



wwPDB X-ray Structure Validation Summary Report ⓘ

Mar 5, 2026 – 07:43 AM UTC

PDB ID : 5VWW / pdb_00005vww
Title : Structure of MurC from Pseudomonas aeruginosa
Authors : Seattle Structural Genomics Center for Infectious Disease (SSGCID)
Deposited on : 2017-05-21
Resolution : 2.30 Å(reported)

This is a wwPDB X-ray Structure Validation Summary 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 types of validation reports are described at

<http://www.wwpdb.org/validation/2017/FAQs#types>.

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

MolProbity	:	4-5-2 with Phenix2.0
Mogul	:	2022.3.0, CSD as543be (2022)
Xtriage (Phenix)	:	2.0
EDS	:	3.0
Percentile statistics	:	20250101.v01 (using entries in the PDB archive January 1st 2025)
CCP4	:	9.0.010 (Gargrove)
Density-Fitness	:	1.0.12
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, RNA)	:	Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP)	:	2.49

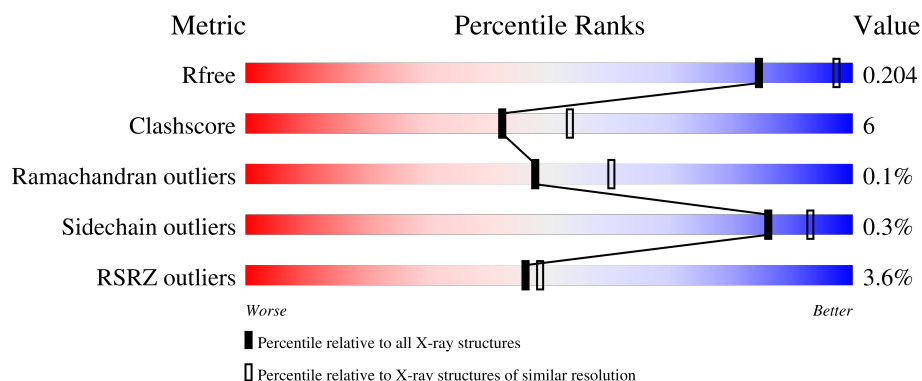
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 2.30 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}	180053	6319 (2.30-2.30)
Clashscore	190562	6919 (2.30-2.30)
Ramachandran outliers	187476	6854 (2.30-2.30)
Sidechain outliers	187428	6854 (2.30-2.30)
RSRZ outliers	180081	6325 (2.30-2.30)

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 ≥ 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	315	3% 82% 14% .
1	B	315	3% 82% 15% .
1	C	315	3% 83% 13% .
1	D	315	3% 83% 14% .
1	E	315	3% 82% 14% .

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Mol	Chain	Length	Quality of chain
1	F	315	 5% 86% 11% •
1	G	315	 4% 85% 12% •
1	H	315	 3% 85% 12% •

2 Entry composition

There are 3 unique types of molecules in this entry. The entry contains 19018 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 UDP-N-acetylmuramate--L-alanine ligase.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	305	Total	C	N	O	S	0	4	0
			2267	1431	396	431	9			
1	B	305	Total	C	N	O	S	0	3	0
			2255	1424	398	423	10			
1	C	305	Total	C	N	O	S	0	2	0
			2249	1418	397	425	9			
1	D	305	Total	C	N	O	S	0	5	0
			2268	1433	397	429	9			
1	E	304	Total	C	N	O	S	0	5	0
			2265	1433	397	426	9			
1	F	305	Total	C	N	O	S	0	3	0
			2270	1435	401	425	9			
1	G	305	Total	C	N	O	S	0	2	0
			2252	1423	397	422	10			
1	H	305	Total	C	N	O	S	0	6	0
			2284	1443	402	430	9			

There are 64 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	8	MET	-	initiating methionine	UNP Q9HW02
A	9	ALA	-	expression tag	UNP Q9HW02
A	10	HIS	-	expression tag	UNP Q9HW02
A	11	HIS	-	expression tag	UNP Q9HW02
A	12	HIS	-	expression tag	UNP Q9HW02
A	13	HIS	-	expression tag	UNP Q9HW02
A	14	HIS	-	expression tag	UNP Q9HW02
A	15	HIS	-	expression tag	UNP Q9HW02
B	8	MET	-	initiating methionine	UNP Q9HW02
B	9	ALA	-	expression tag	UNP Q9HW02
B	10	HIS	-	expression tag	UNP Q9HW02
B	11	HIS	-	expression tag	UNP Q9HW02
B	12	HIS	-	expression tag	UNP Q9HW02

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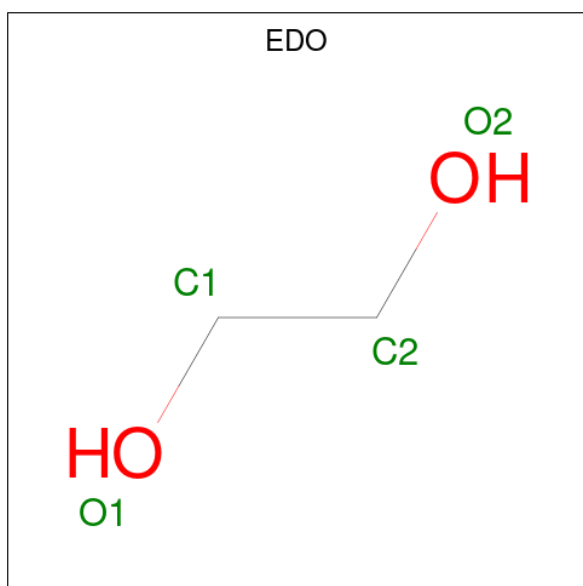
Chain	Residue	Modelled	Actual	Comment	Reference
B	13	HIS	-	expression tag	UNP Q9HW02
B	14	HIS	-	expression tag	UNP Q9HW02
B	15	HIS	-	expression tag	UNP Q9HW02
C	8	MET	-	initiating methionine	UNP Q9HW02
C	9	ALA	-	expression tag	UNP Q9HW02
C	10	HIS	-	expression tag	UNP Q9HW02
C	11	HIS	-	expression tag	UNP Q9HW02
C	12	HIS	-	expression tag	UNP Q9HW02
C	13	HIS	-	expression tag	UNP Q9HW02
C	14	HIS	-	expression tag	UNP Q9HW02
C	15	HIS	-	expression tag	UNP Q9HW02
D	8	MET	-	initiating methionine	UNP Q9HW02
D	9	ALA	-	expression tag	UNP Q9HW02
D	10	HIS	-	expression tag	UNP Q9HW02
D	11	HIS	-	expression tag	UNP Q9HW02
D	12	HIS	-	expression tag	UNP Q9HW02
D	13	HIS	-	expression tag	UNP Q9HW02
D	14	HIS	-	expression tag	UNP Q9HW02
D	15	HIS	-	expression tag	UNP Q9HW02
E	8	MET	-	initiating methionine	UNP Q9HW02
E	9	ALA	-	expression tag	UNP Q9HW02
E	10	HIS	-	expression tag	UNP Q9HW02
E	11	HIS	-	expression tag	UNP Q9HW02
E	12	HIS	-	expression tag	UNP Q9HW02
E	13	HIS	-	expression tag	UNP Q9HW02
E	14	HIS	-	expression tag	UNP Q9HW02
E	15	HIS	-	expression tag	UNP Q9HW02
F	8	MET	-	initiating methionine	UNP Q9HW02
F	9	ALA	-	expression tag	UNP Q9HW02
F	10	HIS	-	expression tag	UNP Q9HW02
F	11	HIS	-	expression tag	UNP Q9HW02
F	12	HIS	-	expression tag	UNP Q9HW02
F	13	HIS	-	expression tag	UNP Q9HW02
F	14	HIS	-	expression tag	UNP Q9HW02
F	15	HIS	-	expression tag	UNP Q9HW02
G	8	MET	-	initiating methionine	UNP Q9HW02
G	9	ALA	-	expression tag	UNP Q9HW02
G	10	HIS	-	expression tag	UNP Q9HW02
G	11	HIS	-	expression tag	UNP Q9HW02
G	12	HIS	-	expression tag	UNP Q9HW02
G	13	HIS	-	expression tag	UNP Q9HW02
G	14	HIS	-	expression tag	UNP Q9HW02

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Chain	Residue	Modelled	Actual	Comment	Reference
G	15	HIS	-	expression tag	UNP Q9HW02
H	8	MET	-	initiating methionine	UNP Q9HW02
H	9	ALA	-	expression tag	UNP Q9HW02
H	10	HIS	-	expression tag	UNP Q9HW02
H	11	HIS	-	expression tag	UNP Q9HW02
H	12	HIS	-	expression tag	UNP Q9HW02
H	13	HIS	-	expression tag	UNP Q9HW02
H	14	HIS	-	expression tag	UNP Q9HW02
H	15	HIS	-	expression tag	UNP Q9HW02

- Molecule 2 is 1,2-ETHANEDIOL (CCD ID: EDO) (formula: C₂H₆O₂).



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

- Molecule 3 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
3	A	101	Total 103	O 103	0	2
3	B	110	Total 111	O 111	0	1
3	C	108	Total 108	O 108	0	0
3	D	112	Total 112	O 112	0	0
3	E	114	Total 114	O 114	0	0
3	F	119	Total 119	O 119	0	0
3	G	97	Total 97	O 97	0	0
3	H	116	Total 116	O 116	0	0

- Molecule 1: UDP-N-acetylmuramate--L-alanine ligase





4 Data and refinement statistics

Property	Value	Source
Space group	C 1 2 1	Depositor
Cell constants a, b, c, α , β , γ	284.82Å 109.40Å 108.58Å 90.00° 112.38° 90.00°	Depositor
Resolution (Å)	29.81 – 2.30 29.81 – 2.30	Depositor EDS
% Data completeness (in resolution range)	99.7 (29.81-2.30) 91.8 (29.81-2.30)	Depositor EDS
R_{merge}	0.08	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	2.98 (at 2.29Å)	Xtriage
Refinement program	PHENIX (dev_2744: ???)	Depositor
R, R_{free}	0.189 , 0.203 0.189 , 0.204	Depositor DCC
R_{free} test set	2013 reflections (1.47%)	wwPDB-VP
Wilson B-factor (Å ²)	31.1	Xtriage
Anisotropy	0.291	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.33 , 43.7	EDS
L-test for twinning ²	$\langle L \rangle = 0.56$, $\langle L^2 \rangle = 0.41$	Xtriage
Estimated twinning fraction	0.010 for -h-k-l,l,k 0.014 for -h+k-l,-l,-k 0.024 for -h-2*l,-k,l	Xtriage
F_o, F_c correlation	0.96	EDS
Total number of atoms	19018	wwPDB-VP
Average B, all atoms (Å ²)	40.0	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 45.77 % 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 1.2599e-04. The detected translational NCS is most likely also responsible for the elevated intensity ratio.*

¹ Intensities estimated from amplitudes.

² 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: 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	0.37	1/2318 (0.0%)	0.55	0/3156
1	B	0.41	1/2303 (0.0%)	0.56	0/3135
1	C	0.36	0/2294	0.55	0/3124
1	D	0.35	0/2322	0.55	0/3161
1	E	0.40	1/2318 (0.0%)	0.54	0/3157
1	F	0.37	0/2319	0.54	0/3156
1	G	0.36	0/2297	0.53	0/3128
1	H	0.37	0/2341	0.52	0/3186
All	All	0.38	3/18512 (0.0%)	0.54	0/25203

All (3) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	A	145	THR	C-O	-5.61	1.17	1.23
1	E	190	ASN	C-O	-5.25	1.17	1.23
1	B	116	HIS	C-O	-5.02	1.17	1.23

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	2267	0	2228	32	0
1	B	2255	0	2222	35	0
1	C	2249	0	2208	29	0
1	D	2268	0	2241	29	0
1	E	2265	0	2248	32	0
1	F	2270	0	2251	25	0
1	G	2252	0	2223	29	0
1	H	2284	0	2264	26	0
2	A	4	0	6	1	0
2	B	4	0	6	3	0
2	C	4	0	6	2	0
2	G	12	0	18	0	0
2	H	4	0	6	2	0
3	A	103	0	0	0	0
3	B	111	0	0	2	0
3	C	108	0	0	3	0
3	D	112	0	0	2	0
3	E	114	0	0	0	0
3	F	119	0	0	3	0
3	G	97	0	0	0	0
3	H	116	0	0	1	0
All	All	19018	0	17927	226	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 6.

The worst 5 of 226 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:F:81:SER:H	1:F:84:ILE:HD13	1.45	0.81
1:C:126:LYS:NZ	3:C:502:HOH:O	2.17	0.78
1:G:225:MET:HE1	1:G:239:ILE:HG13	1.67	0.76
1:E:124:HIS:H	1:E:190:ASN:HD21	1.35	0.73
1:F:49:ALA:HB2	1:F:65:ILE:HD11	1.74	0.69

There are no symmetry-related clashes.

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	307/315 (98%)	295 (96%)	11 (4%)	1 (0%)	36	46
1	B	306/315 (97%)	295 (96%)	10 (3%)	1 (0%)	36	46
1	C	305/315 (97%)	295 (97%)	9 (3%)	1 (0%)	36	46
1	D	308/315 (98%)	300 (97%)	8 (3%)	0	100	100
1	E	307/315 (98%)	297 (97%)	10 (3%)	0	100	100
1	F	306/315 (97%)	297 (97%)	9 (3%)	0	100	100
1	G	305/315 (97%)	301 (99%)	4 (1%)	0	100	100
1	H	309/315 (98%)	301 (97%)	8 (3%)	0	100	100
All	All	2453/2520 (97%)	2381 (97%)	69 (3%)	3 (0%)	48	60

All (3) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	85	ASN
1	C	85	ASN
1	B	157	THR

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	231/248 (93%)	229 (99%)	2 (1%)	70	84
1	B	228/248 (92%)	228 (100%)	0	100	100

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Mol	Chain	Analysed	Rotameric	Outliers	Percentiles	
1	C	228/248 (92%)	228 (100%)	0	100	100
1	D	232/248 (94%)	230 (99%)	2 (1%)	70	84
1	E	232/248 (94%)	230 (99%)	2 (1%)	70	84
1	F	232/248 (94%)	230 (99%)	2 (1%)	70	84
1	G	228/248 (92%)	228 (100%)	0	100	100
1	H	234/248 (94%)	232 (99%)	2 (1%)	70	84
All	All	1845/1984 (93%)	1835 (100%)	10 (0%)	86	90

5 of 10 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	F	187[B]	VAL
1	H	16[A]	ARG
1	H	16[B]	ARG
1	D	50[B]	SER
1	E	16[A]	ARG

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. 5 of 22 such sidechains are listed below:

Mol	Chain	Res	Type
1	E	190	ASN
1	G	238	GLN
1	F	182	GLN
1	H	37	ASN
1	B	292	ASN

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 oligosaccharides in this entry.

5.6 Ligand geometry

7 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	G	403	-	3,3,3	0.45	0	2,2,2	0.42	0
2	EDO	B	401	-	3,3,3	0.51	0	2,2,2	0.11	0
2	EDO	C	401	-	3,3,3	0.50	0	2,2,2	0.24	0
2	EDO	A	401	-	3,3,3	0.50	0	2,2,2	0.27	0
2	EDO	H	401	-	3,3,3	0.47	0	2,2,2	0.29	0
2	EDO	G	401	-	3,3,3	0.42	0	2,2,2	0.41	0
2	EDO	G	402	-	3,3,3	0.45	0	2,2,2	0.37	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	G	403	-	-	0/1/1/1	-
2	EDO	B	401	-	-	1/1/1/1	-
2	EDO	C	401	-	-	1/1/1/1	-
2	EDO	A	401	-	-	0/1/1/1	-
2	EDO	H	401	-	-	1/1/1/1	-
2	EDO	G	401	-	-	0/1/1/1	-
2	EDO	G	402	-	-	0/1/1/1	-

There are no bond length outliers.

There are no bond angle outliers.

There are no chirality outliers.

All (3) torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
2	C	401	EDO	O1-C1-C2-O2
2	H	401	EDO	O1-C1-C2-O2

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Mol	Chain	Res	Type	Atoms
2	B	401	EDO	O1-C1-C2-O2

There are no ring outliers.

4 monomers are involved in 8 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
2	B	401	EDO	3	0
2	C	401	EDO	2	0
2	A	401	EDO	1	0
2	H	401	EDO	2	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	305/315 (96%)	-0.03	10 (3%) 49 51	19, 38, 71, 95	4 (1%)
1	B	305/315 (96%)	-0.14	9 (2%) 52 54	20, 34, 68, 111	3 (0%)
1	C	305/315 (96%)	-0.02	11 (3%) 46 48	24, 37, 69, 102	2 (0%)
1	D	305/315 (96%)	-0.09	11 (3%) 46 48	20, 36, 71, 98	5 (1%)
1	E	304/315 (96%)	-0.16	8 (2%) 57 59	16, 34, 62, 97	5 (1%)
1	F	305/315 (96%)	-0.02	16 (5%) 33 34	20, 37, 70, 108	3 (0%)
1	G	305/315 (96%)	0.03	14 (4%) 37 39	19, 37, 70, 107	2 (0%)
1	H	305/315 (96%)	-0.12	9 (2%) 52 54	15, 34, 72, 119	6 (1%)
All	All	2439/2520 (96%)	-0.07	88 (3%) 46 48	15, 36, 70, 119	30 (1%)

The worst 5 of 88 RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	G	83	ALA	5.3
1	F	83	ALA	4.8
1	G	15	HIS	4.8
1	H	156	GLY	4.7
1	E	82	SER	4.7

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 oligosaccharides 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	G	402	4/4	0.77	0.20	71,71,71,71	0
2	EDO	G	403	4/4	0.81	0.19	55,56,59,71	0
2	EDO	A	401	4/4	0.87	0.16	66,66,66,67	0
2	EDO	H	401	4/4	0.88	0.22	51,52,54,60	0
2	EDO	C	401	4/4	0.91	0.17	44,53,53,57	0
2	EDO	B	401	4/4	0.91	0.17	45,55,55,68	0
2	EDO	G	401	4/4	0.92	0.16	62,63,65,71	0

6.5 Other polymers [i](#)

There are no such residues in this entry.