



# wwPDB X-ray Structure Validation Summary Report

Oct 23, 2024 – 09:09 PM EDT

PDB ID : 2FPO  
Title : Putative methyltransferase yhhF from Escherichia coli.  
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Deposited on : 2006-01-16  
Resolution : 2.05 Å(reported)

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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>.

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The following versions of software and data (see [references](#) ) were used in the production of this report:

MolProbity : 4.02b-467  
Mogul : 2022.3.0, CSD as543be (2022)  
Xtriage (Phenix) : 1.20.1  
EDS : 3.0  
Percentile statistics : 20231227.v01 (using entries in the PDB archive December 27th 2023)  
CCP4 : 9.0.003 (Gargrove)  
Density-Fitness : 1.0.11  
Ideal geometry (proteins) : Engh & Huber (2001)  
Ideal geometry (DNA, RNA) : Parkinson et al. (1996)  
Validation Pipeline (wwPDB-VP) : 2.39

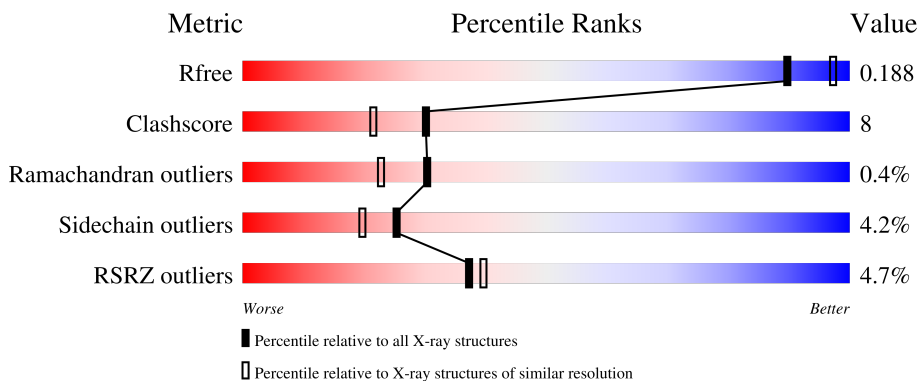
# 1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

*X-RAY DIFFRACTION*

The reported resolution of this entry is 2.05 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))
$R_{free}$	164625	2096 (2.04-2.04)
Clashscore	180529	2229 (2.04-2.04)
Ramachandran outliers	177936	2217 (2.04-2.04)
Sidechain outliers	177891	2217 (2.04-2.04)
RSRZ outliers	164620	2096 (2.04-2.04)

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  $\geq 3$ , 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	202	 2% 74% 13% 12%
1	B	202	 3% 77% 10% 12%
1	C	202	 6% 79% 8% 10%
1	D	202	 4% 79% 9% 11%
1	E	202	 5% 76% 9% 12%

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Mol	Chain	Length	Quality of chain
1	F	202	 <p>A horizontal bar chart representing the quality of the chain. The bar is divided into four segments: a small red segment at the beginning labeled '4%', a large green segment labeled '72%', a yellow segment labeled '12%', and a small grey segment at the end labeled '12%'. A small black dot is visible on the yellow segment.</p>

## 2 Entry composition [i](#)

There are 4 unique types of molecules in this entry. The entry contains 8845 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 methylase yhhF.

Mol	Chain	Residues	Atoms						ZeroOcc	AltConf	Trace
			Total	C	N	O	S	Se			
1	A	177	1414	896	254	259	2	3	0	7	0
1	B	178	1387	877	249	256	2	3	0	1	0
1	C	181	1432	905	262	260	2	3	0	4	0
1	D	179	1408	892	252	259	2	3	0	4	0
1	E	178	1393	881	250	257	2	3	0	2	0
1	F	177	1411	894	256	256	2	3	0	5	0

There are 42 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	-1	GLY	-	cloning artifact	UNP P0ADX9
A	0	HIS	-	cloning artifact	UNP P0ADX9
A	1	MSE	MET	modified residue	UNP P0ADX9
A	83	MSE	MET	modified residue	UNP P0ADX9
A	111	MSE	MET	modified residue	UNP P0ADX9
A	199	GLY	-	cloning artifact	UNP P0ADX9
A	200	SER	-	cloning artifact	UNP P0ADX9
B	-1	GLY	-	cloning artifact	UNP P0ADX9
B	0	HIS	-	cloning artifact	UNP P0ADX9
B	1	MSE	MET	modified residue	UNP P0ADX9
B	83	MSE	MET	modified residue	UNP P0ADX9
B	111	MSE	MET	modified residue	UNP P0ADX9
B	199	GLY	-	cloning artifact	UNP P0ADX9
B	200	SER	-	cloning artifact	UNP P0ADX9
C	-1	GLY	-	cloning artifact	UNP P0ADX9
C	0	HIS	-	cloning artifact	UNP P0ADX9
C	1	MSE	MET	modified residue	UNP P0ADX9

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Chain	Residue	Modelled	Actual	Comment	Reference
C	83	MSE	MET	modified residue	UNP P0ADX9
C	111	MSE	MET	modified residue	UNP P0ADX9
C	199	GLY	-	cloning artifact	UNP P0ADX9
C	200	SER	-	cloning artifact	UNP P0ADX9
D	-1	GLY	-	cloning artifact	UNP P0ADX9
D	0	HIS	-	cloning artifact	UNP P0ADX9
D	1	MSE	MET	modified residue	UNP P0ADX9
D	83	MSE	MET	modified residue	UNP P0ADX9
D	111	MSE	MET	modified residue	UNP P0ADX9
D	199	GLY	-	cloning artifact	UNP P0ADX9
D	200	SER	-	cloning artifact	UNP P0ADX9
E	-1	GLY	-	cloning artifact	UNP P0ADX9
E	0	HIS	-	cloning artifact	UNP P0ADX9
E	1	MSE	MET	modified residue	UNP P0ADX9
E	83	MSE	MET	modified residue	UNP P0ADX9
E	111	MSE	MET	modified residue	UNP P0ADX9
E	199	GLY	-	cloning artifact	UNP P0ADX9
E	200	SER	-	cloning artifact	UNP P0ADX9
F	-1	GLY	-	cloning artifact	UNP P0ADX9
F	0	HIS	-	cloning artifact	UNP P0ADX9
F	1	MSE	MET	modified residue	UNP P0ADX9
F	83	MSE	MET	modified residue	UNP P0ADX9
F	111	MSE	MET	modified residue	UNP P0ADX9
F	199	GLY	-	cloning artifact	UNP P0ADX9
F	200	SER	-	cloning artifact	UNP P0ADX9

- Molecule 2 is CHLORIDE ION (three-letter code: CL) (formula: Cl).

Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
2	A	1	Total Cl 1 1	0	0
2	B	1	Total Cl 1 1	0	0
2	C	1	Total Cl 1 1	0	0
2	D	1	Total Cl 1 1	0	0
2	E	1	Total Cl 1 1	0	0
2	F	1	Total Cl 1 1	0	0

- Molecule 3 is 1,2-ETHANEDIOL (three-letter code: EDO) (formula: C<sub>2</sub>H<sub>6</sub>O<sub>2</sub>).



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

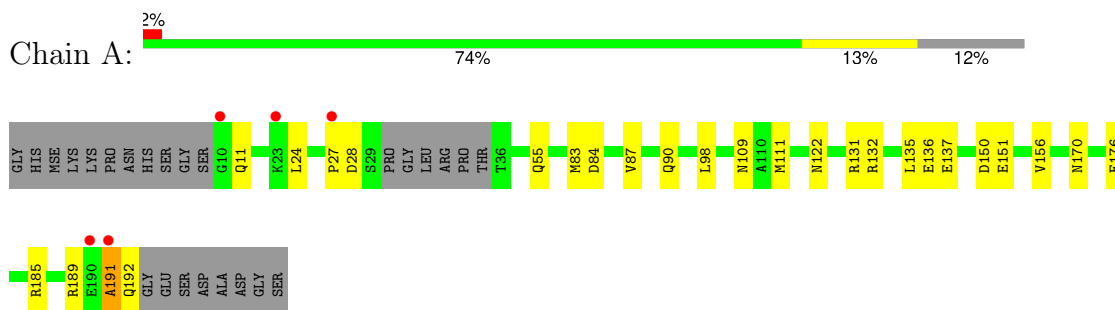
- Molecule 4 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
4	A	73	Total	O	0	0
			73	73		
4	B	67	Total	O	0	0
			67	67		
4	C	54	Total	O	0	0
			54	54		
4	D	71	Total	O	0	0
			71	71		
4	E	66	Total	O	0	0
			66	66		
4	F	59	Total	O	0	0
			59	59		

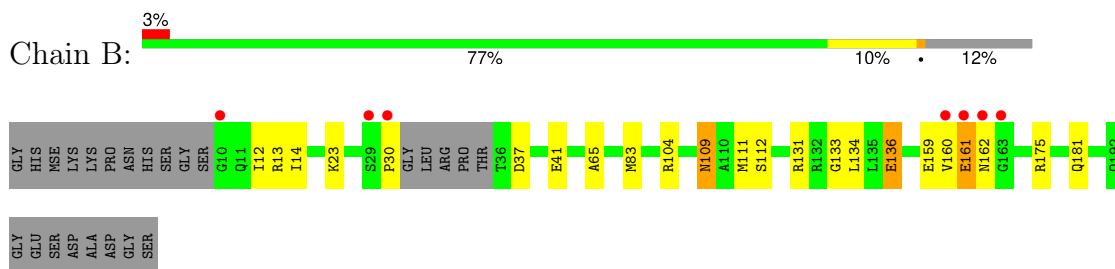
### 3 Residue-property plots [i](#)

These plots are drawn for all protein, RNA, DNA and oligosaccharide chains in the entry. The first graphic for a chain summarises the proportions of the various outlier classes 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.

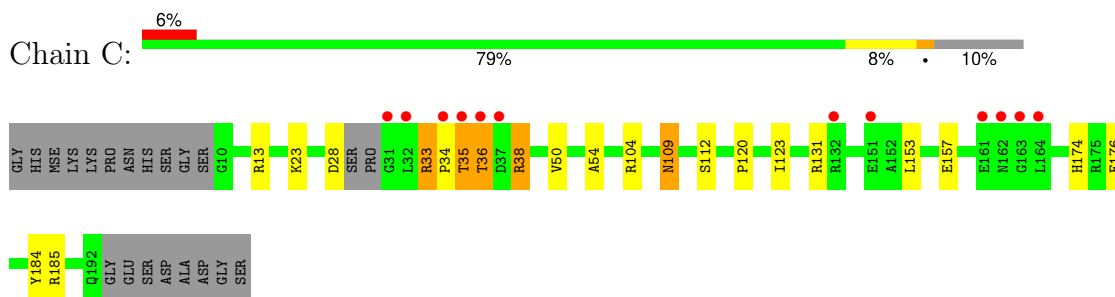
- Molecule 1: methylase yhhF



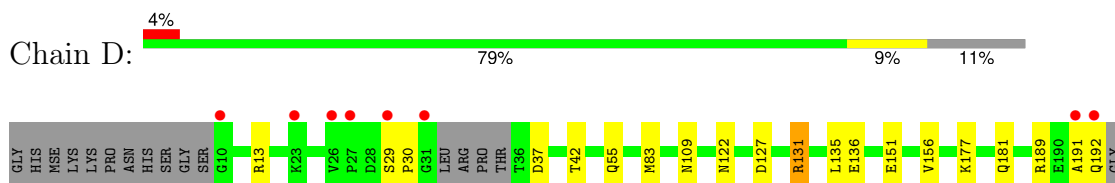
- Molecule 1: methylase yhhF



- Molecule 1: methylase yhhF

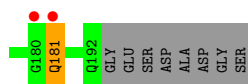
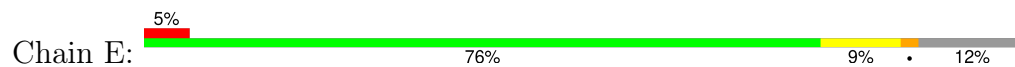


- Molecule 1: methylase yhhF

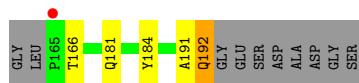
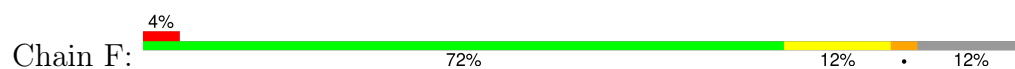


GLU  
SER  
ASP  
ALA  
ASP  
GLY  
SER

- Molecule 1: methylase yhhF



- Molecule 1: methylase yhhF





## 4 Data and refinement statistics

Property	Value	Source
Space group	C 1 2 1	Depositor
Cell constants a, b, c, $\alpha$ , $\beta$ , $\gamma$	70.50Å 96.91Å 193.96Å 90.00° 92.21° 90.00°	Depositor
Resolution (Å)	38.76 – 2.05 38.76 – 2.05	Depositor EDS
% Data completeness (in resolution range)	97.7 (38.76-2.05) 97.7 (38.76-2.05)	Depositor EDS
$R_{merge}$	0.08	Depositor
$R_{sym}$	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ <sup>1</sup>	2.11 (at 2.05Å)	Xtrriage
Refinement program	REFMAC 5.2.0005	Depositor
R, $R_{free}$	0.183 , 0.217 0.184 , 0.188	Depositor DCC
$R_{free}$ test set	3179 reflections (3.98%)	wwPDB-VP
Wilson B-factor (Å <sup>2</sup> )	32.6	Xtrriage
Anisotropy	0.179	Xtrriage
Bulk solvent $k_{sol}$ (e/Å <sup>3</sup> ), $B_{sol}$ (Å <sup>2</sup> )	0.37 , 43.6	EDS
L-test for twinning <sup>2</sup>	$\langle  L  \rangle = 0.47$ , $\langle L^2 \rangle = 0.30$	Xtrriage
Estimated twinning fraction	0.095 for -h,-k,l	Xtrriage
$F_o, F_c$ correlation	0.95	EDS
Total number of atoms	8845	wwPDB-VP
Average B, all atoms (Å <sup>2</sup> )	33.0	wwPDB-VP

Xtrriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 5.26% of the height of the origin peak. No significant pseudotranslation is detected.*

<sup>1</sup>Intensities estimated from amplitudes.

<sup>2</sup>Theoretical 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 [i](#)

### 5.1 Standard geometry [i](#)

Bond lengths and bond angles in the following residue types are not validated in this section: CL, 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	0.67	0/1458	0.67	0/1972
1	B	0.77	1/1414 (0.1%)	0.80	1/1917 (0.1%)
1	C	0.68	0/1468	0.68	0/1988
1	D	0.68	0/1444	0.68	0/1955
1	E	0.75	1/1423 (0.1%)	0.76	1/1929 (0.1%)
1	F	0.68	0/1448	0.71	0/1956
All	All	0.71	2/8655 (0.0%)	0.72	2/11717 (0.0%)

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	F	0	1

All (2) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	E	41	GLU	CG-CD	5.61	1.60	1.51
1	B	41	GLU	CG-CD	5.29	1.59	1.51

All (2) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	B	175	ARG	NE-CZ-NH2	-7.20	116.70	120.30
1	E	175	ARG	NE-CZ-NH2	-6.07	117.26	120.30

There are no chirality outliers.

All (1) planarity outliers are listed below:

Mol	Chain	Res	Type	Group
1	F	37	ASP	Peptide

## 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	1414	0	1439	25	0
1	B	1387	0	1390	34	0
1	C	1432	0	1451	25	0
1	D	1408	0	1423	13	0
1	E	1393	0	1398	24	0
1	F	1411	0	1433	41	0
2	A	1	0	0	0	0
2	B	1	0	0	1	0
2	C	1	0	0	0	0
2	D	1	0	0	1	0
2	E	1	0	0	1	0
2	F	1	0	0	0	0
3	B	4	0	6	0	0
4	A	73	0	0	0	0
4	B	67	0	0	1	0
4	C	54	0	0	0	0
4	D	71	0	0	0	0
4	E	66	0	0	0	0
4	F	59	0	0	2	0
All	All	8845	0	8540	141	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 8.

The worst 5 of 141 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:E:83[A]:MSE:SE	1:E:83[A]:MSE:CE	2.14	1.45
1:F:111:MSE:SE	1:F:111:MSE:CE	2.15	1.44
1:B:83[A]:MSE:CE	1:B:109:ASN:HB3	1.61	1.31
1:A:83[B]:MSE:HE2	1:A:109:ASN:CB	1.73	1.17

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:B:83[A]:MSE:CE	1:B:109:ASN:CB	2.31	1.09

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	180/202 (89%)	171 (95%)	8 (4%)	1 (1%)	22	13
1	B	175/202 (87%)	171 (98%)	4 (2%)	0	100	100
1	C	181/202 (90%)	173 (96%)	7 (4%)	1 (1%)	22	13
1	D	179/202 (89%)	174 (97%)	4 (2%)	1 (1%)	22	13
1	E	176/202 (87%)	171 (97%)	5 (3%)	0	100	100
1	F	175/202 (87%)	166 (95%)	8 (5%)	1 (1%)	22	13
All	All	1066/1212 (88%)	1026 (96%)	36 (3%)	4 (0%)	30	23

All (4) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	F	36	THR
1	D	191	ALA
1	A	191	ALA
1	C	36	THR

#### 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	150/159 (94%)	148 (99%)	2 (1%)	65	66
1	B	145/159 (91%)	140 (97%)	5 (3%)	32	26
1	C	150/159 (94%)	142 (95%)	8 (5%)	19	12
1	D	148/159 (93%)	145 (98%)	3 (2%)	50	47
1	E	146/159 (92%)	135 (92%)	11 (8%)	11	5
1	F	148/159 (93%)	139 (94%)	9 (6%)	15	9
All	All	887/954 (93%)	849 (96%)	38 (4%)	25	19

5 of 38 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	E	181	GLN
1	F	166	THR
1	F	32	LEU
1	F	109	ASN
1	F	192	GLN

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. 5 of 24 such sidechains are listed below:

Mol	Chain	Res	Type
1	D	145	ASN
1	E	109	ASN
1	D	181	GLN
1	E	140	ASN
1	B	140	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 oligosaccharides in this entry.

## 5.6 Ligand geometry [i](#)

Of 7 ligands modelled in this entry, 6 are 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	EDO	B	407	-	3,3,3	0.46	0	2,2,2	0.56	0

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
3	EDO	B	407	-	-	1/1/1/1	-

There are no bond length outliers.

There are no bond angle outliers.

There are no chirality outliers.

All (1) torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
3	B	407	EDO	O1-C1-C2-O2

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

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, 95<sup>th</sup> 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 <sup>2</sup> )	Q<0.9
1	A	175/202 (86%)	0.03	5 (2%) 54 55	17, 31, 45, 60	6 (3%)
1	B	176/202 (87%)	0.02	7 (3%) 43 45	24, 29, 49, 61	0
1	C	179/202 (88%)	0.32	12 (6%) 25 27	15, 31, 53, 71	3 (1%)
1	D	177/202 (87%)	0.26	8 (4%) 39 41	17, 32, 49, 75	3 (1%)
1	E	176/202 (87%)	0.08	10 (5%) 30 32	17, 29, 50, 63	1 (0%)
1	F	175/202 (86%)	0.09	8 (4%) 38 40	15, 31, 50, 75	4 (2%)
All	All	1058/1212 (87%)	0.13	50 (4%) 37 40	15, 31, 50, 75	17 (1%)

The worst 5 of 50 RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	C	34	PRO	6.4
1	C	35	THR	5.8
1	F	32	LEU	5.2
1	F	34	PRO	4.7
1	C	32	LEU	4.6

### 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 monosaccharides 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, 95<sup>th</sup> 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(Å <sup>2</sup> )	Q<0.9
3	EDO	B	407	4/4	0.84	0.19	40,40,42,46	0
2	CL	A	401	1/1	0.96	0.10	36,36,36,36	0
2	CL	D	404	1/1	0.97	0.09	36,36,36,36	0
2	CL	E	405	1/1	0.98	0.12	31,31,31,31	0
2	CL	F	406	1/1	0.98	0.09	35,35,35,35	0
2	CL	B	402	1/1	0.98	0.16	34,34,34,34	0
2	CL	C	403	1/1	0.99	0.17	35,35,35,35	0

## 6.5 Other polymers [i](#)

There are no such residues in this entry.