



# Full wwPDB X-ray Structure Validation Report ⓘ

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PDB ID : 9UJ3 / pdb\_00009uj3  
Title : Improved thermostability of a GH10 xylanase based on its X-ray crystal structure  
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Deposited on : 2025-04-16  
Resolution : 1.91 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](mailto: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>.

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

MolProbity	:	4-5-2 with Phenix2.0
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

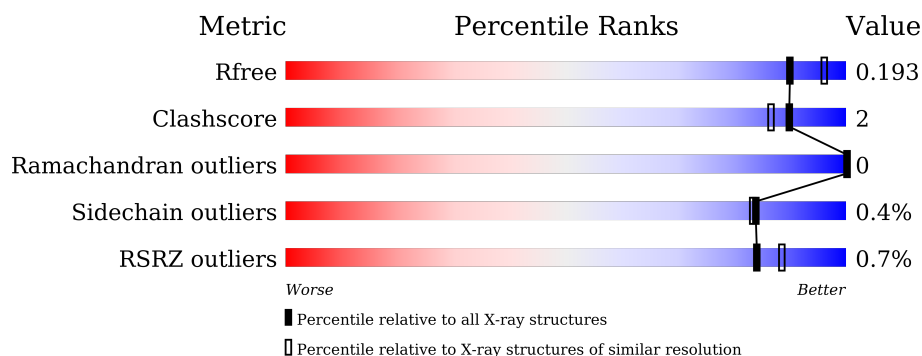
# 1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

*X-RAY DIFFRACTION*

The reported resolution of this entry is 1.91 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	1188 (1.92-1.92)
Clashscore	190562	1209 (1.92-1.92)
Ramachandran outliers	187476	1195 (1.92-1.92)
Sidechain outliers	187428	1195 (1.92-1.92)
RSRZ outliers	180081	1188 (1.92-1.92)

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  $\geq 3$ , 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	383	<div> <div>%</div> <div> <div></div> <div>88%</div> <div>•</div> <div>8%</div> </div> </div>
1	B	383	<div> <div>%</div> <div> <div></div> <div>87%</div> <div>5%</div> <div>8%</div> </div> </div>

## 2 Entry composition

There are 2 unique types of molecules in this entry. The entry contains 6212 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-xylanase.

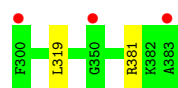
Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	353	Total	C	N	O	S	0	0	0
			2768	1757	502	492	17			
1	B	353	Total	C	N	O	S	0	0	0
			2766	1755	502	492	17			

- Molecule 2 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
2	A	335	Total	O	0	0
			335	335		
2	B	343	Total	O	0	0
			343	343		



- Molecule 1: Beta-xylanase



Chain B:  87% 5% 8%



## 4 Data and refinement statistics

Property	Value	Source
Space group	P 1 21 1	Depositor
Cell constants a, b, c, $\alpha$ , $\beta$ , $\gamma$	53.08Å 68.49Å 90.54Å 90.00° 92.67° 90.00°	Depositor
Resolution (Å)	33.66 – 1.91 33.66 – 1.91	Depositor EDS
% Data completeness (in resolution range)	99.2 (33.66-1.91) 99.2 (33.66-1.91)	Depositor EDS
$R_{merge}$	(Not available)	Depositor
$R_{sym}$	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ <sup>1</sup>	1.89 (at 1.91Å)	Xtriage
Refinement program	REFMAC 5.8.0419	Depositor
R, $R_{free}$	0.159 , 0.193 0.159 , 0.193	Depositor DCC
$R_{free}$ test set	2441 reflections (4.86%)	wwPDB-VP
Wilson B-factor (Å <sup>2</sup> )	18.4	Xtriage
Anisotropy	0.436	Xtriage
Bulk solvent $k_{sol}$ (e/Å <sup>3</sup> ), $B_{sol}$ (Å <sup>2</sup> )	0.35 , 41.4	EDS
L-test for twinning <sup>2</sup>	$\langle  L  \rangle = 0.50$ , $\langle L^2 \rangle = 0.33$	Xtriage
Estimated twinning fraction	0.027 for h,-k,-l	Xtriage
$F_o, F_c$ correlation	0.96	EDS
Total number of atoms	6212	wwPDB-VP
Average B, all atoms (Å <sup>2</sup> )	20.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 5.44% of the height of the origin peak. No significant pseudotranslation is detected.*

<sup>1</sup>Intensities estimated from amplitudes.

<sup>2</sup>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](#)

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	0.30	0/2837	0.54	1/3841 (0.0%)
1	B	0.30	0/2834	0.55	2/3837 (0.1%)
All	All	0.30	0/5671	0.54	3/7678 (0.0%)

There are no bond length outliers.

All (3) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	121	GLN	N-CA-C	7.83	119.81	111.28
1	B	31	PRO	N-CA-CB	7.71	111.48	103.00
1	B	121	GLN	N-CA-C	6.01	117.83	111.28

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	2768	0	2762	8	0
1	B	2766	0	2756	12	0
2	A	335	0	0	1	0
2	B	343	0	0	4	0
All	All	6212	0	5518	20	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 (20) 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:40:LYS:O	1:A:381:ARG:HG2	1.87	0.74
1:B:174:LYS:NZ	2:B:402:HOH:O	2.22	0.73
1:B:136:LYS:NZ	2:B:403:HOH:O	2.22	0.70
1:B:40:LYS:O	1:B:381:ARG:HG2	1.94	0.67
1:B:58:LYS:NZ	2:B:404:HOH:O	2.27	0.66
1:A:52:GLU:HG3	1:A:80:ASN:ND2	2.21	0.56
1:B:342:TRP:HE3	1:B:345:ALA:HB2	1.76	0.50
1:B:42:MET:HE1	1:B:319:LEU:HD22	1.95	0.49
1:B:221:ASP:OD2	2:B:401:HOH:O	2.20	0.48
1:A:142:HIS:HE1	2:A:670:HOH:O	1.97	0.47
1:B:312:ARG:HG2	1:B:370:ALA:HB1	1.97	0.46
1:B:342:TRP:CE3	1:B:345:ALA:HB2	2.51	0.44
1:A:42:MET:HE1	1:A:319:LEU:HD22	1.98	0.44
1:B:235:GLU:O	1:B:239:ARG:HG3	2.19	0.42
1:A:124:LYS:HE2	1:A:124:LYS:HB2	1.84	0.42
1:B:75:MET:HE3	1:B:328:LEU:HG	2.01	0.42
1:A:91:PRO:HD3	1:A:129:TRP:CG	2.55	0.42
1:B:173:PRO:O	1:B:221:ASP:HB3	2.19	0.42
1:A:118:LEU:HD11	1:A:151:ALA:HA	2.02	0.41
1:A:267:LEU:O	1:A:271:ARG:HG3	2.19	0.41

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	351/383 (92%)	344 (98%)	7 (2%)	0	100	100
1	B	351/383 (92%)	345 (98%)	6 (2%)	0	100	100
All	All	702/766 (92%)	689 (98%)	13 (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	279/299 (93%)	278 (100%)	1 (0%)	84	83
1	B	278/299 (93%)	277 (100%)	1 (0%)	84	83
All	All	557/598 (93%)	555 (100%)	2 (0%)	84	83

All (2) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	215	MET
1	B	215	MET

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

Mol	Chain	Res	Type
1	A	142	HIS
1	A	208	GLN
1	B	131	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](#)

There are no ligands in this entry.

## 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, 95<sup>th</sup> 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 <sup>2</sup> )	Q<0.9
1	A	353/383 (92%)	-0.46	3 (0%) 82 88	12, 18, 30, 42	0
1	B	353/383 (92%)	-0.43	2 (0%) 85 89	12, 18, 29, 40	0
All	All	706/766 (92%)	-0.44	5 (0%) 84 88	12, 18, 30, 42	0

All (5) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	383	ALA	3.8
1	A	300	PHE	3.4
1	B	342	TRP	3.1
1	B	31	PRO	3.1
1	A	350	GLY	2.2

### 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](#)

There are no ligands in this entry.

### 6.5 Other polymers [i](#)

There are no such residues in this entry.