



Full wwPDB X-ray Structure Validation Report ⓘ

Mar 7, 2026 – 02:06 AM UTC

PDB ID : 7ZEQ / pdb_00007zeq
Title : Apo crystal structure of beta-xylosidase from Thermotoga maritima
Authors : Gloster, T.M.; Foltanyi, F.
Deposited on : 2022-03-31
Resolution : 1.89 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

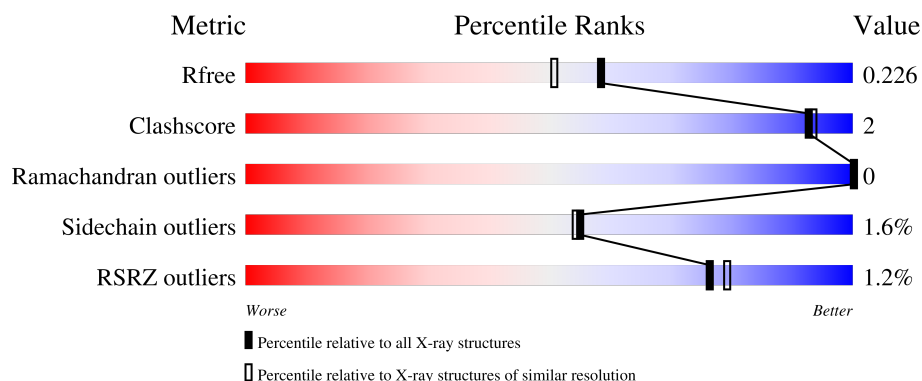
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

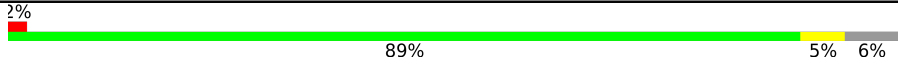
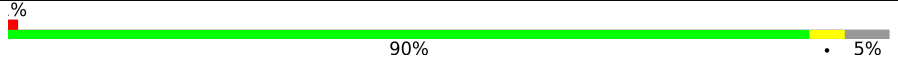
The reported resolution of this entry is 1.89 Å.

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	7789 (1.90-1.90)
Clashscore	190562	8410 (1.90-1.90)
Ramachandran outliers	187476	8333 (1.90-1.90)
Sidechain outliers	187428	8333 (1.90-1.90)
RSRZ outliers	180081	7790 (1.90-1.90)

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	X	801	
1	Y	801	

2 Entry composition [i](#)

There are 3 unique types of molecules in this entry. The entry contains 11961 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-xylosidase.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	X	754	Total	C	N	O	S	0	2	0
			5868	3740	1001	1104	23			
1	Y	759	Total	C	N	O	S	0	2	0
			5895	3757	1010	1105	23			

There are 46 discrepancies between the modelled and reference sequences:

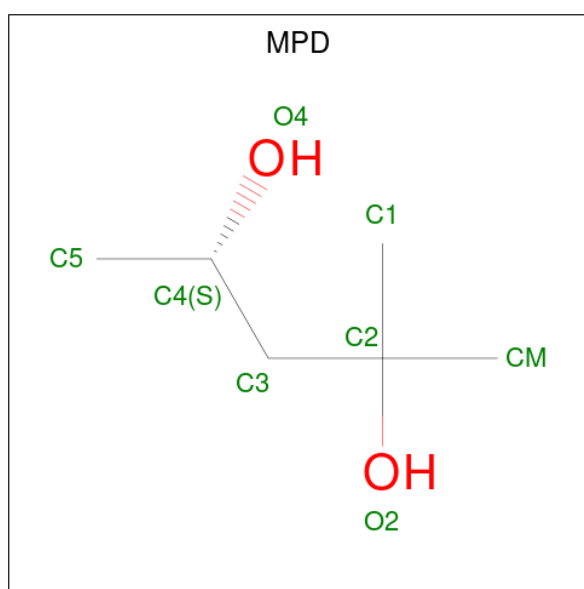
Chain	Residue	Modelled	Actual	Comment	Reference
X	779	ALA	-	expression tag	UNP R4NX63
X	780	ALA	-	expression tag	UNP R4NX63
X	781	ALA	-	expression tag	UNP R4NX63
X	782	LEU	-	expression tag	UNP R4NX63
X	783	GLU	-	expression tag	UNP R4NX63
X	784	GLU	-	expression tag	UNP R4NX63
X	785	ASN	-	expression tag	UNP R4NX63
X	786	LEU	-	expression tag	UNP R4NX63
X	787	TYR	-	expression tag	UNP R4NX63
X	788	PHE	-	expression tag	UNP R4NX63
X	789	GLN	-	expression tag	UNP R4NX63
X	790	GLY	-	expression tag	UNP R4NX63
X	791	ALA	-	expression tag	UNP R4NX63
X	792	HIS	-	expression tag	UNP R4NX63
X	793	HIS	-	expression tag	UNP R4NX63
X	794	HIS	-	expression tag	UNP R4NX63
X	795	HIS	-	expression tag	UNP R4NX63
X	796	HIS	-	expression tag	UNP R4NX63
X	797	HIS	-	expression tag	UNP R4NX63
X	798	HIS	-	expression tag	UNP R4NX63
X	799	HIS	-	expression tag	UNP R4NX63
X	800	HIS	-	expression tag	UNP R4NX63
X	801	HIS	-	expression tag	UNP R4NX63
Y	779	ALA	-	expression tag	UNP R4NX63
Y	780	ALA	-	expression tag	UNP R4NX63

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Chain	Residue	Modelled	Actual	Comment	Reference
Y	781	ALA	-	expression tag	UNP R4NX63
Y	782	LEU	-	expression tag	UNP R4NX63
Y	783	GLU	-	expression tag	UNP R4NX63
Y	784	GLU	-	expression tag	UNP R4NX63
Y	785	ASN	-	expression tag	UNP R4NX63
Y	786	LEU	-	expression tag	UNP R4NX63
Y	787	TYR	-	expression tag	UNP R4NX63
Y	788	PHE	-	expression tag	UNP R4NX63
Y	789	GLN	-	expression tag	UNP R4NX63
Y	790	GLY	-	expression tag	UNP R4NX63
Y	791	ALA	-	expression tag	UNP R4NX63
Y	792	HIS	-	expression tag	UNP R4NX63
Y	793	HIS	-	expression tag	UNP R4NX63
Y	794	HIS	-	expression tag	UNP R4NX63
Y	795	HIS	-	expression tag	UNP R4NX63
Y	796	HIS	-	expression tag	UNP R4NX63
Y	797	HIS	-	expression tag	UNP R4NX63
Y	798	HIS	-	expression tag	UNP R4NX63
Y	799	HIS	-	expression tag	UNP R4NX63
Y	800	HIS	-	expression tag	UNP R4NX63
Y	801	HIS	-	expression tag	UNP R4NX63

- Molecule 2 is (4S)-2-METHYL-2,4-PENTANEDIOL (CCD ID: MPD) (formula: C₆H₁₄O₂).



Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
2	X	1	Total	C	O	0	0
			8	6	2		

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Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
2	Y	1	Total	C	O	0	0
			8	6	2		

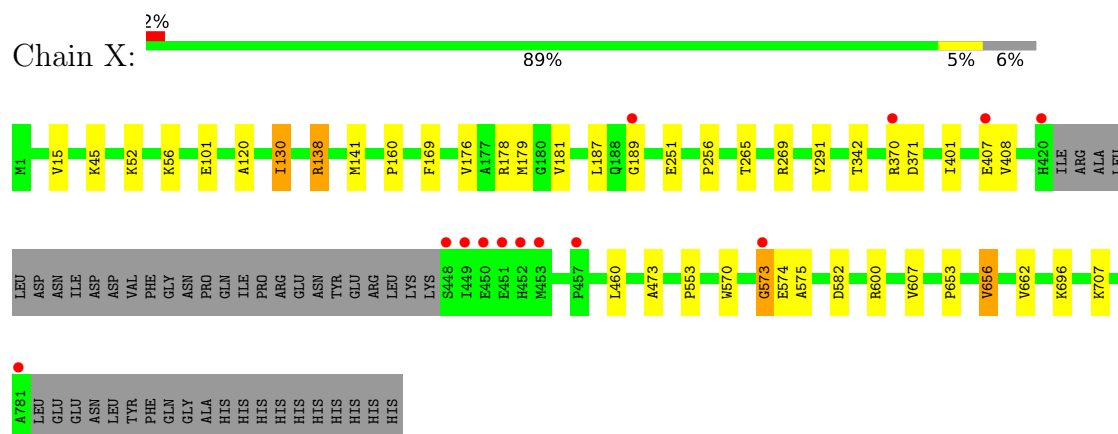
- Molecule 3 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
3	X	79	Total	O	0	0
			79	79		
3	Y	103	Total	O	0	0
			103	103		

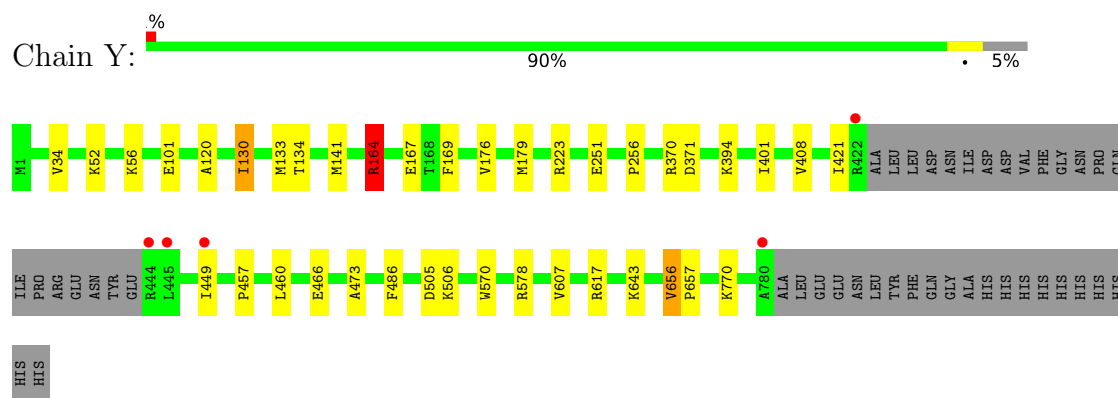
3 Residue-property plots [i](#)

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-xylosidase



• Molecule 1: Beta-xylosidase



4 Data and refinement statistics

Property	Value	Source
Space group	P 21 21 2	Depositor
Cell constants a, b, c, α , β , γ	179.08Å 98.59Å 100.92Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	55.40 – 1.89 55.40 – 1.89	Depositor EDS
% Data completeness (in resolution range)	99.9 (55.40-1.89) 99.9 (55.40-1.89)	Depositor EDS
R_{merge}	(Not available)	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	1.31 (at 1.90Å)	Xtriage
Refinement program	REFMAC 5.8.0267	Depositor
R, R_{free}	0.194 , 0.226 0.194 , 0.226	Depositor DCC
R_{free} test set	7250 reflections (5.07%)	wwPDB-VP
Wilson B-factor (Å ²)	31.2	Xtriage
Anisotropy	0.561	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.32 , 22.7	EDS
L-test for twinning ²	$\langle L \rangle = 0.51$, $\langle L^2 \rangle = 0.34$	Xtriage
Estimated twinning fraction	0.004 for -h,l,k	Xtriage
F_o, F_c correlation	0.97	EDS
Total number of atoms	11961	wwPDB-VP
Average B, all atoms (Å ²)	36.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 4.32% 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: MPD

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	X	0.61	0/5979	0.98	6/8081 (0.1%)
1	Y	0.60	0/6006	0.98	4/8120 (0.0%)
All	All	0.60	0/11985	0.98	10/16201 (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	X	0	2
1	Y	0	1
All	All	0	3

There are no bond length outliers.

All (10) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	X	138	ARG	CB-CG-CD	-7.01	95.18	111.30
1	Y	164	ARG	CB-CG-CD	-6.58	96.17	111.30
1	Y	223	ARG	CG-CD-NE	-5.85	99.14	112.00
1	X	407	GLU	CA-C-N	5.45	127.92	120.46
1	X	407	GLU	C-N-CA	5.45	127.92	120.46
1	X	600	ARG	CG-CD-NE	-5.24	100.47	112.00
1	Y	371	ASP	CA-CB-CG	5.08	117.68	112.60
1	X	582	ASP	CA-CB-CG	5.08	117.68	112.60
1	Y	486	PHE	CA-CB-CG	5.06	118.86	113.80
1	X	371	ASP	CA-CB-CG	5.03	117.62	112.60

There are no chirality outliers.

All (3) planarity outliers are listed below:

Mol	Chain	Res	Type	Group
1	X	189	GLY	Peptide
1	X	573	GLY	Peptide
1	Y	505	ASP	Peptide

5.2 Too-close contacts

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	X	5868	0	5898	19	0
1	Y	5895	0	5915	18	0
2	X	8	0	14	0	0
2	Y	8	0	14	0	0
3	X	79	0	0	0	0
3	Y	103	0	0	1	0
All	All	11961	0	11841	36	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 2.

All (36) 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:X:656:VAL:HG11	1:X:662:VAL:HG22	1.53	0.89
1:X:130:ILE:HG12	1:X:179:MET:HE1	1.54	0.88
1:Y:130:ILE:HG12	1:Y:179:MET:HE1	1.66	0.78
1:X:101:GLU:HB2	1:X:141:MET:HE1	1.66	0.75
1:Y:164:ARG:HD3	1:Y:167:GLU:OE2	1.89	0.72
1:Y:370[B]:ARG:HH12	1:Y:457:PRO:HD2	1.55	0.71
1:Y:101:GLU:HB2	1:Y:141:MET:HE1	1.71	0.71
1:X:653:PRO:HG2	1:X:656:VAL:HG12	1.73	0.70
1:X:120:ALA:HB2	1:X:570:TRP:HB2	1.84	0.59
1:Y:130:ILE:CG1	1:Y:179:MET:HE1	2.31	0.59
1:Y:370[B]:ARG:HH12	1:Y:457:PRO:CD	2.16	0.58
1:X:656:VAL:HG11	1:X:662:VAL:CG2	2.31	0.58
1:X:130:ILE:HG12	1:X:179:MET:CE	2.31	0.56

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:Y:120:ALA:HB2	1:Y:570:TRP:HB2	1.88	0.56
1:X:160:PRO:HB3	1:X:553:PRO:HD2	1.89	0.54
1:Y:421:ILE:HG23	1:Y:449:ILE:HD11	1.90	0.54
1:X:370[B]:ARG:NE	1:X:574:GLU:OE2	2.44	0.51
1:Y:251:GLU:HA	1:Y:256:PRO:HA	1.93	0.51
1:X:291:TYR:OH	1:Y:617:ARG:NH1	2.42	0.48
1:X:251:GLU:HA	1:X:256:PRO:HA	1.97	0.47
1:X:138:ARG:HD2	1:X:187:LEU:O	2.16	0.45
1:Y:169:PHE:HB2	1:Y:176:VAL:HG22	1.98	0.45
1:X:52:LYS:O	1:X:56:LYS:HB3	2.16	0.45
1:X:401:ILE:HA	1:X:473:ALA:O	2.17	0.45
1:Y:52:LYS:O	1:Y:56:LYS:HB3	2.16	0.44
1:Y:656:VAL:HG22	1:Y:657:PRO:HD2	1.98	0.44
1:X:573:GLY:C	1:X:575:ALA:H	2.26	0.44
1:Y:394:LYS:HE2	1:Y:466:GLU:OE2	2.18	0.43
1:Y:133:MET:HE2	1:Y:134:THR:HG23	2.01	0.43
1:Y:401:ILE:HA	1:Y:473:ALA:O	2.18	0.43
1:X:265:THR:HA	1:X:269[B]:ARG:HG3	2.02	0.41
1:Y:164:ARG:CD	1:Y:167:GLU:OE2	2.63	0.41
1:X:169:PHE:HB2	1:X:176:VAL:HG22	2.02	0.41
1:X:15:VAL:HG11	1:X:342:THR:HG23	2.02	0.41
1:X:573:GLY:C	1:X:575:ALA:N	2.76	0.41
1:Y:34:VAL:HG22	3:Y:1034:HOH:O	2.20	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	X	752/801 (94%)	737 (98%)	15 (2%)	0	100	100
1	Y	757/801 (94%)	748 (99%)	9 (1%)	0	100	100

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Mol	Chain	Analysed	Favoured	Allowed	Outliers	Percentiles	
All	All	1509/1602 (94%)	1485 (98%)	24 (2%)	0	100	100

There are no Ramachandran outliers to report.

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	X	624/678 (92%)	614 (98%)	10 (2%)	55	54
1	Y	624/678 (92%)	614 (98%)	10 (2%)	55	54
All	All	1248/1356 (92%)	1228 (98%)	20 (2%)	55	54

All (20) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	X	45	LYS
1	X	130	ILE
1	X	178	ARG
1	X	181	VAL
1	X	408	VAL
1	X	460	LEU
1	X	607	VAL
1	X	656	VAL
1	X	696	LYS
1	X	707	LYS
1	Y	130	ILE
1	Y	164	ARG
1	Y	408	VAL
1	Y	460	LEU
1	Y	506	LYS
1	Y	578	ARG
1	Y	607	VAL
1	Y	643	LYS
1	Y	656	VAL
1	Y	770	LYS

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

Mol	Chain	Res	Type
1	X	57	ASN
1	Y	57	ASN
1	Y	410	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 oligosaccharides 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	MPD	Y	901	-	7,7,7	0.14	0	9,10,10	0.73	0
2	MPD	X	901	-	7,7,7	0.13	0	9,10,10	0.51	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	MPD	Y	901	-	-	0/5/5/5	-
2	MPD	X	901	-	-	0/5/5/5	-

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 [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	X	754/801 (94%)	-0.14	13 (1%) 69 72	16, 35, 54, 77	2 (0%)
1	Y	759/801 (94%)	-0.20	5 (0%) 84 86	15, 34, 54, 72	2 (0%)
All	All	1513/1602 (94%)	-0.17	18 (1%) 76 79	15, 34, 54, 77	4 (0%)

All (18) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	X	449	ILE	4.4
1	X	573	GLY	4.2
1	Y	422	ARG	4.2
1	X	781	ALA	4.0
1	X	420	HIS	3.6
1	Y	444	ARG	3.2
1	X	457	PRO	3.0
1	Y	445	LEU	3.0
1	Y	449	ILE	2.8
1	Y	780	ALA	2.8
1	X	448	SER	2.6
1	X	453	MET	2.5
1	X	450	GLU	2.5
1	X	370[A]	ARG	2.4
1	X	189	GLY	2.4
1	X	452	HIS	2.1
1	X	407	GLU	2.1
1	X	451	GLU	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	MPD	X	901	8/8	0.88	0.16	41,53,61,65	0
2	MPD	Y	901	8/8	0.89	0.14	43,47,57,58	0

6.5 Other polymers [i](#)

There are no such residues in this entry.