Full wwPDB X-ray Structure Validation Report (i)

Dec 3, 2023 – 02:15 am GMT

PDB ID	:	1OIF
Title	:	Family 1 b-glucosidase from Thermotoga maritima
Authors	:	Gloster, T.; Zechel, D.; Boraston, A.B.; Boraston, C.M.; Macdonald, J.M.; Tilbrook, D.M.; Stick, R.V.; Davies, G.J.
Deposited on	:	2003-06-16
Resolution	:	2.12 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 (i) 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 (i)) were used in the production of this report:

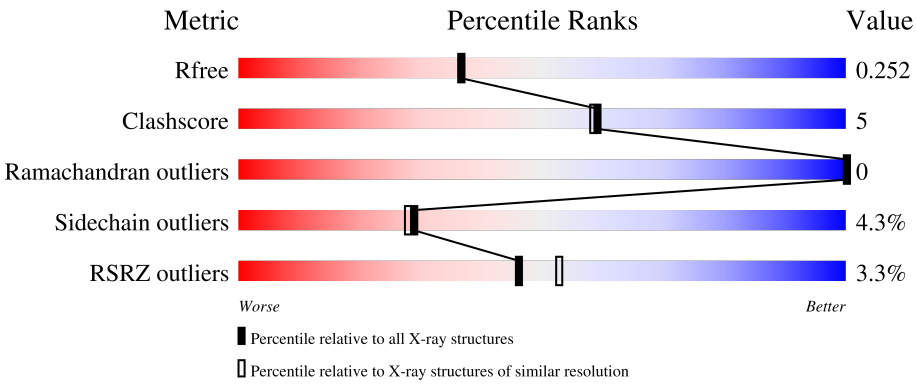
MolProbity	:	4.02b-467
Mogul	:	1.8.4, CSD as541be (2020)
Xtriage (Phenix)	:	1.13
EDS	:	2.36
Percentile statistics	:	20191225.v01 (using entries in the PDB archive December 25th 2019)
Refmac	:	5.8.0158
CCP4	:	7.0.044 (Gargrove)
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, RNA)	:	Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP)	:	2.36

1 Overall quality at a glance (i)

The following experimental techniques were used to determine the structure:
X-RAY DIFFRACTION

The reported resolution of this entry is 2.12 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	6241 (2.14-2.10)
Clashscore	141614	6778 (2.14-2.10)
Ramachandran outliers	138981	6705 (2.14-2.10)
Sidechain outliers	138945	6706 (2.14-2.10)
RSRZ outliers	127900	6112 (2.14-2.10)

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 <=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	468	2% 84% 10% • 5%
1	B	468	4% 81% 13% • 6%

2 Entry composition (i)

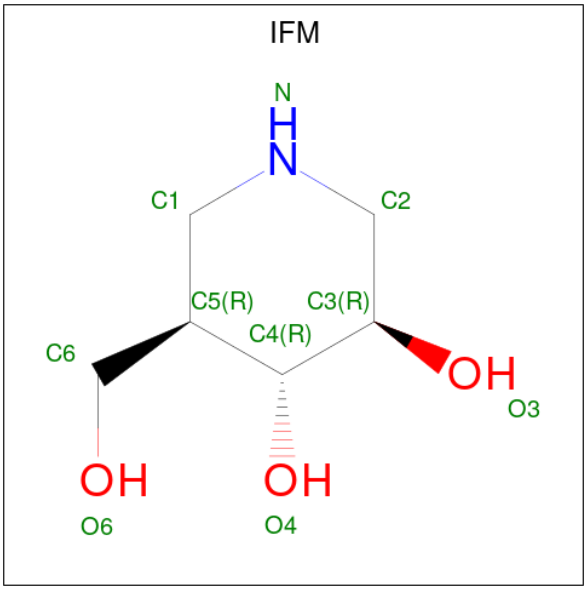
There are 3 unique types of molecules in this entry. The entry contains 7657 atoms, of which 0 are hydrogens and 0 are deuteriums.

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 BETA-GLUCOSIDASE.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
1	A	444	3616	2349	609	652	6	0	4	0
1	B	442	3553	2307	596	644	6	0	2	0

- Molecule 2 is 5-HYDROXYMETHYL-3,4-DIHYDROXYPIPERIDINE (three-letter code: IFM) (formula: $C_6H_{13}NO_3$).



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

- Molecule 3 is water.

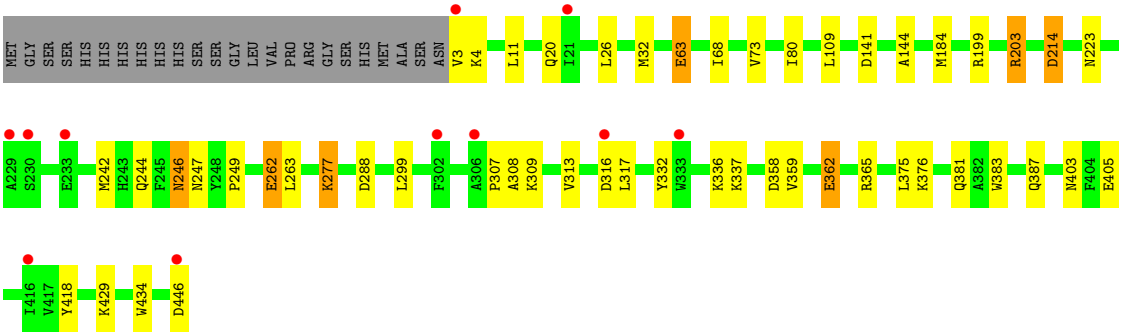
Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
			Total	O		
3	A	271	271	271	0	0
			Total	O		
3	B	197	197	197	0	0

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.

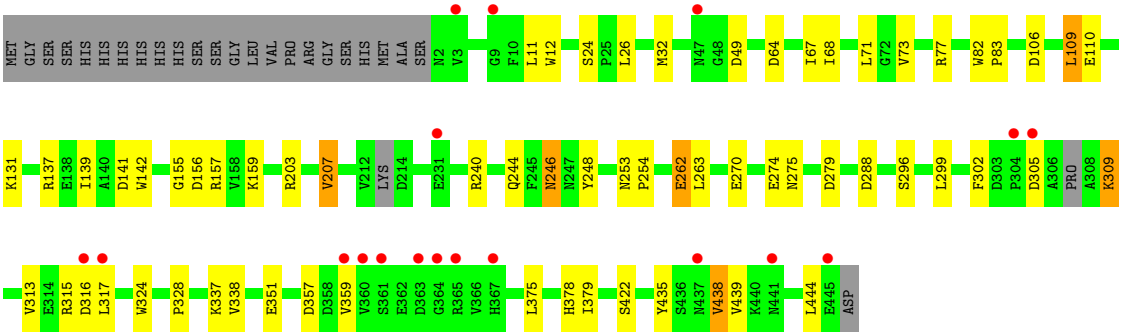
- Molecule 1: BETA-GLUCOSIDASE

Chain A:



- Molecule 1: BETA-GLUCOSIDASE

Chain B:



4 Data and refinement statistics (i)

Property	Value	Source
Space group	P 21 21 21	Depositor
Cell constants a, b, c, α, β, γ	94.65Å 95.19Å 114.16Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	72.55 – 2.12 24.48 – 2.12	Depositor EDS
% Data completeness (in resolution range)	97.7 (72.55-2.12) 97.8 (24.48-2.12)	Depositor EDS
R_{merge}	0.06	Depositor
R_{sym}	(Not available)	Depositor
$< I/\sigma(I) >$ [1]	2.13 (at 2.11Å)	Xtriage
Refinement program	REFMAC 5.1.24	Depositor
R, R_{free}	0.199 , 0.257 0.196 , 0.252	Depositor DCC
R_{free} test set	2935 reflections (5.06%)	wwPDB-VP
Wilson B-factor (Å^2)	35.6	Xtriage
Anisotropy	0.034	Xtriage
Bulk solvent k_{sol}(e/Å^3), B_{sol}(Å^2)	0.34 , 46.6	EDS
L-test for twinning[2]	$< \|L\| > = 0.50$, $< L^2 > = 0.33$	Xtriage
Estimated twinning fraction	0.012 for k,h,-l	Xtriage
F_o,F_c correlation	0.96	EDS
Total number of atoms	7657	wwPDB-VP
Average B, all atoms (Å^2)	38.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 3.38% of the height of the origin peak. No significant pseudotranslation is detected.*

[1] Intensities estimated from amplitudes.

[2] Theoretical values of $< |L| >$, $< L^2 >$ 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: IFM

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	0.74	0/3746	0.81	8/5090 (0.2%)
1	B	0.71	0/3672	0.80	8/4998 (0.2%)
All	All	0.72	0/7418	0.80	16/10088 (0.2%)

There are no bond length outliers.

All (16) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(^{o})	Ideal(^{o})
1	A	288	ASP	CB-CG-OD2	6.68	124.31	118.30
1	B	106	ASP	CB-CG-OD2	6.20	123.88	118.30
1	B	444	LEU	CA-CB-CG	6.19	129.53	115.30
1	A	365	ARG	NE-CZ-NH2	-5.87	117.36	120.30
1	A	199	ARG	NE-CZ-NH1	5.75	123.18	120.30
1	B	316	ASP	CB-CG-OD2	5.63	123.37	118.30
1	A	214	ASP	CB-CG-OD2	5.60	123.34	118.30
1	A	358	ASP	CB-CG-OD2	5.55	123.29	118.30
1	B	49	ASP	CB-CG-OD2	5.50	123.25	118.30
1	B	156	ASP	CB-CG-OD2	5.47	123.22	118.30
1	A	316	ASP	CB-CG-OD2	5.45	123.20	118.30
1	A	365	ARG	NE-CZ-NH1	5.44	123.02	120.30
1	B	288	ASP	CB-CG-OD2	5.38	123.14	118.30
1	B	279	ASP	CB-CG-OD2	5.26	123.04	118.30
1	A	199	ARG	NE-CZ-NH2	-5.09	117.76	120.30
1	B	64	ASP	CB-CG-OD2	5.08	122.87	118.30

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	3616	0	3436	32	0
1	B	3553	0	3325	34	0
2	A	10	0	13	0	0
2	B	10	0	13	0	0
3	A	271	0	0	2	0
3	B	197	0	0	6	0
All	All	7657	0	6787	66	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 5.

All (66) 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:203[A]:ARG:NH2	3:B:2113:HOH:O	1.78	1.15
1:B:203[A]:ARG:CZ	3:B:2113:HOH:O	2.03	1.06
1:B:203[A]:ARG:NE	3:B:2113:HOH:O	1.87	1.05
1:B:262:GLU:HG2	1:B:263:LEU:HD22	1.57	0.86
1:A:362:GLU:H	1:A:362:GLU:CD	1.79	0.82
1:A:144:ALA:HB2	1:A:203[A]:ARG:HG2	1.61	0.82
1:B:141:ASP:OD1	1:B:203[A]:ARG:NH1	2.19	0.73
1:B:68:ILE:CG2	1:B:73:VAL:HG22	2.20	0.72
1:B:270:GLU:HG2	3:B:2141:HOH:O	1.92	0.69
1:B:375:LEU:O	1:B:379:ILE:HG13	1.97	0.65
1:A:262:GLU:HG2	1:A:263:LEU:HD22	1.80	0.64
1:B:244:GLN:NE2	1:B:263:LEU:HD23	2.14	0.63
1:A:244:GLN:HE22	1:A:263:LEU:HD23	1.64	0.62
1:B:67:ILE:O	1:B:71:LEU:HG	2.00	0.61
1:B:315:ARG:HB3	1:B:317:LEU:HD13	1.85	0.59
1:B:68:ILE:HG23	1:B:73:VAL:HG22	1.84	0.58
1:A:4:LYS:HD2	1:A:383:TRP:CE3	2.43	0.54
1:A:307:PRO:O	1:A:308:ALA:HB3	2.08	0.52
1:A:20:GLN:O	1:A:403:ASN:HB2	2.09	0.52
1:B:244:GLN:CD	1:B:263:LEU:HD23	2.30	0.52
1:A:141:ASP:OD1	1:A:203[A]:ARG:NH2	2.40	0.52

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:214:ASP:OD1	1:A:214:ASP:N	2.40	0.51
1:B:240:ARG:NH1	3:B:2127:HOH:O	2.33	0.51
1:B:109:LEU:HD21	1:B:157:ARG:HB3	1.93	0.51
1:A:376:LYS:HB2	1:A:434:TRP:CZ2	2.46	0.50
1:A:223:ASN:HA	1:A:247:ASN:OD1	2.12	0.50
1:B:155:GLY:O	1:B:159:LYS:HE3	2.13	0.48
1:B:12:TRP:HB3	1:B:439:VAL:HG22	1.95	0.48
1:B:246:ASN:ND2	3:B:2129:HOH:O	2.47	0.48
1:A:244:GLN:NE2	1:A:263:LEU:HD23	2.27	0.48
1:A:68:ILE:HG23	1:A:73:VAL:HG22	1.95	0.47
1:A:242:MET:O	1:A:246:ASN:HB2	2.13	0.47
1:B:302:PHE:CE1	1:B:309:LYS:HG2	2.50	0.47
1:B:77:ARG:NH1	1:B:351:GLU:HG3	2.29	0.46
1:A:332:TYR:HB3	1:A:381:GLN:HE21	1.79	0.46
1:A:277:LYS:HB2	3:A:2185:HOH:O	2.15	0.46
1:A:362:GLU:CD	1:A:362:GLU:N	2.58	0.46
1:B:26:LEU:HD21	1:B:32:MET:HG2	1.97	0.46
1:A:299:LEU:HD23	1:A:313:VAL:HG13	1.99	0.45
1:B:77:ARG:HH12	1:B:351:GLU:HG3	1.81	0.45
1:A:362:GLU:N	1:A:362:GLU:OE1	2.50	0.44
1:A:3:VAL:HG12	3:A:2001:HOH:O	2.17	0.44
1:A:376:LYS:HE3	1:A:446:ASP:OXT	2.18	0.44
1:B:435:TYR:HA	1:B:438:VAL:HG13	1.99	0.44
1:A:63:GLU:H	1:A:63:GLU:CD	2.20	0.44
1:A:247:ASN:C	1:A:249:PRO:HD2	2.38	0.43
1:A:4:LYS:CD	1:A:383:TRP:CE3	3.01	0.43
1:B:299:LEU:HB2	1:B:315:ARG:HD3	2.00	0.43
1:B:328:PRO:HA	1:B:378:HIS:NE2	2.35	0.42
1:B:274:GLU:O	1:B:275:ASN:HB2	2.19	0.42
1:B:11:LEU:HD12	1:B:11:LEU:HA	1.92	0.42
1:A:144:ALA:CB	1:A:203[A]:ARG:HG2	2.41	0.42
1:A:299:LEU:HD23	1:A:313:VAL:CG1	2.50	0.42
1:A:383:TRP:CH2	1:A:387:GLN:HG3	2.55	0.42
1:A:405:GLU:HG3	1:A:405:GLU:O	2.19	0.42
1:B:248:TYR:OH	1:B:337:LYS:HB3	2.20	0.41
1:B:82:TRP:HB3	1:B:83:PRO:HD3	2.01	0.41
1:B:253:ASN:HB3	1:B:254:PRO:HD3	2.02	0.41
1:B:296:SER:HB2	1:B:324:TRP:HB3	2.01	0.41
1:A:26:LEU:HD21	1:A:32:MET:HG2	2.02	0.41
1:A:262:GLU:CG	1:A:263:LEU:HD22	2.47	0.41
1:B:139:ILE:HA	1:B:142:TRP:CE3	2.55	0.41

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:418:TYR:HB2	1:A:429:LYS:HE2	2.03	0.41
1:A:184:MET:HE2	1:A:184:MET:HB2	1.71	0.40
1:B:12:TRP:CB	1:B:439:VAL:HG22	2.52	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	446/468 (95%)	435 (98%)	11 (2%)	0	100	100
1	B	438/468 (94%)	431 (98%)	7 (2%)	0	100	100
All	All	884/936 (94%)	866 (98%)	18 (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	370/399 (93%)	354 (96%)	16 (4%)	29	28
1	B	358/399 (90%)	342 (96%)	16 (4%)	27	26
All	All	728/798 (91%)	696 (96%)	32 (4%)	29	27

All (32) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	11	LEU
1	A	63	GLU
1	A	80	ILE
1	A	109	LEU
1	A	203[A]	ARG
1	A	203[B]	ARG
1	A	246	ASN
1	A	262	GLU
1	A	277	LYS
1	A	309	LYS
1	A	317	LEU
1	A	336	LYS
1	A	337	LYS
1	A	359	VAL
1	A	362	GLU
1	A	375	LEU
1	B	24	SER
1	B	109	LEU
1	B	110	GLU
1	B	131	LYS
1	B	137	ARG
1	B	207	VAL
1	B	246	ASN
1	B	262	GLU
1	B	305	ASP
1	B	309	LYS
1	B	313	VAL
1	B	338	VAL
1	B	357	ASP
1	B	359	VAL
1	B	422	SER
1	B	438	VAL

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (2) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	381	GLN
1	B	441	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 monosaccharides 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	IFM	B	1446	-	9,10,10	0.73	0	9,13,13	2.14	5 (55%)
2	IFM	A	1447	-	9,10,10	1.67	3 (33%)	9,13,13	2.20	4 (44%)

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	IFM	B	1446	-	-	0/2/16/16	0/1/1/1
2	IFM	A	1447	-	-	0/2/16/16	0/1/1/1

All (3) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
2	A	1447	IFM	C3-C4	3.14	1.57	1.52
2	A	1447	IFM	C5-C4	2.74	1.56	1.53
2	A	1447	IFM	C2-C3	2.03	1.54	1.52

All (9) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(^{o})	Ideal(^{o})
2	B	1446	IFM	C2-C3-C4	4.21	115.27	110.33
2	A	1447	IFM	C1-N-C2	3.44	115.48	111.70
2	A	1447	IFM	O3-C3-C4	2.84	115.83	110.14
2	B	1446	IFM	C1-N-C2	2.83	114.81	111.70
2	A	1447	IFM	O4-C4-C5	2.78	114.78	110.08
2	A	1447	IFM	C2-C3-C4	2.74	113.55	110.33
2	B	1446	IFM	O4-C4-C5	2.17	113.75	110.08
2	B	1446	IFM	O4-C4-C3	-2.15	105.87	109.99
2	B	1446	IFM	O3-C3-C4	2.04	114.22	110.14

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 (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	444/468 (94%)	-0.01	11 (2%)	57	62	21, 37, 57, 67	0
1	B	442/468 (94%)	0.11	18 (4%)	37	43	22, 38, 57, 66	1 (0%)
All	All	886/936 (94%)	0.05	29 (3%)	46	53	21, 37, 57, 67	1 (0%)

All (29) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	B	359	VAL	4.9
1	A	446	ASP	4.8
1	B	361	SER	4.1
1	B	360	VAL	4.0
1	B	9	GLY	3.7
1	A	3	VAL	3.6
1	B	437	ASN	3.6
1	B	363	ASP	3.3
1	A	302	PHE	3.2
1	B	441	ASN	3.0
1	B	47	ASN	3.0
1	B	304	PRO	2.8
1	B	364	GLY	2.7
1	A	229	ALA	2.7
1	B	367	HIS	2.7
1	B	445	GLU	2.6
1	B	316	ASP	2.4
1	A	306	ALA	2.4
1	A	416	ILE	2.3
1	A	333	TRP	2.3
1	B	231	GLU	2.3
1	B	365	ARG	2.3
1	A	233	GLU	2.2
1	B	3	VAL	2.2

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Mol	Chain	Res	Type	RSRZ
1	A	316	ASP	2.2
1	B	305	ASP	2.1
1	A	230	SER	2.1
1	A	21	ILE	2.1
1	B	317	LEU	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 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, 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	IFM	B	1446	10/10	0.93	0.12	27,31,36,37	0
2	IFM	A	1447	10/10	0.98	0.06	20,25,26,26	0

6.5 Other polymers (i)

There are no such residues in this entry.