



Full wwPDB X-ray Structure Validation Report ⓘ

Feb 19, 2016 – 06:24 PM GMT

PDB ID : 2Z98
Title : The crystal structure of AzoR (azoreductase) from Escherichia coli: Oxidized AzoR in tetragonal crystals (The resolution has improved from 1.8 (1v4b) to 1.4 angstrom)
Authors : Ito, K.
Deposited on : 2007-09-18
Resolution : 1.40 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 : 1.7.1 (RC1), CSD as537be (2016)
Xtriage (Phenix) : 1.9-1692
EDS : rb-20026982
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) : rb-20026982

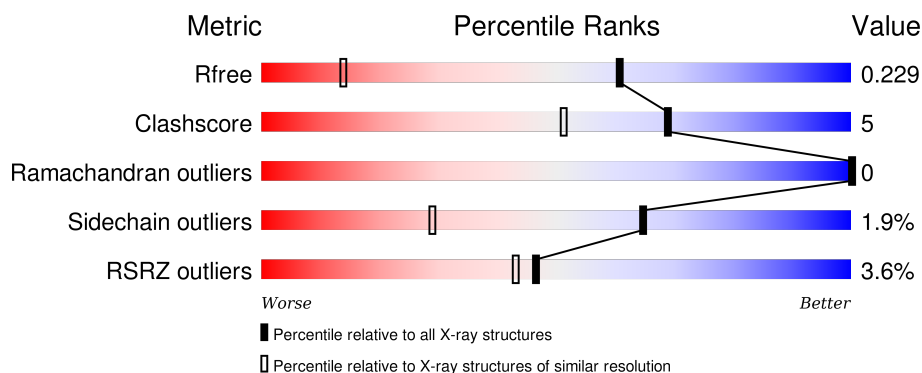
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION


The reported resolution of this entry is 1.40 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	1199 (1.40-1.40)
Clashscore	102246	1295 (1.40-1.40)
Ramachandran outliers	100387	1259 (1.40-1.40)
Sidechain outliers	100360	1258 (1.40-1.40)
RSRZ outliers	91569	1198 (1.40-1.40)

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. 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	200	

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	EDO	A	202	-	-	-	X

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Mol	Type	Chain	Res	Chirality	Geometry	Clashes	Electron density
3	EDO	A	203	-	-	-	X

2 Entry composition [i](#)

There are 4 unique types of molecules in this entry. The entry contains 1632 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 FMN-dependent NADH-azoreductase.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	194	Total	C	N	O	S	2	0	0
			1476	945	243	286	2			

- Molecule 2 is FLAVIN MONONUCLEOTIDE (three-letter code: FMN) (formula: $C_{17}H_{21}N_4O_9P$).



Mol	Chain	Residues	Atoms					ZeroOcc	AltConf
2	A	1	Total	C	N	O	P	0	0
			31	17	4	9	1		

- Molecule 3 is 1,2-ETHANEDIOL (three-letter code: EDO) (formula: $C_2H_6O_2$).



Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
3	A	1	Total	C	O	0	0
			4	2	2		
3	A	1	Total	C	O	0	0
			4	2	2		

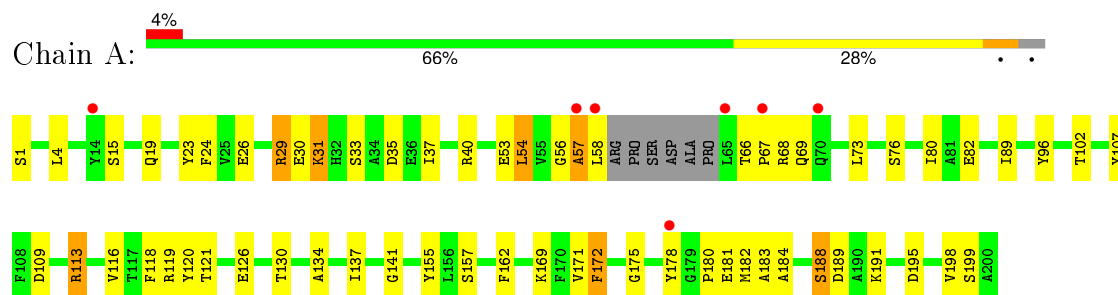
- Molecule 4 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
4	A	117	Total	O	0	0
			117	117		

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 ($\text{RSRZ} > 2$). 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: FMN-dependent NADH-azoreductase



4 Data and refinement statistics

Property	Value	Source
Space group	P 4 ₂ 2 ₁ 2	Depositor
Cell constants a, b, c, α , β , γ	92.20 Å 92.20 Å 51.74 Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	34.30 – 1.40 34.42 – 1.40	Depositor EDS
% Data completeness (in resolution range)	96.0 (34.30-1.40) 96.0 (34.42-1.40)	Depositor EDS
R_{merge}	(Not available)	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	5.52 (at 1.40 Å)	Xtriage
Refinement program	REFMAC 5.2.0019	Depositor
R, R_{free}	0.184 , 0.220 0.193 , 0.229	Depositor DCC
R_{free} test set	2155 reflections (5.33%)	DCC
Wilson B-factor (Å ²)	13.1	Xtriage
Anisotropy	0.105	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.37 , 44.3	EDS
Estimated twinning fraction	No twinning to report.	Xtriage
L-test for twinning ²	$\langle L \rangle = 0.47$, $\langle L^2 \rangle = 0.30$	Xtriage
Outliers	0 of 42551 reflections	Xtriage
F_o, F_c correlation	0.96	EDS
Total number of atoms	1632	wwPDB-VP
Average B, all atoms (Å ²)	17.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 6.90% 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: FMN, EDO

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	2.19	45/1502 (3.0%)	1.96	37/2038 (1.8%)

All (45) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	A	76	SER	CB-OG	-8.67	1.30	1.42
1	A	82	GLU	CD-OE1	8.14	1.34	1.25
1	A	162	PHE	CG-CD1	-8.05	1.26	1.38
1	A	1	SER	CA-CB	-7.87	1.41	1.52
1	A	155	TYR	CG-CD1	7.72	1.49	1.39
1	A	31	LYS	CD-CE	7.35	1.69	1.51
1	A	155	TYR	CB-CG	-7.26	1.40	1.51
1	A	116	VAL	CB-CG2	7.24	1.68	1.52
1	A	178	TYR	C-N	-6.99	1.20	1.33
1	A	15	SER	C-O	6.94	1.36	1.23
1	A	67	PRO	CA-CB	-6.82	1.40	1.53
1	A	182	MET	CG-SD	-6.80	1.63	1.81
1	A	191	LYS	CE-NZ	6.78	1.66	1.49
1	A	56	GLY	N-CA	6.64	1.56	1.46
1	A	53	GLU	CD-OE2	6.59	1.32	1.25
1	A	107	TYR	CE2-CZ	-6.58	1.29	1.38
1	A	184	ALA	C-O	6.38	1.35	1.23
1	A	26	GLU	C-O	5.94	1.34	1.23
1	A	126	GLU	CD-OE2	5.88	1.32	1.25
1	A	96	TYR	CE2-CZ	-5.78	1.31	1.38
1	A	102	THR	N-CA	-5.78	1.34	1.46
1	A	19	GLN	C-O	5.76	1.34	1.23
1	A	181	GLU	CB-CG	5.76	1.63	1.52
1	A	35	ASP	CB-CG	-5.71	1.39	1.51
1	A	191	LYS	CD-CE	5.71	1.65	1.51
1	A	107	TYR	CE1-CZ	-5.69	1.31	1.38

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Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	A	57	ALA	CA-CB	-5.62	1.40	1.52
1	A	29	ARG	CA-CB	-5.58	1.41	1.53
1	A	175	GLY	C-O	5.58	1.32	1.23
1	A	178	TYR	CA-CB	-5.54	1.41	1.53
1	A	126	GLU	CB-CG	-5.52	1.41	1.52
1	A	141	GLY	CA-C	-5.32	1.43	1.51
1	A	155	TYR	CE1-CZ	5.25	1.45	1.38
1	A	24	PHE	CB-CG	-5.23	1.42	1.51
1	A	171	VAL	CB-CG2	5.23	1.63	1.52
1	A	172	PHE	CD1-CE1	-5.22	1.28	1.39
1	A	15	SER	C-N	-5.21	1.22	1.34
1	A	57	ALA	N-CA	5.19	1.56	1.46
1	A	1	SER	N-CA	5.18	1.56	1.46
1	A	162	PHE	CD2-CE2	5.14	1.49	1.39
1	A	157	SER	CA-CB	-5.14	1.45	1.52
1	A	188	SER	C-O	5.06	1.32	1.23
1	A	96	TYR	CD2-CE2	5.06	1.47	1.39
1	A	120	TYR	CB-CG	-5.04	1.44	1.51
1	A	24	PHE	C-O	5.01	1.32	1.23

All (37) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	40	ARG	NE-CZ-NH2	-13.25	113.67	120.30
1	A	35	ASP	CB-CG-OD2	10.73	127.96	118.30
1	A	130	THR	CA-CB-CG2	-10.11	98.24	112.40
1	A	23	TYR	CB-CG-CD1	-8.85	115.69	121.00
1	A	155	TYR	CB-CG-CD1	8.45	126.07	121.00
1	A	195	ASP	CB-CG-OD1	8.20	125.68	118.30
1	A	109	ASP	CB-CG-OD2	-8.15	110.97	118.30
1	A	23	TYR	O-C-N	-7.97	109.94	122.70
1	A	40	ARG	NE-CZ-NH1	7.81	124.20	120.30
1	A	184	ALA	CA-C-N	7.76	134.28	117.20
1	A	82	GLU	OE1-CD-OE2	-7.47	114.33	123.30
1	A	184	ALA	O-C-N	-7.12	111.30	122.70
1	A	189	ASP	CB-CG-OD2	-6.80	112.18	118.30
1	A	19	GLN	CA-C-N	6.79	132.14	117.20
1	A	33	SER	O-C-N	6.79	133.57	122.70
1	A	191	LYS	CD-CE-NZ	6.71	127.14	111.70
1	A	68	ARG	NE-CZ-NH1	6.39	123.49	120.30
1	A	188	SER	O-C-N	-6.14	112.87	122.70
1	A	137	ILE	O-C-N	6.09	132.44	122.70

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Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	178	TYR	O-C-N	5.97	133.35	123.20
1	A	169	LYS	CD-CE-NZ	-5.74	98.50	111.70
1	A	180	PRO	O-C-N	-5.69	113.59	122.70
1	A	183	ALA	N-CA-CB	5.68	118.05	110.10
1	A	82	GLU	CG-CD-OE2	5.66	129.62	118.30
1	A	180	PRO	CA-C-N	5.63	129.58	117.20
1	A	68	ARG	NE-CZ-NH2	-5.60	117.50	120.30
1	A	119	ARG	NE-CZ-NH1	-5.42	117.59	120.30
1	A	30	GLU	O-C-N	-5.40	114.06	122.70
1	A	24	PHE	CB-CG-CD1	-5.33	117.07	120.80
1	A	23	TYR	CB-CG-CD2	5.30	124.18	121.00
1	A	4	LEU	O-C-N	5.22	131.05	122.70
1	A	54	LEU	CB-CG-CD2	5.20	119.84	111.00
1	A	67	PRO	N-CA-CB	5.18	109.51	103.30
1	A	30	GLU	CA-C-N	5.13	128.49	117.20
1	A	73	LEU	CB-CG-CD1	5.12	119.69	111.00
1	A	118	PHE	O-C-N	5.07	130.82	122.70
1	A	23	TYR	CA-C-N	5.06	128.33	117.20

There are no chirality outliers.

There are no planarity outliers.

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	1476	0	1489	14	0
2	A	31	0	19	0	0
3	A	8	0	11	3	0
4	A	117	0	0	1	0
All	All	1632	0	1519	14	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 5.

All (14) 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:29:ARG:NH1	4:A:293:HOH:O	1.83	1.08
1:A:172:PHE:H	3:A:203:EDO:H11	1.23	1.02
1:A:172:PHE:H	3:A:203:EDO:C1	2.05	0.66
1:A:31:LYS:HD3	1:A:198:VAL:HG12	1.78	0.65
1:A:172:PHE:N	3:A:203:EDO:H11	2.06	0.63
1:A:80:ILE:HD11	1:A:113:ARG:HG3	1.89	0.53
1:A:57:ALA:HB2	1:A:69:GLN:HB3	1.91	0.52
1:A:29:ARG:HG2	1:A:37:ILE:HD12	1.95	0.49
1:A:31:LYS:HD3	1:A:198:VAL:CG1	2.46	0.46
1:A:31:LYS:HE3	1:A:199:SER:HB3	1.98	0.45
1:A:89:ILE:O	1:A:134:ALA:HA	2.17	0.45
1:A:57:ALA:HB2	1:A:69:GLN:CB	2.46	0.45
1:A:54:LEU:O	1:A:58:LEU:HG	2.19	0.42
1:A:66:THR:OG1	1:A:69:GLN:HG3	2.19	0.41

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	190/200 (95%)	185 (97%)	5 (3%)	0	100	100

There are no Ramachandran outliers to report.

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	157/162 (97%)	154 (98%)	3 (2%)	65 29

All (3) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	113	ARG
1	A	121	THR
1	A	188	SER

Some sidechains can be flipped to improve hydrogen bonding and reduce clashes. There are no such sidechains identified.

5.3.3 RNA ⓘ

There are no RNA molecules 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 ⓘ

3 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	FMN	A	201	-	32,33,33	3.07	18 (56%)	34,50,50	4.67	17 (50%)
3	EDO	A	202	-	3,3,3	1.12	0	2,2,2	0.22	0
3	EDO	A	203	-	3,3,3	1.40	0	2,2,2	1.79	1 (50%)

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	FMN	A	201	-	-	0/18/18/18	0/3/3/3
3	EDO	A	202	-	-	0/1/1/1	0/0/0/0
3	EDO	A	203	-	-	0/1/1/1	0/0/0/0

All (18) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
2	A	201	FMN	C2-N1	-4.86	1.28	1.38
2	A	201	FMN	C8M-C8	-3.61	1.43	1.51
2	A	201	FMN	C6-C5A	-3.30	1.36	1.41
2	A	201	FMN	C10-N10	-3.13	1.35	1.39
2	A	201	FMN	C5'-C4'	-3.09	1.47	1.51
2	A	201	FMN	P-O5'	-2.94	1.51	1.59
2	A	201	FMN	C9-C9A	-2.87	1.34	1.40
2	A	201	FMN	C4A-N5	-2.83	1.29	1.33
2	A	201	FMN	C9A-N10	-2.71	1.35	1.38
2	A	201	FMN	C4-C4A	-2.10	1.37	1.41
2	A	201	FMN	P-O1P	2.49	1.58	1.50
2	A	201	FMN	O4'-C4'	2.88	1.49	1.43
2	A	201	FMN	C8-C7	3.23	1.49	1.41
2	A	201	FMN	C2-N3	3.62	1.45	1.38
2	A	201	FMN	O4-C4	3.63	1.33	1.24
2	A	201	FMN	C9A-C5A	4.59	1.52	1.42
2	A	201	FMN	C1'-N10	5.59	1.54	1.48
2	A	201	FMN	C4A-C10	9.14	1.57	1.40

All (18) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
2	A	201	FMN	C4-C4A-C10	-13.03	111.60	119.94
2	A	201	FMN	C4A-C10-N10	-12.98	111.09	120.52
2	A	201	FMN	N3-C2-N1	-6.04	117.52	127.69
2	A	201	FMN	C5A-C9A-N10	-5.59	113.39	117.58
2	A	201	FMN	C6-C5A-C9A	-5.46	113.09	119.11
2	A	201	FMN	C1'-N10-C9A	-3.65	114.59	118.83
2	A	201	FMN	O5'-P-O1P	-2.48	100.85	107.08
2	A	201	FMN	C6-C7-C8	-2.43	115.22	119.97
2	A	201	FMN	C9A-C5A-N5	-2.24	118.53	122.18

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Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
3	A	203	EDO	O2-C2-C1	-2.17	97.37	112.23
2	A	201	FMN	C8-C9-C9A	2.45	127.80	119.18
2	A	201	FMN	C7M-C7-C6	2.53	127.46	120.33
2	A	201	FMN	O2P-P-O5'	2.77	114.82	106.72
2	A	201	FMN	C7-C6-C5A	5.02	129.10	120.90
2	A	201	FMN	C4-N3-C2	5.41	119.67	115.16
2	A	201	FMN	C6-C5A-N5	6.90	127.52	118.92
2	A	201	FMN	C4-C4A-N5	7.94	128.36	118.70
2	A	201	FMN	C4A-N5-C5A	8.07	126.23	116.72

There are no chirality outliers.

There are no torsion outliers.

There are no ring outliers.

1 monomer is involved in 3 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
3	A	203	EDO	3	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	194/200 (97%)	-0.18	7 (3%) 46 43	9, 15, 31, 43	2 (1%)

All (7) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	57	ALA	4.3
1	A	58	LEU	3.8
1	A	67	PRO	3.3
1	A	14	TYR	2.4
1	A	65	LEU	2.3
1	A	70	GLN	2.1
1	A	178	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	EDO	A	203	4/4	0.90	0.18	15.24	16,22,35,38	0
3	EDO	A	202	4/4	0.95	0.12	2.59	9,11,12,18	4
2	FMN	A	201	31/31	0.98	0.06	-0.55	6,10,13,13	0

6.5 Other polymers ⓘ

There are no such residues in this entry.