W O R L D W I D E
wwPDB
P R O T E I N   D A T A   B A N K

wwPDB X-ray Structure Validation Summary Report (i)

Feb 27, 2014 – 03:32 PM GMT

PDB ID : 2YIM
Title : The enolisation chemistry of a thioester-dependent racemase: the 1.4 A crystal structure of a complex with a planar reaction intermediate analogue
Authors : Sharma, S.; Bhaumik, P.; Venkatesan, R.; Hiltunen, J.K.; Conzelmann, E.; Juffer, A.H.; Wierenga, R.K.
Deposited on : 2011-05-16
Resolution : 1.41 Å(reported)

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 1.41 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	Percentile Ranks	Value
Rfree		0.204
Clashscore		6
Ramachandran outliers		0.1%
Sidechain outliers		1.6%
RSRZ outliers		7.1%

Worse *Better*

∎ Percentile relative to all X-ray structures

▯ Percentile relative to X-ray structures of similar resolution
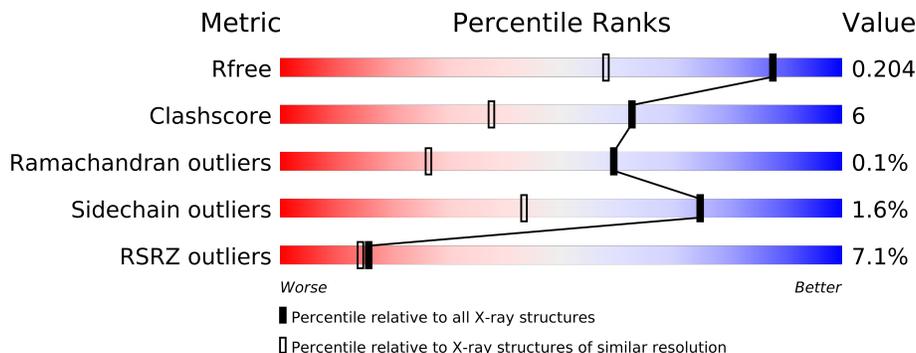
Metric	Whole archive (#Entries)	Similar resolution (#Entries, resolution range(Å))
R_{free}	66092	1110 (1.44-1.40)
Clashscore	79885	1263 (1.44-1.40)
Ramachandran outliers	78287	1226 (1.44-1.40)
Sidechain outliers	78261	1225 (1.44-1.40)
RSRZ outliers	66119	1110 (1.44-1.40)

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. 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	360	
1	B	360	
1	C	360	
1	D	360	

The following table lists non-polymeric compounds that are outliers for geometric or electron-density-fit criteria:

Mol	Type	Chain	Res	Geometry	Electron density
2	GOL	A	1361	-	X
2	GOL	B	1362	-	X
2	GOL	C	1362	-	X
4	PO4	B	1361	-	X
4	PO4	D	1361	-	X

WORLDWIDE wwPDB PROTEIN DATA BANK

2 Entry composition ⓘ

There are 5 unique types of molecules in this entry. The entry contains 13495 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 PROBABLE ALPHA-METHYLACYL-COA RACEMASE MCR (2-METHYLACYL-COA RACEMASE) (2-ARYLPROPIONYL-COA EPIMERASE).

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	355	Total	C	N	O	S	0	26	0
			2833	1797	502	513	21			
1	B	355	Total	C	N	O	S	0	29	0
			2857	1803	508	524	22			
1	C	355	Total	C	N	O	S	0	31	0
			2854	1805	503	524	22			
1	D	355	Total	C	N	O	S	0	31	0
			2866	1811	507	527	21			

- Molecule 2 is GLYCEROL (three-letter code: GOL) (formula: $C_3H_8O_3$).
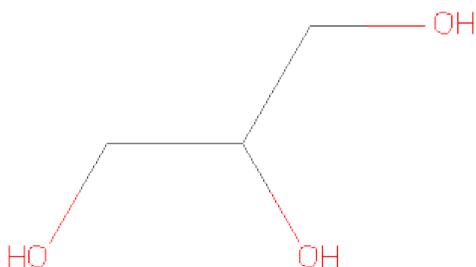
Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
2	A	1	Total	C	O	0	0
			6	3	3		

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Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
2	B	1	Total 6	C 3	O 3	0	0
2	C	1	Total 6	C 3	O 3	0	0
2	C	1	Total 6	C 3	O 3	0	0
2	D	1	Total 6	C 3	O 3	0	0

- Molecule 3 is 2-METHYLACETOACETYL COA (three-letter code: MC4) (formula: $C_{26}H_{41}N_7O_{18}P_3S$).
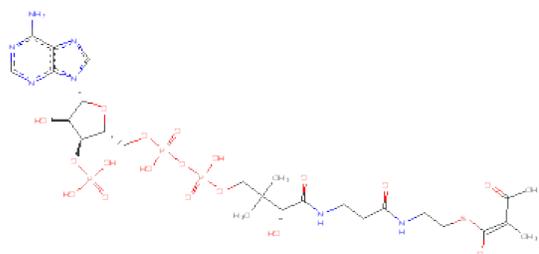
Mol	Chain	Residues	Atoms						ZeroOcc	AltConf
3	A	1	Total 55	C 26	N 7	O 18	P 3	S 1	0	0
3	B	1	Total 55	C 26	N 7	O 18	P 3	S 1	0	0
3	C	1	Total 55	C 26	N 7	O 18	P 3	S 1	0	0
3	D	1	Total 55	C 26	N 7	O 18	P 3	S 1	0	0

- Molecule 4 is PHOSPHATE ION (three-letter code: PO4) (formula: O_4P).
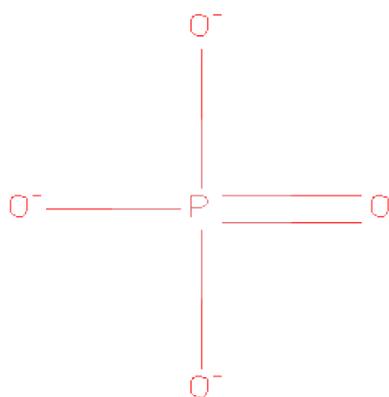
Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
4	B	1	Total 5	O 4	P 1	0	0
4	D	1	Total 5	O 4	P 1	0	0

• Molecule 5 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
5	A	515	Total 516	O 516	0	1
5	B	398	Total 398	O 398	0	0
5	C	483	Total 485	O 485	0	2
5	D	422	Total 426	O 426	0	4

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: PROBABLE ALPHA-METHYLACYL-COA RACEMASE MCR (2-METHYLACYL-COA RACEMASE) (2-ARYLPROPIONYL-COA EPIMERASE)

Chain A:

• Molecule 1: PROBABLE ALPHA-METHYLACYL-COA RACEMASE MCR (2-METHYLACYL-COA RACEMASE) (2-ARYLPROPIONYL-COA EPIMERASE)

Chain B:

• Molecule 1: PROBABLE ALPHA-METHYLACYL-COA RACEMASE MCR (2-METHYLACYL-COA RACEMASE) (2-ARYLPROPIONYL-COA EPIMERASE)

Chain C:

• Molecule 1: PROBABLE ALPHA-METHYLACYL-COA RACEMASE MCR (2-METHYLACYL-COA RACEMASE) (2-ARYLPROPIONYL-COA EPIMERASE)

Chain D:
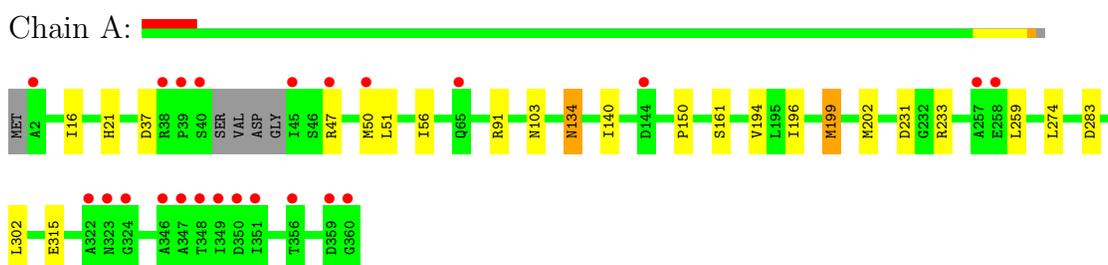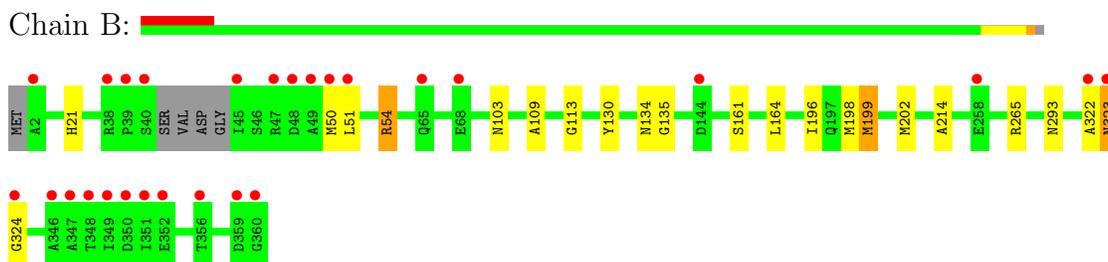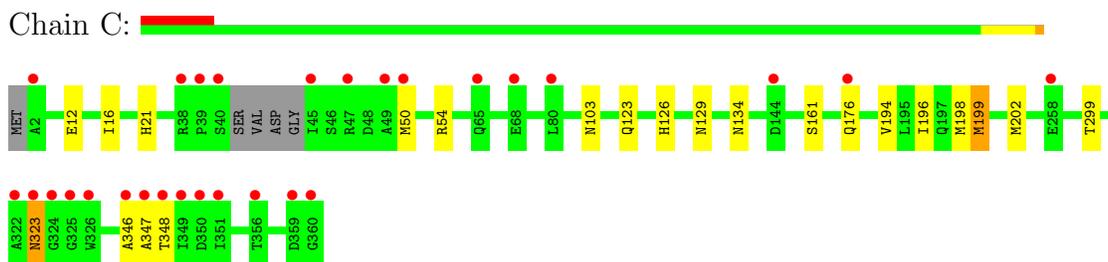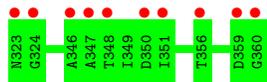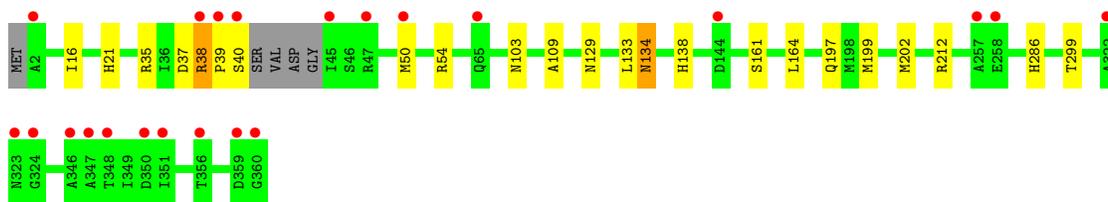
4 Data and refinement statistics ⓘ

Property	Value	Source
Space group	C 1 2 1	Depositor
Cell constants a, b, c, α, β, γ	181.59Å 80.17Å 118.88Å 90.00° 91.41° 90.00°	Depositor
Resolution (Å)	118.84 – 1.41 21.23 – 1.41	Depositor EDS
% Data completeness (in resolution range)	98.6 (118.84-1.41) 98.6 (21.23-1.41)	Depositor EDS
R_{merge}	0.06	Depositor
R_{sym}	(Not available)	Depositor
$< I/\sigma(I) >$ [1]	2.27 (at 1.41Å)	Xtriage
Refinement program	REFMAC 5.5.0109	Depositor
R, R_{free}	0.186 , 0.205 0.186 , 0.204	Depositor DCC
R_{free} test set	16290 reflections (5.32%)	DCC
Wilson B-factor (Å^2)	11.4	Xtriage
Anisotropy	0.104	Xtriage
Bulk solvent k_{sol}(e/Å^3), B_{sol}(Å^2)	0.40 , 38.6	EDS
Estimated twinning fraction	0.137 for -h,-k,l	Xtriage
L-test for twinning	$< |L| > = 0.48, < L^2 > = 0.31$	Xtriage
Outliers	0 of 322759 reflections	Xtriage
F_o,F_c correlation	0.96	EDS
Total number of atoms	13495	wwPDB-VP
Average B, all atoms (Å^2)	15.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The analyses of the Patterson function reveals a significant off-origin peak that is 62.38 % of the origin peak, indicating pseudo translational symmetry. The chance of finding a peak of this or larger height randomly in a structure without pseudo translational symmetry is equal to 1.1371e-05. The detected translational NCS is most likely also responsible for the elevated intensity ratio.*

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[1]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: GOL, PO4, MC4

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	0.33	0/2975	0.50	0/4040
1	B	0.34	0/2986	0.50	0/4051
1	C	0.34	0/2982	0.50	0/4053
1	D	0.33	0/2999	0.50	0/4071
All	All	0.33	0/11942	0.50	0/16215

There are no bond length outliers.

There are no bond angle outliers.

There are no chirality outliers.

There are no planarity outliers.

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	2833	0	2857	29	0
1	B	2857	0	2859	38	0
1	C	2854	0	2850	44	0
1	D	2866	0	2866	31	0
2	A	6	0	8	2	0
2	B	6	0	8	0	0
2	C	12	0	16	0	0
2	D	6	0	8	0	0

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Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
3	A	55	0	37	3	0
3	B	55	0	37	2	0
3	C	55	0	37	5	0
3	D	55	0	37	3	0
4	B	5	0	0	0	0
4	D	5	0	0	0	0
5	A	516	0	0	4	0
5	B	398	0	0	1	0
5	C	485	0	0	1	1
5	D	426	0	0	5	1
All	All	13495	0	11620	131	1

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 6.

The worst 5 of 131 close contacts within the same asymmetric unit are listed below.

Atom-1	Atom-2	Distance(Å)	Clash(Å)
1:C:347[B]:ALA:CB	1:C:348[B]:THR:OG1	1.83	1.26
1:C:347[A]:ALA:CB	1:C:348[A]:THR:HA	1.66	1.18
1:C:347[A]:ALA:HB1	1:C:348[A]:THR:CA	1.75	1.15
1:C:199[A]:MET:HE2	1:C:202[A]:MET:HE1	1.29	1.12
1:C:347[B]:ALA:HB1	1:C:348[B]:THR:OG1	0.96	1.11

All (1) symmetry-related close contacts are listed below. The label for Atom-2 includes the symmetry operator and encoded unit-cell translations to be applied.

Atom-1	Atom-2	Distance(Å)	Clash(Å)
5:C:2151:HOH:O	5:D:2151:HOH:O[4_656]	1.21	0.99

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	377/360 (105%)	366 (97%)	11 (3%)	0	100	100

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Mol	Chain	Analysed	Favoured	Allowed	Outliers	Percentiles	
1	B	380/360 (106%)	369 (97%)	11 (3%)	0	100	100
1	C	382/360 (106%)	367 (96%)	13 (3%)	2 (0%)	38	11
1	D	382/360 (106%)	367 (96%)	15 (4%)	0	100	100
All	All	1521/1440 (106%)	1469 (97%)	50 (3%)	2 (0%)	59	26

All (2) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	C	323[A]	ASN
1	C	323[B]	ASN

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	296/275 (108%)	291 (98%)	5 (2%)	73	40
1	B	297/275 (108%)	289 (97%)	8 (3%)	57	19
1	C	296/275 (108%)	291 (98%)	5 (2%)	73	40
1	D	298/275 (108%)	293 (98%)	5 (2%)	73	40
All	All	1187/1100 (108%)	1164 (98%)	23 (2%)	75	33

5 of 23 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	B	199[B]	MET
1	B	323[B]	ASN
1	D	199[A]	MET
1	B	323[A]	ASN
1	C	103	ASN

Some sidechains can be flipped to improve hydrogen bonding and reduce clashes. 5 of 20 such sidechains are listed below:

Mol	Chain	Res	Type
1	C	21	HIS

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Mol	Chain	Res	Type
1	C	103	ASN
1	D	103	ASN
1	B	134	ASN
1	B	263	ASN

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 ⓘ

11 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	GOL	A	1361	-	5,5,5	0.34	0	5,5,5	0.27	0
3	MC4	A	1363	-	57,57,57	2.03	10 (17%)	83,85,85	1.35	8 (9%)
4	PO4	B	1361	-	4,4,4	0.30	0	6,6,6	0.31	0
2	GOL	B	1362	-	5,5,5	0.31	0	5,5,5	0.40	0
3	MC4	B	1363	-	57,57,57	2.02	10 (17%)	83,85,85	1.34	8 (9%)
2	GOL	C	1361	-	5,5,5	0.31	0	5,5,5	0.29	0
2	GOL	C	1362	-	5,5,5	0.30	0	5,5,5	0.34	0
3	MC4	C	1363	-	57,57,57	2.03	10 (17%)	83,85,85	1.33	8 (9%)
4	PO4	D	1361	-	4,4,4	0.32	0	6,6,6	0.31	0

Mol	Type	Chain	Res	Link	Bond lengths			Bond angles		
					Counts	RMSZ	#$\lvert Z \rvert > 2$	Counts	RMSZ	#$\lvert Z \rvert > 2$
2	GOL	D	1362	-	5,5,5	0.31	0	5,5,5	0.31	0
3	MC4	D	1363	-	57,57,57	2.03	10 (17%)	83,85,85	1.34	8 (9%)

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	GOL	A	1361	-	-	0/4/4/4	0/0/0/0
3	MC4	A	1363	-	-	0/54/75/75	0/1/3/3
4	PO4	B	1361	-	-	0/0/0/0	0/0/0/0
2	GOL	B	1362	-	-	0/4/4/4	0/0/0/0
3	MC4	B	1363	-	-	0/54/75/75	0/1/3/3
2	GOL	C	1361	-	-	0/4/4/4	0/0/0/0
2	GOL	C	1362	-	-	0/4/4/4	0/0/0/0
3	MC4	C	1363	-	-	0/54/75/75	0/1/3/3
4	PO4	D	1361	-	-	0/0/0/0	0/0/0/0
2	GOL	D	1362	-	-	0/4/4/4	0/0/0/0
3	MC4	D	1363	-	-	0/54/75/75	0/1/3/3

The worst 5 of 40 bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
3	A	1363	MC4	O3-C3	6.23	1.37	1.23
3	D	1363	MC4	O3-C3	6.21	1.36	1.23
3	B	1363	MC4	O3-C3	6.16	1.36	1.23
3	C	1363	MC4	O3-C3	6.13	1.36	1.23
3	C	1363	MC4	P3B-O9A	5.65	1.70	1.51

The worst 5 of 32 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
3	B	1363	MC4	N3A-C4A-N9A	6.24	136.70	125.43
3	A	1363	MC4	N3A-C4A-N9A	6.20	136.62	125.43
3	C	1363	MC4	N3A-C4A-N9A	6.09	136.43	125.43
3	D	1363	MC4	N3A-C4A-N9A	6.08	136.40	125.43
3	A	1363	MC4	N3A-C2A-N1A	-5.67	123.96	128.71

There are no chirality outliers.

There are no torsion outliers.

There are no ring outliers.

5.7 Other polymers (i)

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, 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	355/360 (98%)	0.18	23 (6%)	18	18	5, 11, 26, 34	0
1	B	355/360 (98%)	0.23	27 (7%)	14	12	5, 11, 26, 36	0
1	C	355/360 (98%)	0.27	28 (7%)	13	11	5, 11, 26, 36	0
1	D	355/360 (98%)	0.16	22 (6%)	20	19	5, 11, 24, 33	0
All	All	1420/1440 (98%)	0.21	100 (7%)	16	15	5, 11, 26, 36	0

The worst 5 of 100 RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	C	347[A]	ALA	9.7
1	C	45	ILE	9.3
1	B	45	ILE	9.0
1	A	45	ILE	8.6
1	C	40	SER	8.3

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, 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	RSR	LLDF	B-factors(Å^2)	Q<0.9
4	PO4	B	1361	5/5	0.33	17.37	85,85,85,85	0
2	GOL	A	1361	6/6	0.32	8.99	39,40,40,41	0
2	GOL	B	1362	6/6	0.17	4.56	17,19,20,20	0
2	GOL	C	1362	6/6	0.15	3.41	15,17,18,18	0
4	PO4	D	1361	5/5	0.13	2.13	35,36,36,36	0
2	GOL	D	1362	6/6	0.13	1.00	26,26,27,28	0
2	GOL	C	1361	6/6	0.12	0.85	26,27,27,28	0
3	MC4	C	1363	55/55	0.09	0.02	9,14,21,21	0
3	MC4	B	1363	55/55	0.09	-0.07	9,15,22,22	0
3	MC4	A	1363	55/55	0.08	-0.13	9,14,20,20	0
3	MC4	D	1363	55/55	0.08	-0.25	8,14,18,20	0

6.5 Other polymers ⓘ

There are no such residues in this entry.