:HD11	1:B:124:LEU:HD13	1.97	0.46
1:A:119:ALA:HB3	1:A:122:PRO:HB3	1.98	0.46
1:B:20:ARG:NH2	1:B:119:ALA:O	2.38	0.45
1:A:246:TYR:CZ	1:A:250:VAL:CG2	3.00	0.44
1:A:60:ASN:HD21	1:A:77:ASN:HA	1.82	0.43
1:B:53:GLU:HA	1:B:54:PRO:HD3	1.83	0.42
1:A:69:GLU:O	1:A:73:MET:HB3	2.21	0.41
1:B:246:TYR:HE1	4:B:324:HOH:O	2.02	0.41
1:B:47:ASP:O	1:B:116:LEU:HD22	2.21	0.40
1:A:157:ASP:OD2	1:B:106:ARG:NH2	2.54	0.40
1:A:88:LYS:HD2	1:A:91:ARG:CB	2.48	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	240/280 (86%)	234 (98%)	6 (2%)	0	100	100
1	B	223/280 (80%)	213 (96%)	8 (4%)	2 (1%)	21	13
All	All	463/560 (83%)	447 (96%)	14 (3%)	2 (0%)	39	34

All (2) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	B	117	LYS
1	B	115	LYS

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	212/256 (83%)	206 (97%)	6 (3%)	51	52
1	B	200/256 (78%)	188 (94%)	12 (6%)	24	18
All	All	412/512 (80%)	394 (96%)	18 (4%)	35	31

All (18) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	25	SER
1	A	35	SER
1	A	60	ASN
1	A	169	SER

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Mol	Chain	Res	Type
1	A	206	GLU
1	A	226	ASP
1	B	38	VAL
1	B	46	GLU
1	B	57	ARG
1	B	85	MET
1	B	116	LEU
1	B	162	MET
1	B	179	GLN
1	B	211	LYS
1	B	217	LEU
1	B	241	ASP
1	B	242	PHE
1	B	250	VAL

Some sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (3) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	60	ASN
1	A	156	GLN
1	B	179	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](#)

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	ADP	A	301	-	22,29,29	2.49	3 (13%)	27,45,45	4.05	8 (29%)
3	LTT	A	302	-	12,16,16	0.58	0	14,22,22	1.75	4 (28%)
2	ADP	B	301	-	22,29,29	2.50	5 (22%)	27,45,45	3.75	4 (14%)
3	LTT	B	302	-	12,16,16	0.54	0	14,22,22	1.08	1 (7%)

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	ADP	A	301	-	-	0/12/32/32	0/3/3/3
3	LTT	A	302	-	-	0/2/15/15	0/2/2/2
2	ADP	B	301	-	-	0/12/32/32	0/3/3/3
3	LTT	B	302	-	-	0/2/15/15	0/2/2/2

All (8) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
2	B	301	ADP	C6-N6	-2.46	1.27	1.34
2	B	301	ADP	PB-O2B	-2.34	1.46	1.54
2	A	301	ADP	C6-N6	-2.02	1.28	1.34
2	B	301	ADP	O4'-C1'	2.17	1.43	1.41
2	A	301	ADP	C2-N1	6.37	1.46	1.33
2	B	301	ADP	C2-N1	6.82	1.46	1.33
2	B	301	ADP	C2-N3	7.86	1.46	1.32
2	A	301	ADP	C2-N3	8.73	1.47	1.32

All (17) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
2	A	301	ADP	N3-C2-N1	-19.16	114.23	128.89
2	B	301	ADP	N3-C2-N1	-17.93	115.17	128.89

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Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
2	B	301	ADP	C4-C5-N7	-3.70	106.07	109.48
2	A	301	ADP	O4'-C1'-N9	-3.15	101.51	108.10
2	A	301	ADP	C4-C5-N7	-2.92	106.79	109.48
2	A	301	ADP	O3'-C3'-C4'	-2.77	102.75	111.05
3	A	302	LTT	C6-C4-N1	-2.56	106.81	112.54
3	A	302	LTT	O4-C8-C2	-2.51	104.51	111.45
3	A	302	LTT	C5-C3-N2	-2.42	118.75	121.80
3	B	302	LTT	C1-N2-C3	2.02	118.47	115.61
2	A	301	ADP	N6-C6-N1	2.12	123.75	119.20
2	A	301	ADP	O2A-PA-O3A	2.35	115.77	105.09
2	B	301	ADP	C2-N1-C6	3.15	124.39	118.77
2	B	301	ADP	O2B-PB-O1B	3.18	120.83	110.58
3	A	302	LTT	C1-N2-C3	3.32	120.29	115.61
2	A	301	ADP	O2B-PB-O1B	3.49	121.81	110.58
2	A	301	ADP	C2-N1-C6	3.61	125.22	118.77

There are no chirality outliers.

There are no torsion outliers.

There are no ring outliers.

No monomer is involved in short contacts.

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	242/280 (86%)	0.31	16 (6%) 22 30	22, 34, 54, 62	0
1	B	227/280 (81%)	0.35	16 (7%) 19 26	23, 36, 56, 67	0
All	All	469/560 (83%)	0.33	32 (6%) 20 28	22, 35, 56, 67	0

All (32) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	B	260	LEU	5.2
1	B	77	ASN	4.0
1	B	190	TYR	3.9
1	A	226	ASP	3.9
1	B	115	LYS	3.5
1	A	100	ALA	3.4
1	A	101	CYS	3.4
1	A	260	LEU	3.3
1	B	113	ASN	3.1
1	B	118	ASP	2.9
1	A	98	THR	2.9
1	B	167	GLY	2.8
1	B	168	GLN	2.6
1	A	132	SER	2.5
1	B	78	GLY	2.5
1	A	119	ALA	2.5
1	A	259	THR	2.4
1	B	166	PHE	2.4
1	B	245	LYS	2.4
1	A	117	LYS	2.4
1	A	20	ARG	2.3
1	B	129	SER	2.3
1	A	102	LEU	2.3
1	B	98	THR	2.2

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Mol	Chain	Res	Type	RSRZ
1	B	226	ASP	2.2
1	A	58	TRP	2.2
1	B	26	ILE	2.2
1	B	244	ASP	2.1
1	A	222	LYS	2.1
1	A	120	GLU	2.1
1	A	158	TRP	2.1
1	A	99	TYR	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, 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(\AA^2)	Q<0.9
3	LTT	A	302	15/15	0.97	0.20	0.43	23,26,32,36	0
3	LTT	B	302	15/15	0.95	0.14	0.01	26,29,37,38	0
2	ADP	A	301	27/27	0.98	0.11	-0.74	24,28,31,33	0
2	ADP	B	301	27/27	0.98	0.10	-0.92	21,28,30,32	0

6.5 Other polymers [i](#)

There are no such residues in this entry.