



# wwPDB X-ray Structure Validation Summary Report ⓘ

May 15, 2020 – 12:55 pm BST

PDB ID : 5F1Q  
Title : Crystal Structure of Periplasmic Dipeptide Transport Protein from *Yersinia pestis*  
Authors : Kim, Y.; Zhou, M.; Shatsman, S.; Anderson, W.F.; Joachimiak, A.; Center for Structural Genomics of Infectious Diseases (CSGID)  
Deposited on : 2015-11-30  
Resolution : 1.96 Å(reported)

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We welcome your comments at [validation@mail.wwpdb.org](mailto: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.

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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 : 1.8.5 (274361), CSD as541be (2020)  
Xtriage (Phenix) : 1.13  
EDS : 2.11  
Percentile statistics : 20191225.v01 (using entries in the PDB archive December 25th 2019)  
Refmac : 5.8.0158  
CCP4 : 7.0.044 (Gargrove)  
Ideal geometry (proteins) : Engh & Huber (2001)  
Ideal geometry (DNA, RNA) : Parkinson et al. (1996)  
Validation Pipeline (wwPDB-VP) : 2.11

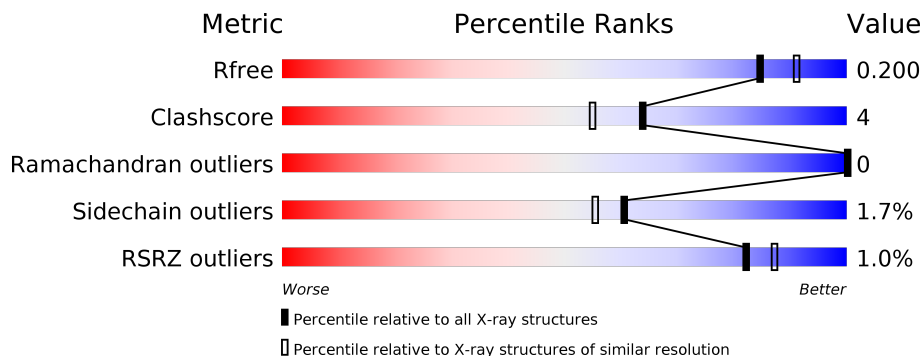
# 1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

*X-RAY DIFFRACTION*

The reported resolution of this entry is 1.96 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))
$R_{free}$	130704	2580 (1.96-1.96)
Clashscore	141614	2705 (1.96-1.96)
Ramachandran outliers	138981	2678 (1.96-1.96)
Sidechain outliers	138945	2678 (1.96-1.96)
RSRZ outliers	127900	2539 (1.96-1.96)

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  $\geq 3$ , 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	543	 86% 8% 6%
1	B	543	 82% 12% 7%

## 2 Entry composition [i](#)

There are 7 unique types of molecules in this entry. The entry contains 8856 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 Periplasmic dipeptide transport protein.

Mol	Chain	Residues	Atoms						ZeroOcc	AltConf	Trace
			Total	C	N	O	S	Se			
1	A	513	4164	2652	694	796	4	18	0	8	0
1	B	507	4105	2615	685	783	4	18	0	7	0

There are 16 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	536	ALA	-	expression tag	UNP A0A0H2YM47
A	537	GLY	-	expression tag	UNP A0A0H2YM47
A	538	GLU	-	expression tag	UNP A0A0H2YM47
A	539	ASN	-	expression tag	UNP A0A0H2YM47
A	540	LEU	-	expression tag	UNP A0A0H2YM47
A	541	TYR	-	expression tag	UNP A0A0H2YM47
A	542	PHE	-	expression tag	UNP A0A0H2YM47
A	543	GLN	-	expression tag	UNP A0A0H2YM47
B	536	ALA	-	expression tag	UNP A0A0H2YM47
B	537	GLY	-	expression tag	UNP A0A0H2YM47
B	538	GLU	-	expression tag	UNP A0A0H2YM47
B	539	ASN	-	expression tag	UNP A0A0H2YM47
B	540	LEU	-	expression tag	UNP A0A0H2YM47
B	541	TYR	-	expression tag	UNP A0A0H2YM47
B	542	PHE	-	expression tag	UNP A0A0H2YM47
B	543	GLN	-	expression tag	UNP A0A0H2YM47

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



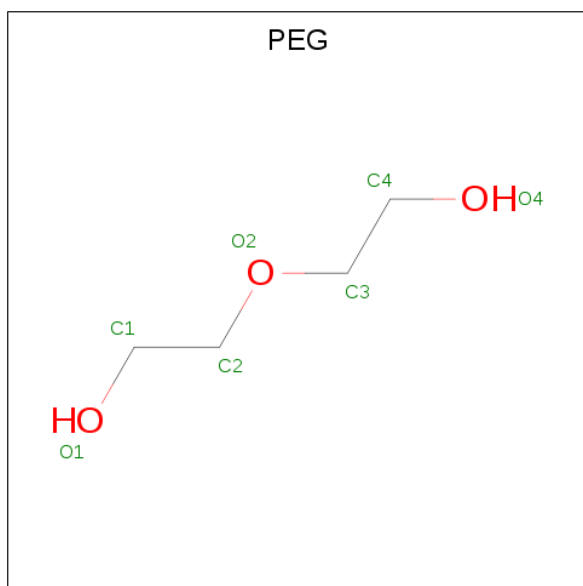
Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
2	A	1	Total C O 4 2 2	0	0
2	A	1	Total C O 4 2 2	0	0
2	A	1	Total C O 4 2 2	0	0
2	A	1	Total C O 4 2 2	0	0
2	A	1	Total C O 4 2 2	0	0
2	B	1	Total C O 4 2 2	0	0
2	B	1	Total C O 4 2 2	0	0
2	B	1	Total C O 4 2 2	0	0
2	B	1	Total C O 4 2 2	0	0
2	B	1	Total C O 4 2 2	0	0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

- Molecule 3 is GLYCEROL (three-letter code: GOL) (formula: C<sub>3</sub>H<sub>8</sub>O<sub>3</sub>).



Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
3	A	1	Total	C	O	0	0
			6	3	3		

- Molecule 4 is DI(HYDROXYETHYL)ETHER (three-letter code: PEG) (formula:  $C_4H_{10}O_3$ ).

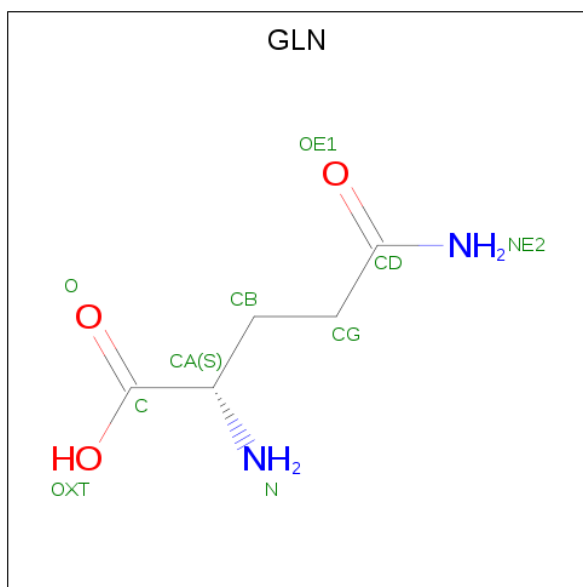


Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
4	A	1	Total	C	O	0	0
			7	4	3		

- Molecule 5 is CHLORIDE ION (three-letter code: CL) (formula: Cl).

Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
5	B	1	Total Cl 1 1	0	0
5	A	1	Total Cl 1 1	0	0

- Molecule 6 is GLUTAMINE (three-letter code: GLN) (formula: C<sub>5</sub>H<sub>10</sub>N<sub>2</sub>O<sub>3</sub>).



Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
6	A	1	Total C N O 9 5 2 2	0	0
6	A	1	Total C N O 10 5 2 3	0	0
6	B	1	Total C N O 9 5 2 2	0	0
6	B	1	Total C N O 10 5 2 3	0	0

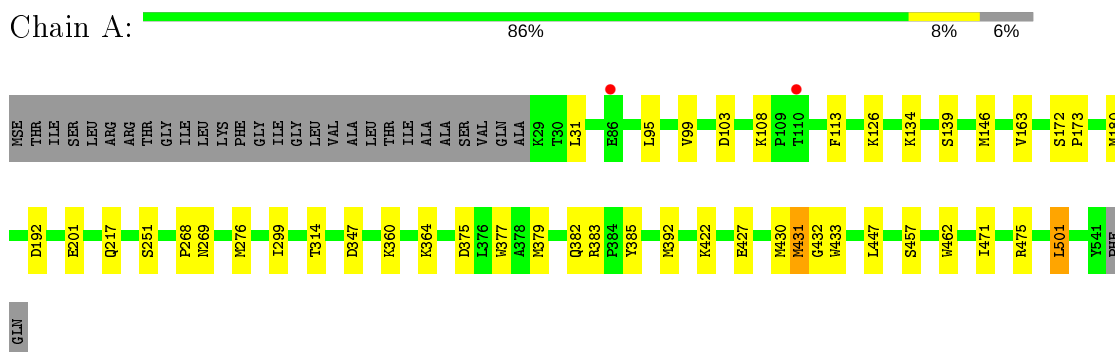
- Molecule 7 is water.

Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
7	A	265	Total O 265 265	0	0
7	B	217	Total O 217 217	0	0

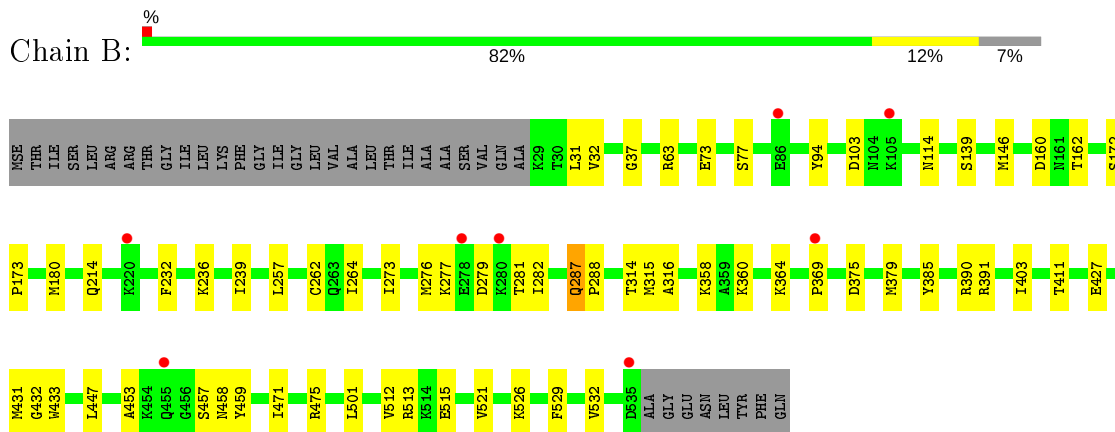
### 3 Residue-property plots [i](#)

These plots are drawn for all protein, RNA and DNA chains in the entry. The first graphic for a chain summarises the proportions of 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: Periplasmic dipeptide transport protein



- Molecule 1: Periplasmic dipeptide transport protein



## 4 Data and refinement statistics

Property	Value	Source
Space group	C 1 2 1	Depositor
Cell constants a, b, c, $\alpha$ , $\beta$ , $\gamma$	289.29Å 59.74Å 80.63Å 90.00° 103.96° 90.00°	Depositor
Resolution (Å)	28.31 – 1.96 28.31 – 1.96	Depositor EDS
% Data completeness (in resolution range)	91.1 (28.31-1.96) 91.1 (28.31-1.96)	Depositor EDS
$R_{merge}$	(Not available)	Depositor
$R_{sym}$	0.15	Depositor
$\langle I/\sigma(I) \rangle$ <sup>1</sup>	1.18 (at 1.95Å)	Xtrriage
Refinement program	PHENIX (phenix.refine: dev_1839)	Depositor
R, $R_{free}$	0.166 , 0.200 0.168 , 0.200	Depositor DCC
$R_{free}$ test set	4439 reflections (5.03%)	wwPDB-VP
Wilson B-factor (Å <sup>2</sup> )	22.0	Xtrriage
Anisotropy	0.143	Xtrriage
Bulk solvent $k_{sol}$ (e/Å <sup>3</sup> ), $B_{sol}$ (Å <sup>2</sup> )	0.37 , 54.2	EDS
L-test for twinning <sup>2</sup>	$\langle  L  \rangle = 0.48$ , $\langle L^2 \rangle = 0.31$	Xtrriage
Estimated twinning fraction	0.020 for -h-2*1,-k,l	Xtrriage
$F_o, F_c$ correlation	0.95	EDS
Total number of atoms	8856	wwPDB-VP
Average B, all atoms (Å <sup>2</sup> )	26.0	wwPDB-VP

Xtrriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 4.04% 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: GOL, PEG, EDO, CL

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	0.44	0/4252	0.55	0/5733
1	B	0.41	0/4193	0.53	0/5656
All	All	0.43	0/8445	0.54	0/11389

There are no bond length outliers.

There are no bond angle outliers.

There are no chirality outliers.

There are no planarity outliers.

### 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	4164	0	4036	27	0
1	B	4105	0	3986	41	0
2	A	20	0	30	0	0
2	B	32	0	48	5	0
3	A	6	0	8	0	0
4	A	7	0	10	0	0
5	A	1	0	0	0	0
5	B	1	0	0	0	0
6	A	19	0	15	1	0
6	B	19	0	15	2	0
7	A	265	0	0	4	0

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Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
7	B	217	0	0	2	0
All	All	8856	0	8148	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 4.

The worst 5 of 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:431[A]:MSE:SE	6:A:609:GLN:HE21	2.03	0.91
1:B:521:VAL:H	2:B:605:EDO:H21	1.37	0.89
1:A:392:MSE:SE	1:A:430[B]:MSE:HE1	2.28	0.83
1:A:375[B]:ASP:OD2	7:A:701:HOH:O	2.05	0.74
2:B:602:EDO:O1	7:B:701:HOH:O	2.13	0.67

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	519/543 (96%)	508 (98%)	11 (2%)	0	100	100
1	B	512/543 (94%)	501 (98%)	11 (2%)	0	100	100
All	All	1031/1086 (95%)	1009 (98%)	22 (2%)	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	445/443 (100%)	436 (98%)	9 (2%)	55	48
1	B	440/443 (99%)	434 (99%)	6 (1%)	67	62
All	All	885/886 (100%)	870 (98%)	15 (2%)	60	55

5 of 15 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	431[A]	MSE
1	A	431[B]	MSE
1	B	390[A]	ARG
1	A	379	MSE
1	B	379	MSE

Some sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (5) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	219	GLN
1	A	269	ASN
1	B	217	GLN
1	B	328	GLN
1	B	495	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

Of 21 ligands modelled in this entry, 2 are monoatomic - leaving 19 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
2	EDO	B	602	-	3,3,3	0.45	0	2,2,2	0.32	0
2	EDO	B	609	-	3,3,3	0.55	0	2,2,2	0.19	0
2	EDO	A	605	-	3,3,3	0.52	0	2,2,2	0.15	0
4	PEG	A	604	-	6,6,6	0.40	0	5,5,5	0.35	0
2	EDO	B	610	-	3,3,3	0.54	0	2,2,2	0.14	0
2	EDO	A	601	-	3,3,3	0.49	0	2,2,2	0.33	0
2	EDO	A	610	-	3,3,3	0.45	0	2,2,2	0.40	0
2	EDO	B	611	-	3,3,3	0.47	0	2,2,2	0.16	0
2	EDO	B	604	-	3,3,3	0.48	0	2,2,2	0.30	0
2	EDO	A	607	-	3,3,3	0.42	0	2,2,2	0.40	0
3	GOL	A	602	-	5,5,5	0.37	0	5,5,5	0.19	0
2	EDO	B	605	-	3,3,3	0.47	0	2,2,2	0.26	0
2	EDO	B	608	-	3,3,3	0.50	0	2,2,2	0.23	0
2	EDO	A	603	-	3,3,3	0.48	0	2,2,2	0.36	0
2	EDO	B	601	-	3,3,3	0.50	0	2,2,2	0.34	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
2	EDO	B	602	-	-	0/1/1/1	-
2	EDO	B	609	-	-	1/1/1/1	-
2	EDO	A	605	-	-	1/1/1/1	-
4	PEG	A	604	-	-	2/4/4/4	-
2	EDO	B	610	-	-	1/1/1/1	-
2	EDO	A	601	-	-	0/1/1/1	-
2	EDO	A	610	-	-	0/1/1/1	-
2	EDO	B	611	-	-	1/1/1/1	-
2	EDO	B	604	-	-	0/1/1/1	-

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Mol	Type	Chain	Res	Link	Chirals	Torsions	Rings
2	EDO	A	607	-	-	0/1/1/1	-
3	GOL	A	602	-	-	4/4/4/4	-
2	EDO	B	605	-	-	1/1/1/1	-
2	EDO	B	608	-	-	0/1/1/1	-
2	EDO	A	603	-	-	1/1/1/1	-
2	EDO	B	601	-	-	0/1/1/1	-

There are no bond length outliers.

There are no bond angle outliers.

There are no chirality outliers.

5 of 12 torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
3	A	602	GOL	O1-C1-C2-C3
3	A	602	GOL	O1-C1-C2-O2
4	A	604	PEG	O2-C3-C4-O4
3	A	602	GOL	C1-C2-C3-O3
4	A	604	PEG	O1-C1-C2-O2

There are no ring outliers.

4 monomers are involved in 5 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
2	B	602	EDO	1	0
2	B	605	EDO	1	0
2	B	608	EDO	2	0
2	B	601	EDO	1	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, 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	497/543 (91%)	-0.38	2 (0%) 92 95	11, 21, 38, 60	0
1	B	491/543 (90%)	-0.20	8 (1%) 72 79	14, 27, 47, 80	0
All	All	988/1086 (90%)	-0.29	10 (1%) 82 87	11, 24, 44, 80	0

The worst 5 of 10 RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	B	455	GLN	3.5
1	B	535	ASP	3.3
1	A	86	GLU	2.8
1	B	280	LYS	2.6
1	B	86	GLU	2.6

### 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 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. 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( $\text{\AA}^2$ )	Q<0.9
2	EDO	B	605	4/4	0.76	0.28	58,59,59,62	0
2	EDO	A	610	4/4	0.77	0.25	56,57,57,59	0
2	EDO	A	605	4/4	0.78	0.13	41,41,42,42	0
2	EDO	B	602	4/4	0.79	0.28	57,58,59,62	0
2	EDO	A	603	4/4	0.79	0.12	44,46,48,50	0
2	EDO	B	609	4/4	0.87	0.14	34,34,35,40	0
3	GOL	A	602	6/6	0.87	0.18	45,47,48,48	0
2	EDO	B	608	4/4	0.88	0.22	45,47,50,51	0
2	EDO	A	601	4/4	0.88	0.16	46,48,48,49	0
2	EDO	B	610	4/4	0.89	0.12	37,39,39,41	0
2	EDO	B	604	4/4	0.90	0.09	39,39,41,41	0
4	PEG	A	604	7/7	0.90	0.14	41,41,44,47	0
6	GLN	B	607	10/10	0.92	0.17	14,19,55,57	0
2	EDO	B	601	4/4	0.92	0.14	40,42,43,43	0
6	GLN	B	606	9/10	0.92	0.20	16,20,40,44	0
2	EDO	A	607	4/4	0.93	0.10	46,47,48,49	0
6	GLN	A	609	10/10	0.93	0.14	11,16,39,45	0
2	EDO	B	611	4/4	0.94	0.12	46,49,49,52	0
6	GLN	A	608	9/10	0.95	0.16	8,11,38,40	0
5	CL	A	606	1/1	0.99	0.05	20,20,20,20	0
5	CL	B	603	1/1	0.99	0.04	21,21,21,21	0

## 6.5 Other polymers [i](#)

There are no such residues in this entry.