



Full wwPDB X-ray Structure Validation Report ⓘ

Feb 1, 2016 – 08:17 AM GMT

PDB ID : 3E31
Title : H. influenzae beta-carbonic anhydrase, variant V47A
Authors : Rowlett, R.S.; Lee, J.
Deposited on : 2008-08-05
Resolution : 2.95 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

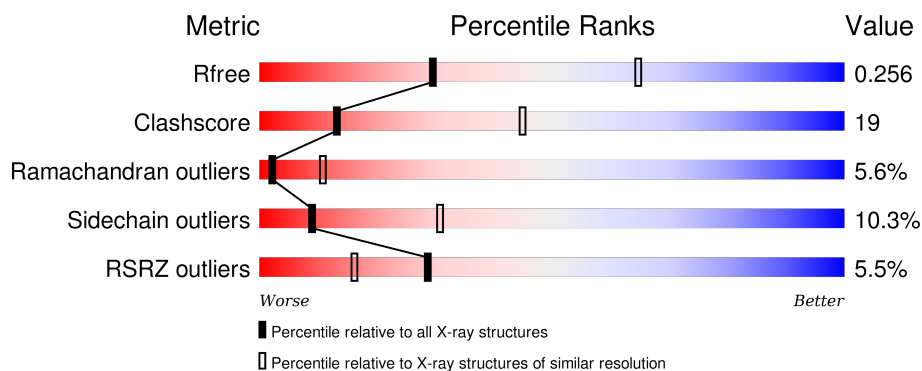
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 2.95 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	2184 (3.00-2.92)
Clashscore	102246	2552 (3.00-2.92)
Ramachandran outliers	100387	2468 (3.00-2.92)
Sidechain outliers	100360	2471 (3.00-2.92)
RSRZ outliers	91569	2201 (3.00-2.92)

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	229	 3% 46% 26% 7% • 20%
1	B	229	 5% 50% 24% • • 21%

2 Entry composition

There are 3 unique types of molecules in this entry. The entry contains 2905 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 Carbonic anhydrase 2.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	183	Total	C	N	O	S	0	0	0
			1452	923	261	261	7			
1	B	181	Total	C	N	O	S	0	0	0
			1435	912	258	258	7			

There are 2 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	47	ALA	VAL	ENGINEERED	UNP P45148
B	47	ALA	VAL	ENGINEERED	UNP P45148

- Molecule 2 is ZINC ION (three-letter code: ZN) (formula: Zn).

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

- Molecule 3 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
3	A	10	Total	O	0	0
			10	10		
3	B	6	Total	O	0	0
			6	6		

4 Data and refinement statistics

Property	Value	Source
Space group	P 41 21 2	Depositor
Cell constants a, b, c, α , β , γ	82.28 Å 82.28 Å 188.78 Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	37.72 – 2.95 37.71 – 2.95	Depositor EDS
% Data completeness (in resolution range)	99.9 (37.72-2.95) 99.9 (37.71-2.95)	Depositor EDS
R_{merge}	0.08	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	4.69 (at 2.95 Å)	Xtriage
Refinement program	REFMAC 5.2	Depositor
R, R_{free}	0.197 , 0.247 0.203 , 0.256	Depositor DCC
R_{free} test set	718 reflections (5.28%)	DCC
Wilson B-factor (Å ²)	80.9	Xtriage
Anisotropy	0.157	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.35 , 65.0	EDS
Estimated twinning fraction	No twinning to report.	Xtriage
L-test for twinning ²	$\langle L \rangle = 0.49$, $\langle L^2 \rangle = 0.32$	Xtriage
Outliers	0 of 14323 reflections	Xtriage
F_o, F_c correlation	0.95	EDS
Total number of atoms	2905	wwPDB-VP
Average B, all atoms (Å ²)	42.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 3.80% 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

5.1 Standard geometry

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

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	0.76	0/1484	0.80	0/2014
1	B	0.79	1/1467 (0.1%)	0.82	0/1991
All	All	0.77	1/2951 (0.0%)	0.81	0/4005

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	2
All	All	0	4

All (1) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	B	42	CYS	CB-SG	-6.05	1.72	1.82

There are no bond angle outliers.

There are no chirality outliers.

All (4) planarity outliers are listed below:

Mol	Chain	Res	Type	Group
1	A	190	ASP	Peptide
1	A	49	ALA	Peptide
1	B	192	GLY	Peptide
1	B	213	SER	Peptide

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	1452	0	1447	57	0
1	B	1435	0	1428	54	0
2	A	1	0	0	0	0
2	B	1	0	0	0	0
3	A	10	0	0	1	0
3	B	6	0	0	3	0
All	All	2905	0	2875	109	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 19.

All (109) 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:214:ILE:O	1:B:214:ILE:HG22	1.67	0.94
1:B:213:SER:O	3:B:235:HOH:O	1.85	0.94
1:B:52:LEU:HD21	1:B:181:TYR:CE2	2.12	0.83
1:A:116:ILE:HD11	1:A:120:LEU:HD11	1.62	0.79
1:A:116:ILE:HD11	1:A:120:LEU:CD1	2.15	0.76
1:A:190:ASP:OD2	1:A:191:GLN:O	2.04	0.75
1:B:34:THR:HG23	1:B:35:PRO:HD2	1.72	0.72
1:B:214:ILE:CG2	1:B:214:ILE:O	2.38	0.72
1:B:39:TRP:CZ2	1:B:49:ALA:HB2	2.25	0.71
1:A:53:THR:OG1	1:A:55:LEU:HD12	1.90	0.71
1:B:133:LEU:HD11	1:B:212:LEU:O	1.91	0.70
1:A:48:PRO:O	1:A:50:GLU:O	2.11	0.69
1:A:156:TYR:O	1:A:160:ARG:HD3	1.91	0.69
1:A:130:HIS:CD2	1:A:149:ILE:HG21	2.28	0.68
1:A:81:VAL:HG12	1:A:163:ILE:HG21	1.76	0.67
1:A:53:THR:OG1	1:A:54:ASN:N	2.29	0.65
1:A:47:ALA:HA	1:A:52:LEU:HD12	1.79	0.65
1:B:113:LEU:HB2	1:B:116:ILE:CG2	2.27	0.64
1:B:52:LEU:HD11	1:B:181:TYR:CE2	2.33	0.64
1:B:39:TRP:CE2	1:B:49:ALA:HB2	2.32	0.63
1:A:131:GLY:O	1:A:135:GLY:N	2.32	0.63

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:82:GLN:HG2	1:A:163:ILE:HG12	1.81	0.62
1:B:49:ALA:O	1:B:53:THR:HG23	2.00	0.61
1:B:156:TYR:O	1:B:160:ARG:HD3	2.00	0.61
1:B:52:LEU:HD11	1:B:181:TYR:CD2	2.34	0.61
1:A:151:VAL:O	1:A:155:VAL:HG23	2.00	0.61
1:A:81:VAL:HG12	1:A:163:ILE:HD13	1.81	0.61
1:A:35:PRO:HD2	1:A:88:LEU:HD22	1.82	0.61
1:A:38:LEU:HD12	1:A:39:TRP:N	2.16	0.61
1:B:41:GLY:O	1:B:64:ARG:HA	2.02	0.60
1:B:99:THR:OG1	1:B:183:VAL:HG22	2.02	0.60
1:B:105:HIS:HB3	3:B:236:HOH:O	2.01	0.60
1:A:191:GLN:HG2	1:A:212:LEU:HD22	1.85	0.59
1:B:52:LEU:HD21	1:B:181:TYR:CZ	2.38	0.58
1:A:50:GLU:OE2	3:A:235:HOH:O	2.17	0.58
1:B:93:ILE:HG21	1:B:158:LEU:HD21	1.85	0.58
1:B:135:GLY:O	1:B:137:LEU:N	2.38	0.56
1:A:47:ALA:HA	1:A:52:LEU:CD1	2.36	0.55
1:B:39:TRP:HB2	1:B:60:LEU:HD21	1.87	0.55
1:A:35:PRO:CD	1:A:88:LEU:HD22	2.36	0.55
1:B:87:VAL:HG12	1:B:88:LEU:HD23	1.89	0.54
1:A:188:LEU:N	1:A:188:LEU:HD23	2.23	0.54
1:A:116:ILE:HD12	1:A:120:LEU:HG	1.88	0.54
1:A:47:ALA:O	1:A:49:ALA:N	2.42	0.53
1:A:82:GLN:OE1	1:B:113:LEU:O	2.25	0.53
1:A:134:LEU:HA	1:A:137:LEU:HD13	1.90	0.53
1:A:113:LEU:O	1:A:116:ILE:HG23	2.09	0.52
1:B:116:ILE:HG13	1:B:120:LEU:HD22	1.91	0.51
1:B:38:LEU:HD12	1:B:39:TRP:N	2.25	0.51
1:B:34:THR:HG23	1:B:35:PRO:CD	2.39	0.51
1:B:36:HIS:O	1:B:90:ILE:HG23	2.11	0.51
1:A:151:VAL:HG21	1:A:180:VAL:HG22	1.94	0.50
1:A:130:HIS:CD2	1:A:149:ILE:CG2	2.94	0.50
1:B:53:THR:OG1	1:B:54:ASN:N	2.45	0.49
1:A:98:HIS:CE1	1:A:101:CYS:HB2	2.46	0.49
1:A:81:VAL:CG1	1:A:163:ILE:HG21	2.43	0.49
1:A:136:LYS:O	1:A:137:LEU:HD12	2.12	0.49
1:B:176:LEU:O	1:B:194:MET:HA	2.14	0.48
1:A:148:LYS:HE2	1:A:191:GLN:HE22	1.77	0.48
1:B:142:ARG:O	1:B:143:ALA:C	2.52	0.48
1:A:60:LEU:HD22	1:A:62:VAL:CG2	2.44	0.48
1:B:159:GLY:HA3	1:B:201:LEU:HD22	1.95	0.48

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:B:53:THR:O	1:B:54:ASN:CB	2.61	0.47
1:B:188:LEU:O	1:B:189:VAL:CG2	2.62	0.47
1:B:54:ASN:C	1:B:54:ASN:HD22	2.18	0.47
1:B:51:LYS:O	1:B:52:LEU:C	2.53	0.47
1:A:71:ILE:HG22	1:A:73:THR:H	1.80	0.47
1:B:47:ALA:N	3:B:234:HOH:O	2.35	0.46
1:A:136:LYS:NZ	1:A:215:LEU:HD21	2.29	0.46
1:B:49:ALA:HA	1:B:52:LEU:HB2	1.97	0.46
1:A:91:GLU:HG2	1:A:173:LYS:O	2.16	0.46
1:A:79:SER:O	1:B:116:ILE:HD13	2.15	0.46
1:A:48:PRO:C	1:A:50:GLU:O	2.54	0.46
1:A:43:SER:O	1:A:45:SER:N	2.45	0.46
1:A:35:PRO:HG2	1:A:88:LEU:HD13	1.97	0.45
1:A:34:THR:O	1:A:59:GLU:HG2	2.16	0.45
1:A:44:ASP:O	1:A:46:ARG:N	2.50	0.45
1:B:113:LEU:HB2	1:B:116:ILE:HG21	1.99	0.45
1:A:134:LEU:O	1:A:136:LYS:N	2.49	0.45
1:A:53:THR:CB	1:A:55:LEU:HD12	2.47	0.44
1:A:91:GLU:HA	1:A:174:LEU:HD12	2.00	0.44
1:A:162:SER:O	1:A:163:ILE:C	2.56	0.44
1:A:46:ARG:HE	1:A:46:ARG:CA	2.31	0.44
1:B:98:HIS:CE1	1:B:101:CYS:HA	2.53	0.44
1:B:35:PRO:HA	1:B:59:GLU:HA	2.00	0.43
1:A:61:PHE:CE2	1:A:80:VAL:HG13	2.53	0.43
1:A:137:LEU:O	1:A:138:SER:C	2.56	0.43
1:A:126:ILE:HD13	1:A:153:GLU:CB	2.49	0.43
1:A:159:GLY:HA3	1:A:201:LEU:HD22	2.01	0.43
1:B:133:LEU:HD23	1:B:133:LEU:C	2.39	0.43
1:B:197:SER:N	1:B:200:THR:OG1	2.51	0.43
1:B:39:TRP:CE2	1:B:49:ALA:CB	3.02	0.42
1:A:90:ILE:HG22	1:A:92:HIS:H	1.84	0.42
1:A:49:ALA:O	1:A:50:GLU:C	2.57	0.42
1:B:129:LYS:NZ	1:B:205:TYR:OH	2.47	0.42
1:A:110:ASP:O	1:A:111:LYS:C	2.59	0.42
1:B:144:ASP:O	1:B:147:THR:HB	2.20	0.41
1:A:116:ILE:CD1	1:A:120:LEU:CD1	2.93	0.41
1:A:188:LEU:O	1:A:190:ASP:N	2.53	0.41
1:B:36:HIS:C	1:B:90:ILE:HD12	2.42	0.41
1:B:44:ASP:HB2	1:B:98:HIS:NE2	2.36	0.41
1:B:128:PHE:O	1:B:129:LYS:C	2.59	0.41
1:B:156:TYR:O	1:B:160:ARG:CD	2.66	0.40

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:82:GLN:NE2	1:A:86:ASP:OD2	2.52	0.40
1:B:162:SER:O	1:B:163:ILE:C	2.60	0.40
1:B:82:GLN:HG2	1:B:163:ILE:HG12	2.03	0.40
1:B:181:TYR:CE1	1:B:183:VAL:HA	2.57	0.40
1:B:49:ALA:N	1:B:52:LEU:HD12	2.36	0.40
1:B:83:TYR:CZ	1:B:87:VAL:HG11	2.57	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	181/229 (79%)	153 (84%)	15 (8%)	13 (7%)	1	6
1	B	179/229 (78%)	151 (84%)	21 (12%)	7 (4%)	4	19
All	All	360/458 (79%)	304 (84%)	36 (10%)	20 (6%)	2	11

All (20) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	B	54	ASN
1	B	136	LYS
1	B	143	ALA
1	A	44	ASP
1	A	45	SER
1	A	49	ALA
1	A	191	GLN
1	B	50	GLU
1	B	52	LEU
1	B	100	ASN
1	A	34	THR
1	A	50	GLU

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Mol	Chain	Res	Type
1	A	51	LYS
1	A	56	GLU
1	A	163	ILE
1	A	189	VAL
1	A	48	PRO
1	A	87	VAL
1	A	135	GLY
1	B	189	VAL

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	157/200 (78%)	138 (88%)	19 (12%)	6	23
1	B	155/200 (78%)	142 (92%)	13 (8%)	14	42
All	All	312/400 (78%)	280 (90%)	32 (10%)	9	31

All (32) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	33	GLN
1	A	46	ARG
1	A	50	GLU
1	A	55	LEU
1	A	60	LEU
1	A	82	GLN
1	A	112	ASP
1	A	115	LEU
1	A	116	ILE
1	A	121	LEU
1	A	162	SER
1	A	169	GLU
1	A	173	LYS
1	A	175	SER
1	A	183	VAL

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Mol	Chain	Res	Type
1	A	191	GLN
1	A	198	ARG
1	A	211	ARG
1	A	215	LEU
1	B	34	THR
1	B	45	SER
1	B	54	ASN
1	B	56	GLU
1	B	60	LEU
1	B	101	CYS
1	B	115	LEU
1	B	120	LEU
1	B	181	TYR
1	B	185	ASP
1	B	196	THR
1	B	212	LEU
1	B	213	SER

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	92	HIS
1	B	54	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](#)

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.

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	183/229 (79%)	0.30	8 (4%) 38 22	25, 41, 63, 67	0
1	B	181/229 (79%)	0.42	12 (6%) 22 11	24, 39, 71, 78	0
All	All	364/458 (79%)	0.36	20 (5%) 29 16	24, 40, 64, 78	0

All (20) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	B	49	ALA	4.8
1	A	34	THR	4.3
1	A	215	LEU	4.2
1	B	59	GLU	4.2
1	A	191	GLN	3.8
1	B	187	PHE	3.6
1	B	34	THR	3.3
1	B	50	GLU	3.3
1	B	184	ASN	2.9
1	B	186	GLY	2.8
1	B	54	ASN	2.7
1	B	136	LYS	2.7
1	A	140	GLU	2.6
1	A	61	PHE	2.5
1	A	132	HIS	2.4
1	B	52	LEU	2.4
1	A	59	GLU	2.2
1	B	51	LYS	2.2
1	A	139	PRO	2.0
1	B	58	GLY	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
2	ZN	B	230	1/1	0.99	0.09	-1.24	51,51,51,51	0
2	ZN	A	230	1/1	0.99	0.08	-2.13	57,57,57,57	0

6.5 Other polymers [i](#)

There are no such residues in this entry.