



Full wwPDB X-ray Structure Validation Report ⓘ

Mar 9, 2026 – 12:35 PM UTC

PDB ID : 4Z3P / pdb_00004z3p
Title : MATE transporter ClbM in complex with Rb+
Authors : Mousa, J.J.; Bruner, S.D.
Deposited on : 2015-03-31
Resolution : 3.30 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 : 2022.3.0, CSD as543be (2022)
Xtriage (Phenix) : 2.0
EDS : 3.0
Percentile statistics : 20250101.v01 (using entries in the PDB archive January 1st 2025)
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) : 2.49

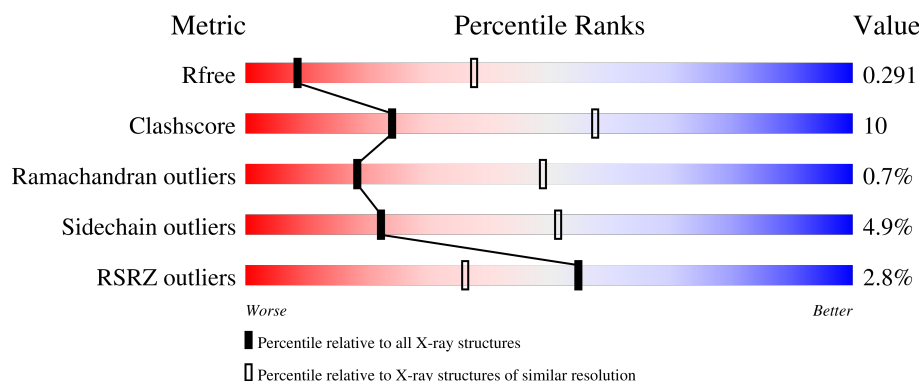
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 3.30 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}	180053	1169 (3.32-3.28)
Clashscore	190562	1209 (3.32-3.28)
Ramachandran outliers	187476	1188 (3.32-3.28)
Sidechain outliers	187428	1187 (3.32-3.28)
RSRZ outliers	180081	1169 (3.32-3.28)

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	499	

The following table lists non-polymeric compounds, carbohydrate monomers and non-standard residues in protein, DNA, RNA chains that are outliers for geometric or electron-density-fit criteria:

Mol	Type	Chain	Res	Chirality	Geometry	Clashes	Electron density
3	CAC	A	502	-	X	X	-

2 Entry composition

There are 4 unique types of molecules in this entry. The entry contains 3352 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 Putative drug/sodium antiporter.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	431	Total	C	N	O	S	0	0	0
			3345	2248	529	541	27			

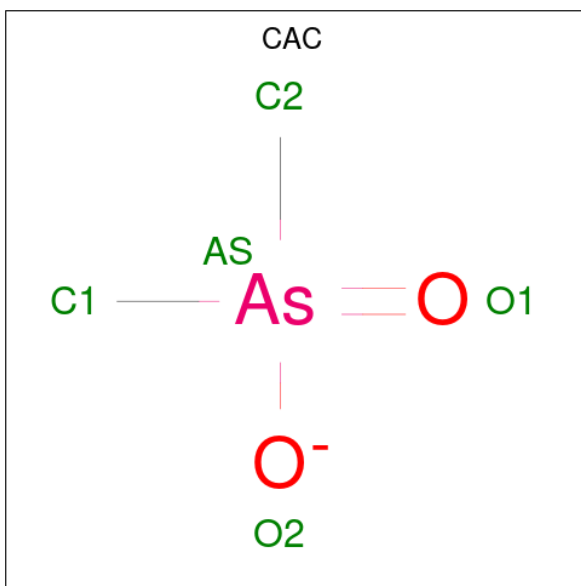
There are 20 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	480	ALA	-	expression tag	UNP Q0P7K3
A	481	ASP	-	expression tag	UNP Q0P7K3
A	482	ASP	-	expression tag	UNP Q0P7K3
A	483	ASP	-	expression tag	UNP Q0P7K3
A	484	ASP	-	expression tag	UNP Q0P7K3
A	485	LYS	-	expression tag	UNP Q0P7K3
A	486	LEU	-	expression tag	UNP Q0P7K3
A	487	ALA	-	expression tag	UNP Q0P7K3
A	488	ALA	-	expression tag	UNP Q0P7K3
A	489	ALA	-	expression tag	UNP Q0P7K3
A	490	HIS	-	expression tag	UNP Q0P7K3
A	491	HIS	-	expression tag	UNP Q0P7K3
A	492	HIS	-	expression tag	UNP Q0P7K3
A	493	HIS	-	expression tag	UNP Q0P7K3
A	494	HIS	-	expression tag	UNP Q0P7K3
A	495	HIS	-	expression tag	UNP Q0P7K3
A	496	HIS	-	expression tag	UNP Q0P7K3
A	497	HIS	-	expression tag	UNP Q0P7K3
A	498	HIS	-	expression tag	UNP Q0P7K3
A	499	HIS	-	expression tag	UNP Q0P7K3

- Molecule 2 is RUBIDIUM ION (CCD ID: RB) (formula: Rb).

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
2	A	1	Total	Rb	0	0
			1	1		

- Molecule 3 is CACODYLATE ION (CCD ID: CAC) (formula: $C_2H_6AsO_2$).



Mol	Chain	Residues	Atoms				ZeroOcc	AltConf
			Total	As	C	O		
3	A	1	5	1	2	2	0	0

- Molecule 4 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
4	A	1	Total	O	0	0
			1	1		

4 Data and refinement statistics

Property	Value	Source
Space group	P 31 2 1	Depositor
Cell constants a, b, c, α , β , γ	80.22Å 80.22Å 175.25Å 90.00° 90.00° 120.00°	Depositor
Resolution (Å)	39.10 – 3.30 39.10 – 3.30	Depositor EDS
% Data completeness (in resolution range)	96.7 (39.10-3.30) 90.5 (39.10-3.30)	Depositor EDS
R_{merge}	0.13	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	1.81 (at 3.32Å)	Xtriage
Refinement program	PHENIX 1.8.4_1496	Depositor
R, R_{free}	0.198 , 0.287 0.206 , 0.291	Depositor DCC
R_{free} test set	1011 reflections (10.09%)	wwPDB-VP
Wilson B-factor (Å ²)	56.9	Xtriage
Anisotropy	0.220	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.29 , 50.3	EDS
L-test for twinning ²	$\langle L \rangle = 0.48$, $\langle L^2 \rangle = 0.31$	Xtriage
Estimated twinning fraction	0.044 for -h,-k,l	Xtriage
F_o, F_c correlation	0.90	EDS
Total number of atoms	3352	wwPDB-VP
Average B, all atoms (Å ²)	39.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 6.64% 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, 0.333 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: RB, CAC

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	0.75	4/3421 (0.1%)	1.15	17/4651 (0.4%)

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	1

All (4) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	A	254	ARG	CD-NE	-9.54	1.32	1.46
1	A	144	THR	C-O	-6.89	1.15	1.24
1	A	143	ALA	CA-CB	-6.12	1.44	1.53
1	A	254	ARG	CZ-NH1	5.64	1.40	1.32

All (17) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	141	LEU	CA-C-N	17.69	136.80	121.58
1	A	141	LEU	C-N-CA	17.69	136.80	121.58
1	A	254	ARG	CD-NE-CZ	-11.45	108.37	124.40
1	A	141	LEU	O-C-N	-10.66	108.41	122.59
1	A	162	VAL	N-CA-C	9.70	119.74	110.42
1	A	143	ALA	O-C-N	-8.24	113.61	123.16
1	A	428	LEU	N-CA-C	-6.82	101.08	110.35
1	A	143	ALA	CA-C-N	6.38	133.93	122.06
1	A	143	ALA	C-N-CA	6.38	133.93	122.06

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Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	413	HIS	N-CA-C	6.36	121.21	113.38
1	A	149	GLY	N-CA-C	-5.70	105.74	112.64
1	A	124	ILE	N-CA-C	5.62	115.75	110.30
1	A	148	ILE	CB-CA-C	-5.58	102.15	111.29
1	A	415	PHE	N-CA-C	5.49	118.02	111.71
1	A	148	ILE	N-CA-C	5.13	120.01	109.34
1	A	104	ARG	CA-C-N	-5.07	115.26	122.41
1	A	104	ARG	C-N-CA	-5.07	115.26	122.41

There are no chirality outliers.

All (1) planarity outliers are listed below:

Mol	Chain	Res	Type	Group
1	A	141	LEU	Mainchain

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	3345	0	3542	69	0
2	A	1	0	0	0	0
3	A	5	0	0	4	0
4	A	1	0	0	1	0
All	All	3352	0	3542	69	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 10.

All (69) 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:144:THR:HG21	1:A:148:ILE:HD12	1.34	1.08
1:A:144:THR:CG2	1:A:148:ILE:HD12	2.01	0.90
1:A:462:ARG:NH1	3:A:502:CAC:O1	2.18	0.77
1:A:95:LEU:HD11	1:A:255:GLU:HG3	1.76	0.68

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:197:MET:O	1:A:200:PRO:HD2	1.97	0.64
1:A:132:VAL:HG23	1:A:133:TYR:HD1	1.62	0.64
1:A:404:TYR:OH	1:A:459:ARG:NH2	2.35	0.59
1:A:92:MET:HE3	1:A:174:LEU:HD13	1.85	0.58
1:A:98:ARG:HD3	1:A:398:ALA:O	2.05	0.57
1:A:73:LEU:HD11	1:A:142:GLY:HA3	1.88	0.56
1:A:74:VAL:O	1:A:74:VAL:HG12	2.04	0.56
1:A:459:ARG:NH2	3:A:502:CAC:O2	2.39	0.55
1:A:56:TRP:CZ2	1:A:200:PRO:HG3	2.41	0.55
1:A:20:VAL:HG21	1:A:179:GLY:HA3	1.91	0.53
1:A:385:PHE:HA	1:A:388:ILE:HD12	1.91	0.52
1:A:128:VAL:HG12	1:A:129:LEU:HD12	1.92	0.52
1:A:20:VAL:HG22	1:A:180:LYS:HZ3	1.75	0.52
1:A:94:SER:O	1:A:98:ARG:HG3	2.11	0.51
1:A:346:VAL:HG12	1:A:350:MET:HE3	1.91	0.51
1:A:148:ILE:HG23	1:A:149:GLY:N	2.26	0.50
1:A:251:LYS:HG3	1:A:252:ILE:N	2.27	0.50
1:A:144:THR:HG21	1:A:148:ILE:CD1	2.24	0.50
1:A:389:SER:OG	1:A:412:ARG:HD3	2.13	0.48
1:A:68:ILE:HG23	1:A:150:TYR:HD1	1.78	0.48
1:A:137:LEU:O	1:A:141:LEU:HG	2.12	0.48
1:A:23:MET:SD	1:A:316:VAL:HA	2.55	0.47
1:A:198:LEU:HD23	1:A:201:ILE:HD12	1.97	0.47
1:A:383:LEU:HA	1:A:383:LEU:HD23	1.65	0.46
1:A:182:MET:HE3	1:A:186:LYS:HE3	1.98	0.46
1:A:282:VAL:HG23	1:A:289:MET:HB2	1.98	0.46
1:A:68:ILE:HG12	1:A:150:TYR:CE1	2.51	0.45
1:A:68:ILE:HG23	1:A:150:TYR:CD1	2.51	0.45
1:A:144:THR:HB	1:A:148:ILE:HB	1.98	0.45
1:A:199:ASP:O	1:A:203:ILE:HG13	2.16	0.45
1:A:330:LEU:HD23	1:A:330:LEU:HA	1.77	0.45
1:A:135:GLN:HG3	1:A:139:ARG:NH1	2.32	0.45
1:A:253:TYR:O	1:A:257:LEU:HB2	2.16	0.45
1:A:222:LEU:HD23	1:A:222:LEU:HA	1.76	0.45
1:A:120:LEU:O	1:A:124:ILE:HG13	2.18	0.44
1:A:74:VAL:O	1:A:74:VAL:CG1	2.65	0.44
1:A:95:LEU:HD11	1:A:255:GLU:CG	2.47	0.44
1:A:265:LEU:O	1:A:269:ILE:HG13	2.18	0.44
1:A:459:ARG:CZ	3:A:502:CAC:O2	2.65	0.44
1:A:257:LEU:HD23	1:A:257:LEU:HA	1.85	0.43
1:A:161:THR:O	1:A:165:ILE:HG12	2.16	0.43

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:210:VAL:O	1:A:213:VAL:HG22	2.19	0.43
1:A:307:LEU:O	1:A:311:THR:HG23	2.18	0.43
1:A:144:THR:HG22	1:A:148:ILE:HB	2.01	0.43
1:A:302:ILE:HD11	1:A:351:HIS:HB2	2.00	0.43
1:A:95:LEU:HB3	1:A:111:ILE:HD13	2.00	0.42
1:A:350:MET:HA	1:A:353:VAL:HG22	2.01	0.42
1:A:44:LEU:HD23	1:A:44:LEU:HA	1.76	0.42
1:A:180:LYS:HA	1:A:180:LYS:HD3	1.83	0.42
1:A:38:PRO:HB2	1:A:181:ILE:HG22	2.02	0.42
1:A:307:LEU:HD23	1:A:307:LEU:HA	1.73	0.42
1:A:380:ALA:O	1:A:383:LEU:HB2	2.20	0.41
1:A:94:SER:OG	1:A:98:ARG:NH1	2.52	0.41
1:A:90:ILE:HD12	1:A:314:LEU:HD22	2.02	0.41
1:A:381:LEU:O	1:A:384:PRO:HD2	2.19	0.41
1:A:84:ILE:HD12	1:A:126:ILE:HD11	2.02	0.41
1:A:462:ARG:CZ	3:A:502:CAC:O1	2.69	0.41
1:A:144:THR:CG2	1:A:148:ILE:HB	2.51	0.41
1:A:387:ALA:O	1:A:391:LEU:HB2	2.21	0.41
1:A:453:LEU:HD23	1:A:453:LEU:HA	1.89	0.41
1:A:68:ILE:O	1:A:71:VAL:HG23	2.21	0.41
1:A:325:ASN:O	1:A:329:THR:HG23	2.21	0.41
1:A:193:LEU:HD23	1:A:193:LEU:HA	1.94	0.40
1:A:195:ASN:ND2	4:A:601:HOH:O	2.40	0.40
1:A:304:THR:O	1:A:307:LEU:HB2	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	425/499 (85%)	407 (96%)	15 (4%)	3 (1%)	18 49

All (3) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	148	ILE
1	A	427	VAL
1	A	20	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	348/408 (85%)	331 (95%)	17 (5%)	22	51

All (17) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	19	THR
1	A	44	LEU
1	A	68	ILE
1	A	84	ILE
1	A	90	ILE
1	A	106	ASP
1	A	111	ILE
1	A	116	ILE
1	A	128	VAL
1	A	168	ILE
1	A	225	VAL
1	A	274	ILE
1	A	282	VAL
1	A	303	ILE
1	A	309	ILE
1	A	327	THR
1	A	443	THR

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](#)

Of 2 ligands modelled in this entry, 1 is monoatomic - leaving 1 for Mogul analysis.

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	CAC	A	502	-	2,4,4	1.36	0	4,6,6	2.48	4 (100%)

There are no bond length outliers.

All (4) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
3	A	502	CAC	O1-AS-C1	-2.79	108.02	111.50
3	A	502	CAC	O2-AS-C2	2.51	111.91	105.84
3	A	502	CAC	O1-AS-C2	-2.39	108.52	111.50
3	A	502	CAC	O2-AS-C1	2.17	111.09	105.84

There are no chirality outliers.

There are no torsion outliers.

There are no ring outliers.

1 monomer is involved in 4 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
3	A	502	CAC	4	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	431/499 (86%)	-0.14	12 (2%) 55 36	18, 36, 68, 114	0

All (12) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	143	ALA	5.0
1	A	25	ASP	4.9
1	A	146	SER	4.6
1	A	144	THR	3.6
1	A	67	ILE	3.1
1	A	147	ILE	3.0
1	A	230	TYR	2.8
1	A	250	TRP	2.7
1	A	145	LYS	2.5
1	A	148	ILE	2.4
1	A	58	SER	2.4
1	A	106	ASP	2.2

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($\text{\AA}^2$)	Q<0.9
2	RB	A	501	1/1	0.91	0.12	104,104,104,104	0
3	CAC	A	502	5/5	0.94	0.13	57,61,84,94	0

6.5 Other polymers [i](#)

There are no such residues in this entry.