



Full wwPDB X-ray Structure Validation Report ⓘ

May 13, 2020 – 10:31 am BST

PDB ID : 6MNU
Title : Crystal structure of Yersinia pestis UDP-glucose pyrophosphorylase
Authors : Gibbs, M.E.; Lountos, G.T.; Gumpena, R.; Waugh, D.S.
Deposited on : 2018-10-03
Resolution : 2.17 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 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

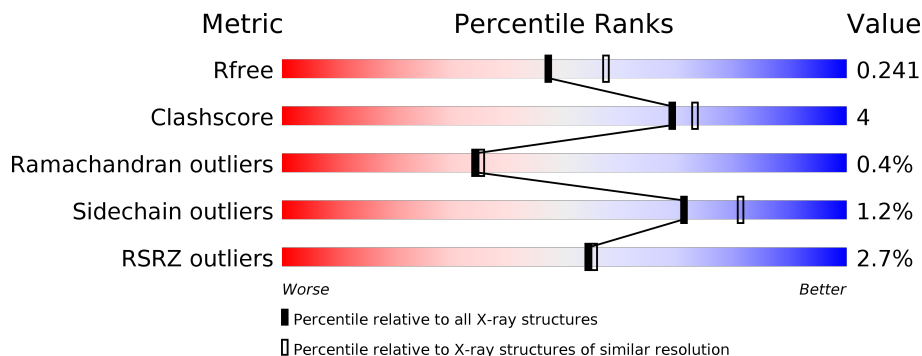
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 2.17 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	6864 (2.20-2.16)
Clashscore	141614	7689 (2.20-2.16)
Ramachandran outliers	138981	7564 (2.20-2.16)
Sidechain outliers	138945	7564 (2.20-2.16)
RSRZ outliers	127900	6738 (2.20-2.16)

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 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	296	 % 90% 8% •
1	B	296	 3% 87% 10% •
1	C	296	 3% 88% 11% •
1	D	296	 4% 85% 11% •

2 Entry composition [i](#)

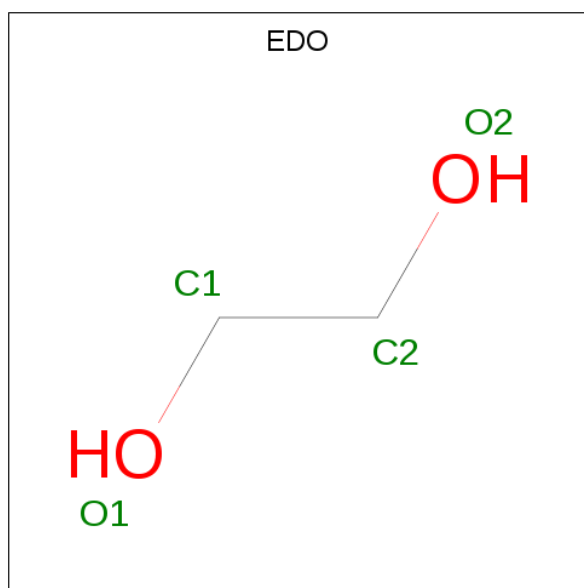
There are 3 unique types of molecules in this entry. The entry contains 9311 atoms, of which 0 are hydrogens and 0 are deuteriums.

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 UTP--glucose-1-phosphate uridylyltransferase.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
1	A	289	Total 2175	C 1383	N 363	O 411	S 18	0	0	0
1	B	288	Total 2169	C 1380	N 364	O 406	S 19	0	1	0
1	C	292	Total 2182	C 1386	N 363	O 415	S 18	0	1	0
1	D	287	Total 2154	C 1371	N 360	O 405	S 18	0	0	0

- Molecule 2 is 1,2-ETHANEDIOL (three-letter code: EDO) (formula: C₂H₆O₂).



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

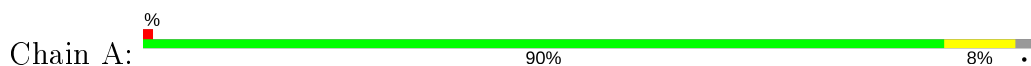
- Molecule 3 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
3	A	167	Total 167	O 167	0	0
3	B	175	Total 175	O 175	0	0
3	C	149	Total 149	O 149	0	0
3	D	132	Total 132	O 132	0	0

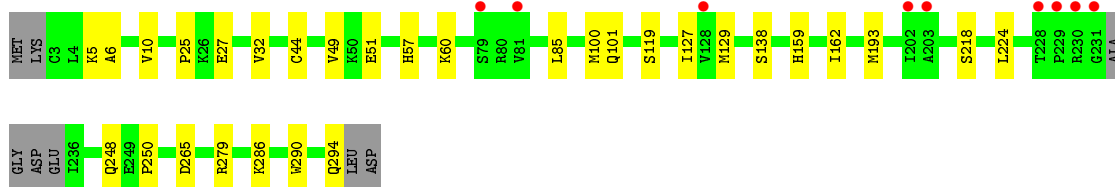
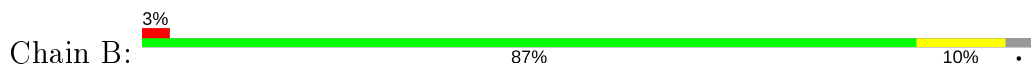
3 Residue-property plots [i](#)

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.

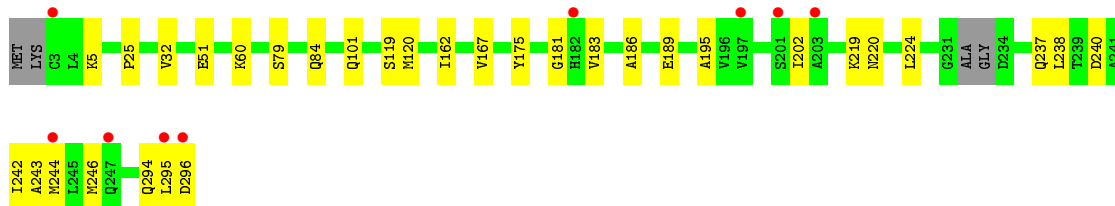
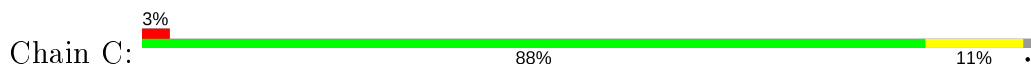
- Molecule 1: UTP--glucose-1-phosphate uridylyltransferase



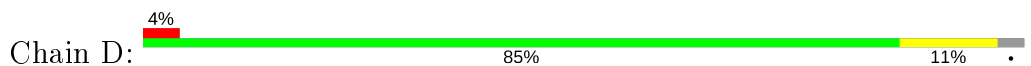
- Molecule 1: UTP--glucose-1-phosphate uridylyltransferase



- Molecule 1: UTP--glucose-1-phosphate uridylyltransferase



- Molecule 1: UTP--glucose-1-phosphate uridylyltransferase





4 Data and refinement statistics

Property	Value	Source
Space group	P 21 21 21	Depositor
Cell constants a, b, c, α , β , γ	92.19Å 99.42Å 128.66Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	26.71 – 2.17 26.71 – 2.17	Depositor EDS
% Data completeness (in resolution range)	97.4 (26.71-2.17) 97.4 (26.71-2.17)	Depositor EDS
R_{merge}	(Not available)	Depositor
R_{sym}	0.08	Depositor
$\langle I/\sigma(I) \rangle$ ¹	2.08 (at 2.17Å)	Xtrriage
Refinement program	PHENIX 1.14_3260	Depositor
R, R_{free}	0.177 , 0.241 0.177 , 0.241	Depositor DCC
R_{free} test set	1997 reflections (3.26%)	wwPDB-VP
Wilson B-factor (Å ²)	31.2	Xtrriage
Anisotropy	0.380	Xtrriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.31 , 41.6	EDS
L-test for twinning ²	$\langle L \rangle = 0.48$, $\langle L^2 \rangle = 0.31$	Xtrriage
Estimated twinning fraction	No twinning to report.	Xtrriage
F_o, F_c correlation	0.95	EDS
Total number of atoms	9311	wwPDB-VP
Average B, all atoms (Å ²)	35.0	wwPDB-VP

Xtrriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 3.48% 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 [i](#)

5.1 Standard geometry [i](#)

Bond lengths and bond angles in the following residue types are not validated in this section: 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	0.42	0/2214	0.57	0/3002
1	B	0.41	0/2208	0.57	0/2994
1	C	0.41	0/2220	0.57	0/3015
1	D	0.41	0/2193	0.57	0/2978
All	All	0.41	0/8835	0.57	0/11989

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	2175	0	2202	14	0
1	B	2169	0	2200	16	0
1	C	2182	0	2179	21	0
1	D	2154	0	2175	19	0
2	C	4	0	6	0	0
2	D	4	0	6	0	0
3	A	167	0	0	1	0
3	B	175	0	0	0	0
3	C	149	0	0	1	0

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Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
3	D	132	0	0	1	0
All	All	9311	0	8768	64	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.

All (64) 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:56:SER:HB3	1:A:101:GLN:HE21	1.31	0.94
1:C:295:LEU:HD11	1:D:292:LYS:HA	1.58	0.85
1:A:50:LYS:NZ	1:A:96:ASP:OD2	2.24	0.65
1:C:243:ALA:HA	1:C:246:MET:HE2	1.80	0.63
1:C:5:LYS:NZ	1:C:120:MET:O	2.32	0.63
1:A:243:ALA:HA	1:A:246:MET:HE2	1.81	0.62
1:B:162:ILE:HB	1:B:193:MET:HE1	1.82	0.61
1:D:281:HIS:ND1	1:D:282:THR:HG23	2.17	0.59
1:D:185:LEU:HG	1:D:255:HIS:HB2	1.85	0.59
1:B:25:PRO:HB3	1:B:60:LYS:HD2	1.84	0.58
1:A:162:ILE:HB	1:A:193:MET:HE1	1.86	0.57
1:A:115:LEU:HG	1:A:225:LEU:HG	1.88	0.56
1:B:224:LEU:HD21	1:B:248:GLN:HE22	1.70	0.56
1:D:82:LYS:HE2	1:D:85:LEU:HD12	1.89	0.55
1:C:242:ILE:O	1:C:246:MET:HG3	2.08	0.54
1:B:138:SER:HB3	1:B:279:ARG:CZ	2.37	0.54
1:A:267:LEU:HD22	1:B:286:LYS:HE3	1.89	0.53
1:B:5:LYS:HG2	1:B:51:GLU:HB2	1.91	0.53
1:C:238:LEU:HG	1:C:242:ILE:HD11	1.92	0.52
1:C:162:ILE:HD11	1:C:242:ILE:HG21	1.92	0.51
1:D:106:HIS:O	1:D:108:LYS:N	2.44	0.51
1:C:219:LYS:NZ	1:C:220:ASN:OD1	2.45	0.50
1:A:118:LYS:NZ	3:A:308:HOH:O	2.44	0.50
1:D:61:ASN:HB2	3:D:421:HOH:O	2.12	0.50
1:B:159:HIS:CE1	1:B:250:PRO:HG2	2.48	0.49
1:B:119:SER:OG	1:C:51:GLU:HG2	2.13	0.49
1:D:239:THR:HA	1:D:242:ILE:HB	1.94	0.49
1:C:294:GLN:O	1:C:295:LEU:HB2	2.13	0.47
1:A:271:LYS:HE2	1:B:290:TRP:CD1	2.49	0.47
1:A:100:MET:HG2	1:D:120:MET:SD	2.55	0.47
1:C:237:GLN:HB2	1:C:240:ASP:OD2	2.15	0.47
1:D:157:THR:HB	1:D:159:HIS:ND1	2.30	0.47

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:56:SER:HB3	1:A:101:GLN:NE2	2.14	0.46
1:C:224:LEU:HD22	1:C:244:MET:HB3	1.97	0.46
1:B:57:HIS:HB3	1:B:60:LYS:HG2	1.98	0.46
1:D:44:CYS:SG	1:D:129:MET:SD	3.13	0.46
1:B:6:ALA:HA	1:B:127:ILE:HB	1.98	0.46
1:D:101:GLN:HB3	1:D:101:GLN:HE21	1.66	0.45
1:C:195:ALA:HA	1:C:246:MET:HE1	1.97	0.45
1:B:44[A]:CYS:SG	1:B:129:MET:SD	3.14	0.45
1:C:84[A]:GLN:HG2	3:C:522:HOH:O	2.17	0.45
1:D:159:HIS:CD2	1:D:250:PRO:HG2	2.52	0.45
1:C:167:VAL:HG11	1:C:175:TYR:CE2	2.51	0.45
1:A:170:ALA:HA	1:A:202:ILE:HD12	1.99	0.44
1:A:89:ILE:O	1:A:92:ILE:HG13	2.17	0.44
1:C:202:ILE:H	1:C:202:ILE:HD12	1.83	0.44
1:C:294:GLN:O	1:C:296:ASP:N	2.51	0.44
1:A:120:MET:SD	1:D:100:MET:HG2	2.58	0.44
1:B:290:TRP:O	1:B:294:GLN:HG2	2.19	0.43
1:A:224:LEU:HD22	1:A:244:MET:HE2	2.00	0.43
1:C:238:LEU:HG	1:C:242:ILE:CD1	2.49	0.42
1:C:238:LEU:O	1:C:242:ILE:HD12	2.19	0.42
1:C:25:PRO:HB3	1:C:60:LYS:HD2	2.01	0.42
1:C:181:GLY:O	1:C:183:VAL:N	2.50	0.42
1:D:162:ILE:HD12	1:D:215:TYR:HD2	1.84	0.42
1:D:193:MET:HB2	1:D:193:MET:HE2	1.81	0.42
1:B:10:VAL:HG12	1:B:27:GLU:HG2	2.02	0.42
1:D:246:MET:HA	1:D:249:GLU:O	2.20	0.41
1:D:94:PRO:HB2	1:D:97:VAL:HG23	2.02	0.41
1:D:164:VAL:HA	1:D:210:ALA:O	2.20	0.41
1:B:44[B]:CYS:SG	1:B:49:VAL:HB	2.61	0.41
1:B:85:LEU:HD23	1:B:85:LEU:HA	1.94	0.41
1:D:236:ILE:N	1:D:236:ILE:HD12	2.36	0.40
1:C:186:ALA:HB3	1:C:189:GLU:HG3	2.03	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	285/296 (96%)	278 (98%)	6 (2%)	1 (0%)	34	35
1	B	285/296 (96%)	272 (95%)	12 (4%)	1 (0%)	34	35
1	C	289/296 (98%)	273 (94%)	15 (5%)	1 (0%)	41	43
1	D	283/296 (96%)	275 (97%)	6 (2%)	2 (1%)	22	20
All	All	1142/1184 (96%)	1098 (96%)	39 (3%)	5 (0%)	34	35

All (5) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	32	VAL
1	D	107	ALA
1	B	32	VAL
1	C	32	VAL
1	D	32	VAL

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	237/248 (96%)	236 (100%)	1 (0%)	91	95
1	B	236/248 (95%)	232 (98%)	4 (2%)	60	72
1	C	234/248 (94%)	231 (99%)	3 (1%)	69	79
1	D	234/248 (94%)	231 (99%)	3 (1%)	69	79
All	All	941/992 (95%)	930 (99%)	11 (1%)	71	81

All (11) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	265	ASP

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Mol	Chain	Res	Type
1	B	100	MET
1	B	101	GLN
1	B	218	SER
1	B	265	ASP
1	C	79	SER
1	C	101	GLN
1	C	119	SER
1	D	101	GLN
1	D	218	SER
1	D	266	LYS

Some sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (3) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	101	GLN
1	B	248	GLN
1	C	101	GLN

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 [i](#)

2 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	EDO	D	301	-	3,3,3	0.61	0	2,2,2	0.06	0
2	EDO	C	301	-	3,3,3	0.56	0	2,2,2	0.21	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	D	301	-	-	0/1/1/1	-
2	EDO	C	301	-	-	0/1/1/1	-

There are no bond length outliers.

There are no bond angle outliers.

There are no chirality outliers.

There are no torsion outliers.

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 [i](#)

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	289/296 (97%)	-0.21	2 (0%) 87 88	20, 31, 49, 57	0
1	B	288/296 (97%)	-0.13	9 (3%) 49 50	20, 32, 55, 71	0
1	C	292/296 (98%)	0.05	9 (3%) 49 50	19, 36, 61, 75	0
1	D	287/296 (96%)	-0.05	11 (3%) 40 41	20, 36, 57, 73	0
All	All	1156/1184 (97%)	-0.08	31 (2%) 54 55	19, 33, 57, 75	0

All (31) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	B	229	PRO	5.7
1	B	231	GLY	4.6
1	D	229	PRO	4.4
1	B	202	ILE	4.0
1	C	203	ALA	3.9
1	A	203	ALA	3.8
1	C	247	GLN	3.5
1	B	203	ALA	3.5
1	A	182	HIS	3.2
1	C	182	HIS	3.2
1	D	228	THR	2.9
1	B	230	ARG	2.9
1	C	3	CYS	2.8
1	C	197	VAL	2.7
1	D	81	VAL	2.6
1	B	228	THR	2.6
1	C	244	MET	2.6
1	D	227	LYS	2.5
1	D	123	ASP	2.5
1	D	3	CYS	2.4
1	B	79	SER	2.3

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Mol	Chain	Res	Type	RSRZ
1	D	204	GLU	2.3
1	D	215	TYR	2.2
1	D	173	SER	2.2
1	C	295	LEU	2.2
1	C	296	ASP	2.2
1	D	244	MET	2.1
1	B	81	VAL	2.1
1	C	201	SER	2.1
1	D	236	ILE	2.1
1	B	128	VAL	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. 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(Å ²)	Q<0.9
2	EDO	D	301	4/4	0.91	0.23	36,38,38,46	0
2	EDO	C	301	4/4	0.98	0.09	31,32,32,35	0

6.5 Other polymers [i](#)

There are no such residues in this entry.