



Full wwPDB X-ray Structure Validation Report ⓘ

Mar 6, 2026 – 07:11 PM UTC

PDB ID : 3CZ8 / pdb_00003cz8
Title : Crystal structure of putative sporulation-specific glycosylase ydhD from *Bacillus subtilis*
Authors : Patskovsky, Y.; Romero, R.; Rutter, M.; Chang, S.; Maletic, M.; Smith, D.; Wasserman, S.R.; Sauder, J.M.; Burley, S.K.; Almo, S.C.; New York SGX Research Center for Structural Genomics (NYSGXRC)
Deposited on : 2008-04-28
Resolution : 2.20 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 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

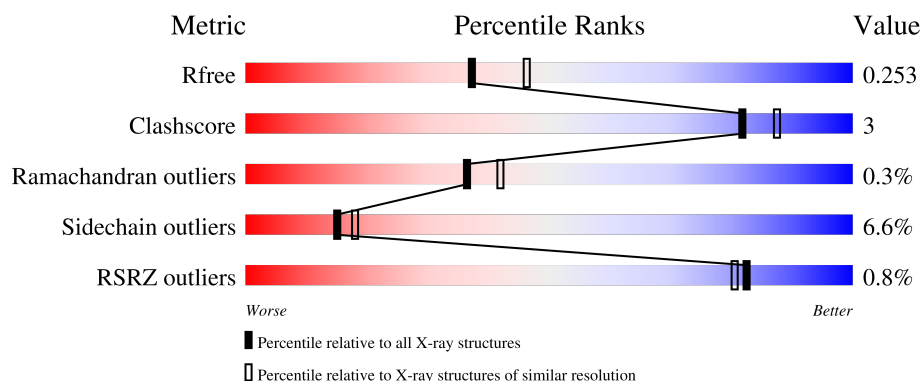
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 2.20 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	6164 (2.20-2.20)
Clashscore	190562	6851 (2.20-2.20)
Ramachandran outliers	187476	6768 (2.20-2.20)
Sidechain outliers	187428	6769 (2.20-2.20)
RSRZ outliers	180081	6166 (2.20-2.20)

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	319	 83% 11% 5%
1	B	319	 82% 10% 7%

2 Entry composition

There are 3 unique types of molecules in this entry. The entry contains 5148 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 Putative sporulation-specific glycosylase ydhD.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	302	Total	C	N	O	S	0	13	0
			2474	1587	426	456	5			
1	B	298	Total	C	N	O	S	0	12	0
			2434	1560	420	449	5			

There are 24 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	93	MET	-	expression tag	UNP O05495
A	94	SER	-	expression tag	UNP O05495
A	95	LEU	-	expression tag	UNP O05495
A	376	GLY	ASP	engineered mutation	UNP O05495
A	404	GLU	-	expression tag	UNP O05495
A	405	GLY	-	expression tag	UNP O05495
A	406	HIS	-	expression tag	UNP O05495
A	407	HIS	-	expression tag	UNP O05495
A	408	HIS	-	expression tag	UNP O05495
A	409	HIS	-	expression tag	UNP O05495
A	410	HIS	-	expression tag	UNP O05495
A	411	HIS	-	expression tag	UNP O05495
B	93	MET	-	expression tag	UNP O05495
B	94	SER	-	expression tag	UNP O05495
B	95	LEU	-	expression tag	UNP O05495
B	376	GLY	ASP	engineered mutation	UNP O05495
B	404	GLU	-	expression tag	UNP O05495
B	405	GLY	-	expression tag	UNP O05495
B	406	HIS	-	expression tag	UNP O05495
B	407	HIS	-	expression tag	UNP O05495
B	408	HIS	-	expression tag	UNP O05495
B	409	HIS	-	expression tag	UNP O05495
B	410	HIS	-	expression tag	UNP O05495
B	411	HIS	-	expression tag	UNP O05495

- Molecule 2 is GLYCEROL (CCD ID: GOL) (formula: $C_3H_8O_3$).



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

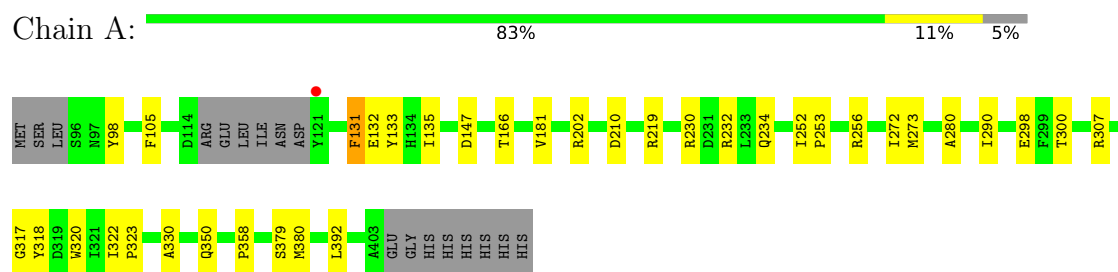
- Molecule 3 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
3	A	116	Total	O	0	0
			116	116		
3	B	76	Total	O	0	0
			76	76		

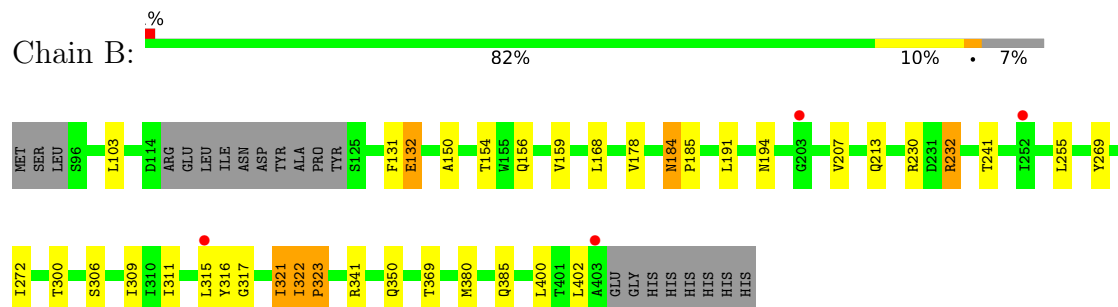
3 Residue-property plots [i](#)

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: Putative sporulation-specific glycosylase ydhD



- Molecule 1: Putative sporulation-specific glycosylase ydhD



4 Data and refinement statistics

Property	Value	Source
Space group	P 65	Depositor
Cell constants a, b, c, α , β , γ	84.97Å 84.97Å 188.04Å 90.00° 90.00° 120.00°	Depositor
Resolution (Å)	20.00 – 2.20 20.00 – 2.20	Depositor EDS
% Data completeness (in resolution range)	100.0 (20.00-2.20) 99.8 (20.00-2.20)	Depositor EDS
R_{merge}	0.08	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	1.95 (at 2.16Å)	Xtriage
Refinement program	REFMAC 5.3.0034	Depositor
R, R_{free}	0.196 , 0.258 0.197 , 0.253	Depositor DCC
R_{free} test set	1311 reflections (3.14%)	wwPDB-VP
Wilson B-factor (Å ²)	39.5	Xtriage
Anisotropy	0.123	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.31 , 51.5	EDS
L-test for twinning ²	$\langle L \rangle = 0.50$, $\langle L^2 \rangle = 0.33$	Xtriage
Estimated twinning fraction	0.063 for h,-h-k,-l	Xtriage
F_o, F_c correlation	0.96	EDS
Total number of atoms	5148	wwPDB-VP
Average B, all atoms (Å ²)	49.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 3.13% 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

5.1 Standard geometry

Bond lengths and bond angles in the following residue types are not validated in this section: GOL

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	0.61	1/2568 (0.0%)	0.86	1/3503 (0.0%)
1	B	0.61	0/2530	0.90	3/3450 (0.1%)
All	All	0.61	1/5098 (0.0%)	0.88	4/6953 (0.1%)

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	A	0	2
1	B	0	2
All	All	0	4

All (1) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	A	131	PHE	C-O	-5.49	1.17	1.23

All (4) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	B	184	ASN	CA-C-N	5.56	125.40	119.28
1	B	184	ASN	C-N-CA	5.56	125.40	119.28
1	B	317	GLY	N-CA-C	-5.50	103.10	112.51
1	A	317	GLY	N-CA-C	-5.07	104.56	112.58

There are no chirality outliers.

All (4) planarity outliers are listed below:

Mol	Chain	Res	Type	Group
1	A	131	PHE	Peptide
1	A	322	ILE	Peptide
1	B	131	PHE	Peptide
1	B	322	ILE	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	2474	0	2440	11	0
1	B	2434	0	2413	14	0
2	A	24	0	32	0	0
2	B	24	0	32	0	0
3	A	116	0	0	1	0
3	B	76	0	0	0	0
All	All	5148	0	4917	25	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 3.

All (25) 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:B:232[A]:ARG:HG2	1:B:232[A]:ARG:HH21	1.00	1.07
1:B:232[A]:ARG:HH21	1:B:232[A]:ARG:CG	1.74	0.99
1:B:232[A]:ARG:HG2	1:B:232[A]:ARG:NH2	1.68	0.90
1:B:315[A]:LEU:HD12	1:B:316[A]:TYR:CE2	2.32	0.64
1:B:272:ILE:HD11	1:B:300:THR:HG21	1.90	0.53
1:B:232[A]:ARG:CG	1:B:232[A]:ARG:NH2	2.46	0.53
1:A:166:THR:HG22	1:A:210:ASP:HB3	1.95	0.49
1:A:272:ILE:HD11	1:A:300:THR:HG21	1.95	0.48
1:B:241:THR:HG22	1:B:269:TYR:HB2	1.98	0.46
1:A:280:ALA:HA	1:A:330:ALA:HB3	1.97	0.46
1:A:105:PHE:CZ	1:A:273:MET:HE1	2.50	0.45
1:A:232:ARG:NH2	3:A:712:HOH:O	2.42	0.45
1:B:306:SER:HA	1:B:309:ILE:HD12	2.00	0.43
1:A:132:GLU:H	1:A:132:GLU:HG3	1.63	0.43

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:B:150:ALA:O	1:B:154[A]:THR:HG22	2.20	0.42
1:A:252:ILE:HA	1:A:253:PRO:HD3	1.88	0.42
1:A:358:PRO:HD3	1:A:379[A]:SER:OG	2.19	0.42
1:B:321:ILE:H	1:B:321:ILE:HG13	1.62	0.42
1:B:322:ILE:HG13	1:B:369[A]:THR:HG23	2.02	0.41
1:B:132:GLU:H	1:B:132:GLU:HG3	1.62	0.41
1:A:318:TYR:HB2	1:A:320:TRP:CH2	2.54	0.41
1:A:133:TYR:OH	1:A:147:ASP:OD1	2.39	0.41
1:A:135:ILE:HD12	1:A:181:VAL:HG21	2.02	0.41
1:B:184:ASN:HA	1:B:185:PRO:HD3	1.85	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	311/319 (98%)	303 (97%)	7 (2%)	1 (0%)	36	42
1	B	306/319 (96%)	296 (97%)	9 (3%)	1 (0%)	36	42
All	All	617/638 (97%)	599 (97%)	16 (3%)	2 (0%)	36	42

All (2) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	323	PRO
1	B	323	PRO

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	264/268 (98%)	251 (95%)	13 (5%)	22	29
1	B	261/268 (97%)	238 (91%)	23 (9%)	9	10
All	All	525/536 (98%)	489 (93%)	36 (7%)	15	16

All (36) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	98	TYR
1	A	202	ARG
1	A	219[A]	ARG
1	A	219[B]	ARG
1	A	230	ARG
1	A	234	GLN
1	A	256	ARG
1	A	290	ILE
1	A	298	GLU
1	A	307	ARG
1	A	350	GLN
1	A	380	MET
1	A	392	LEU
1	B	103	LEU
1	B	132	GLU
1	B	156	GLN
1	B	159	VAL
1	B	168	LEU
1	B	178	VAL
1	B	191	LEU
1	B	194	ASN
1	B	207	VAL
1	B	213[A]	GLN
1	B	213[B]	GLN
1	B	232[A]	ARG
1	B	232[B]	ARG
1	B	255	LEU
1	B	311	ILE
1	B	321	ILE
1	B	323	PRO
1	B	341	ARG
1	B	350	GLN
1	B	380	MET

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Mol	Chain	Res	Type
1	B	385	GLN
1	B	400	LEU
1	B	402	LEU

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (10) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	144	GLN
1	A	184	ASN
1	A	278	HIS
1	A	303	GLN
1	A	350	GLN
1	A	393	GLN
1	B	251	ASN
1	B	278	HIS
1	B	337	ASN
1	B	350	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 oligosaccharides in this entry.

5.6 Ligand geometry [i](#)

8 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	GOL	A	505	-	5,5,5	0.38	0	5,5,5	0.35	0
2	GOL	B	508	-	5,5,5	0.35	0	5,5,5	0.28	0
2	GOL	B	504	-	5,5,5	0.34	0	5,5,5	0.43	0
2	GOL	A	502	-	5,5,5	0.37	0	5,5,5	0.37	0
2	GOL	A	501	-	5,5,5	0.36	0	5,5,5	0.25	0
2	GOL	B	507	-	5,5,5	0.35	0	5,5,5	0.38	0
2	GOL	B	503	-	5,5,5	0.37	0	5,5,5	0.26	0
2	GOL	A	506	-	5,5,5	0.34	0	5,5,5	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	GOL	A	505	-	-	2/4/4/4	-
2	GOL	B	508	-	-	3/4/4/4	-
2	GOL	B	504	-	-	4/4/4/4	-
2	GOL	A	502	-	-	4/4/4/4	-
2	GOL	A	501	-	-	0/4/4/4	-
2	GOL	B	507	-	-	4/4/4/4	-
2	GOL	B	503	-	-	2/4/4/4	-
2	GOL	A	506	-	-	2/4/4/4	-

There are no bond length outliers.

There are no bond angle outliers.

There are no chirality outliers.

All (21) torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
2	A	502	GOL	O1-C1-C2-O2
2	A	502	GOL	O1-C1-C2-C3
2	A	505	GOL	O1-C1-C2-C3
2	A	506	GOL	O1-C1-C2-C3
2	B	503	GOL	O2-C2-C3-O3
2	B	507	GOL	C1-C2-C3-O3

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Mol	Chain	Res	Type	Atoms
2	B	503	GOL	C1-C2-C3-O3
2	B	504	GOL	O1-C1-C2-C3
2	B	507	GOL	O1-C1-C2-C3
2	B	508	GOL	O1-C1-C2-C3
2	B	508	GOL	C1-C2-C3-O3
2	A	505	GOL	O1-C1-C2-O2
2	A	506	GOL	O1-C1-C2-O2
2	B	507	GOL	O2-C2-C3-O3
2	B	504	GOL	O1-C1-C2-O2
2	B	504	GOL	O2-C2-C3-O3
2	B	507	GOL	O1-C1-C2-O2
2	A	502	GOL	O2-C2-C3-O3
2	B	508	GOL	O2-C2-C3-O3
2	B	504	GOL	C1-C2-C3-O3
2	A	502	GOL	C1-C2-C3-O3

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 [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	302/319 (94%)	-0.19	1 (0%) 90 88	16, 41, 73, 113	13 (4%)
1	B	298/319 (93%)	0.04	4 (1%) 75 73	17, 49, 86, 97	12 (4%)
All	All	600/638 (94%)	-0.07	5 (0%) 82 80	16, 45, 81, 113	25 (4%)

All (5) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	B	252	ILE	2.5
1	B	315[A]	LEU	2.5
1	A	121	TYR	2.3
1	B	403	ALA	2.2
1	B	203	GLY	2.1

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($\text{\AA}^2$)	Q<0.9
2	GOL	B	507	6/6	0.84	0.13	64,96,101,102	0
2	GOL	A	501	6/6	0.85	0.14	50,58,65,69	0
2	GOL	A	505	6/6	0.86	0.18	56,66,77,88	0
2	GOL	B	503	6/6	0.90	0.13	54,66,77,78	0
2	GOL	B	508	6/6	0.91	0.09	42,46,53,60	0
2	GOL	A	506	6/6	0.92	0.09	69,77,84,88	0
2	GOL	B	504	6/6	0.93	0.16	41,76,87,88	0
2	GOL	A	502	6/6	0.94	0.09	41,63,73,78	0

6.5 Other polymers [i](#)

There are no such residues in this entry.