



# wwPDB X-ray Structure Validation Summary Report ⓘ

Oct 28, 2024 – 11:32 am GMT

PDB ID : 4UZ8  
Title : The SeMet structure of the family 46 carbohydrate-binding module (CBM46) of endo-beta-1,4-glucanase B (Cel5B) from *Bacillus halodurans*  
Authors : Venditto, I.; Santos, H.; Ferreira, L.M.A.; Sakka, K.; Fontes, C.M.G.A.; Najmudin, S.  
Deposited on : 2014-09-04  
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](mailto:validation@mail.wwpdb.org)

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<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 : 4.02b-467  
Mogul : 1.8.4, CSD as541be (2020)  
Xtriage (Phenix) : 1.13  
EDS : 3.0  
Percentile statistics : 20231227.v01 (using entries in the PDB archive December 27th 2023)  
CCP4 : 9.0.003 (Gargrove)  
Density-Fitness : 1.0.11  
Ideal geometry (proteins) : Engh & Huber (2001)  
Ideal geometry (DNA, RNA) : Parkinson et al. (1996)  
Validation Pipeline (wwPDB-VP) : 2.39

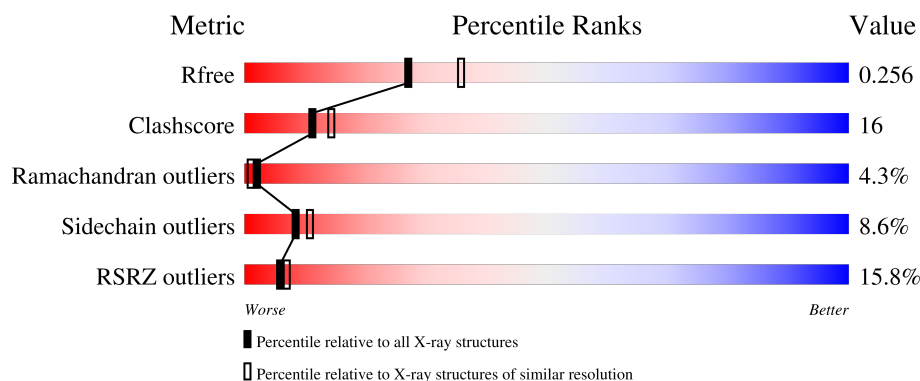
# 1 Overall quality at a glance

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))
$R_{free}$	164625	5963 (2.30-2.30)
Clashscore	180529	6698 (2.30-2.30)
Ramachandran outliers	177936	6640 (2.30-2.30)
Sidechain outliers	177891	6640 (2.30-2.30)
RSRZ outliers	164620	5963 (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  $\geq 3$ , 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	130	
1	B	130	

The following table lists non-polymeric compounds, carbohydrate monomers and non-standard residues in protein, DNA, RNA chains that are outliers for geometric or electron-density-fit criteria:

Mol	Type	Chain	Res	Chirality	Geometry	Clashes	Electron density
2	SO4	B	1564	-	-	X	-

## 2 Entry composition [i](#)

There are 3 unique types of molecules in this entry. The entry contains 1745 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 ENDO-BETA-1,4-GLUCANASE (CELULASE B).

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	107	Total	C	N	O	Se	0	3	0
			857	545	145	165	2			
1	B	106	Total	C	N	O	Se	0	0	0
			824	522	138	162	2			

There are 46 discrepancies between the modelled and reference sequences:

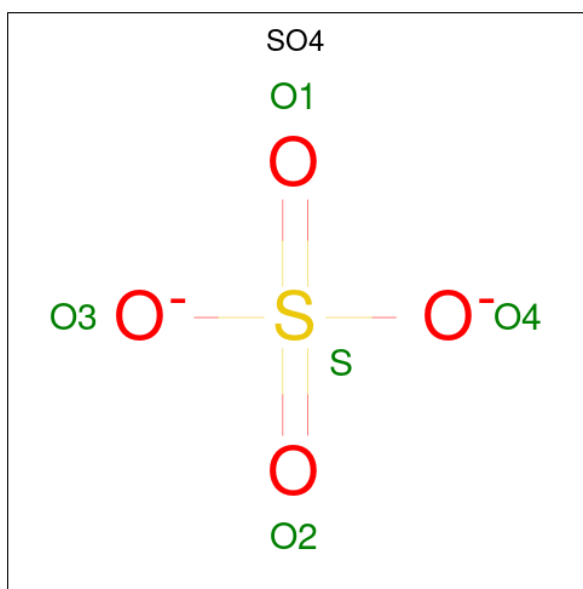
Chain	Residue	Modelled	Actual	Comment	Reference
A	434	MSE	-	expression tag	UNP Q9KF82
A	435	GLY	-	expression tag	UNP Q9KF82
A	436	SER	-	expression tag	UNP Q9KF82
A	437	SER	-	expression tag	UNP Q9KF82
A	438	HIS	-	expression tag	UNP Q9KF82
A	439	HIS	-	expression tag	UNP Q9KF82
A	440	HIS	-	expression tag	UNP Q9KF82
A	441	HIS	-	expression tag	UNP Q9KF82
A	442	HIS	-	expression tag	UNP Q9KF82
A	443	HIS	-	expression tag	UNP Q9KF82
A	444	SER	-	expression tag	UNP Q9KF82
A	445	SER	-	expression tag	UNP Q9KF82
A	446	GLY	-	expression tag	UNP Q9KF82
A	447	LEU	-	expression tag	UNP Q9KF82
A	448	VAL	-	expression tag	UNP Q9KF82
A	449	PRO	-	expression tag	UNP Q9KF82
A	450	ARG	-	expression tag	UNP Q9KF82
A	451	GLY	-	expression tag	UNP Q9KF82
A	452	SER	-	expression tag	UNP Q9KF82
A	453	HIS	-	expression tag	UNP Q9KF82
A	454	MSE	-	expression tag	UNP Q9KF82
A	455	ALA	-	expression tag	UNP Q9KF82
A	456	SER	-	expression tag	UNP Q9KF82
B	434	MSE	-	expression tag	UNP Q9KF82
B	435	GLY	-	expression tag	UNP Q9KF82

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Chain	Residue	Modelled	Actual	Comment	Reference
B	436	SER	-	expression tag	UNP Q9KF82
B	437	SER	-	expression tag	UNP Q9KF82
B	438	HIS	-	expression tag	UNP Q9KF82
B	439	HIS	-	expression tag	UNP Q9KF82
B	440	HIS	-	expression tag	UNP Q9KF82
B	441	HIS	-	expression tag	UNP Q9KF82
B	442	HIS	-	expression tag	UNP Q9KF82
B	443	HIS	-	expression tag	UNP Q9KF82
B	444	SER	-	expression tag	UNP Q9KF82
B	445	SER	-	expression tag	UNP Q9KF82
B	446	GLY	-	expression tag	UNP Q9KF82
B	447	LEU	-	expression tag	UNP Q9KF82
B	448	VAL	-	expression tag	UNP Q9KF82
B	449	PRO	-	expression tag	UNP Q9KF82
B	450	ARG	-	expression tag	UNP Q9KF82
B	451	GLY	-	expression tag	UNP Q9KF82
B	452	SER	-	expression tag	UNP Q9KF82
B	453	HIS	-	expression tag	UNP Q9KF82
B	454	MSE	-	expression tag	UNP Q9KF82
B	455	ALA	-	expression tag	UNP Q9KF82
B	456	SER	-	expression tag	UNP Q9KF82

- Molecule 2 is SULFATE ION (three-letter code: SO4) (formula: O<sub>4</sub>S).



Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
2	B	1	Total	O	S	0	0
			5	4	1		

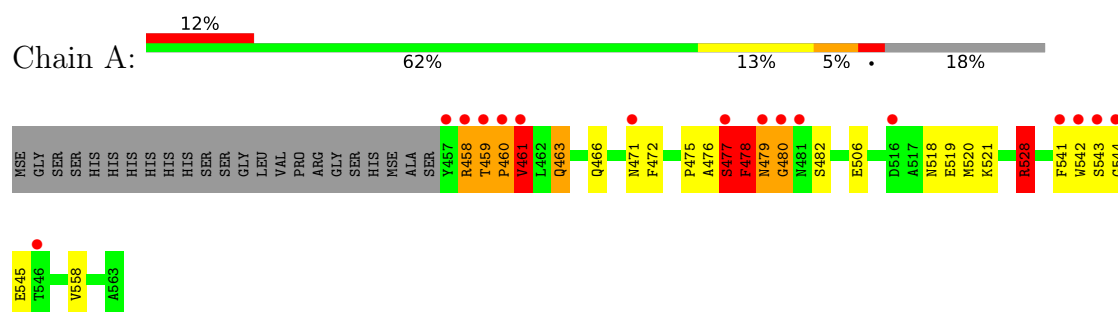
- Molecule 3 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
3	A	31	Total 31	O 31	0	0
3	B	28	Total 28	O 28	0	0

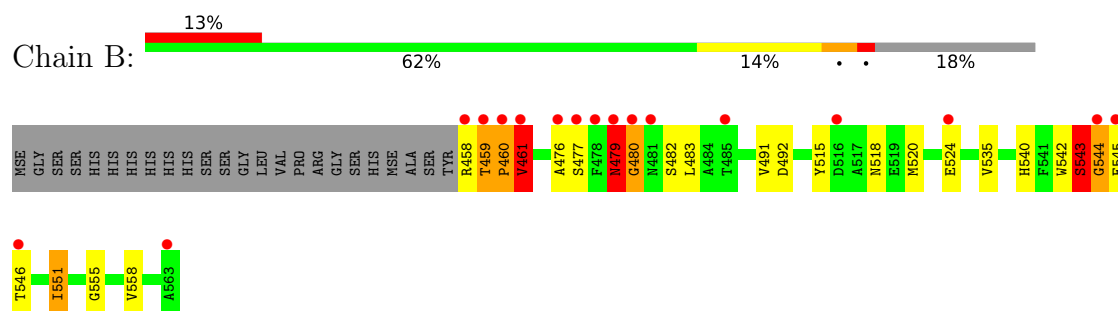
### 3 Residue-property plots [i](#)

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: ENDO-BETA-1,4-GLUCANASE (CELULASE B)



- Molecule 1: ENDO-BETA-1,4-GLUCANASE (CELULASE B)



## 4 Data and refinement statistics

Property	Value	Source
Space group	I 41 2 2	Depositor
Cell constants a, b, c, $\alpha$ , $\beta$ , $\gamma$	120.85Å 120.85Å 76.38Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	85.45 – 2.30 85.45 – 2.30	Depositor EDS
% Data completeness (in resolution range)	100.0 (85.45-2.30) 99.9 (85.45-2.30)	Depositor EDS
$R_{merge}$	0.12	Depositor
$R_{sym}$	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ <sup>1</sup>	3.53 (at 2.29Å)	Xtriage
Refinement program	REFMAC 5.8.0073	Depositor
R, $R_{free}$	0.204 , 0.254 0.219 , 0.256	Depositor DCC
$R_{free}$ test set	629 reflections (4.89%)	wwPDB-VP
Wilson B-factor (Å <sup>2</sup> )	34.1	Xtriage
Anisotropy	0.024	Xtriage
Bulk solvent $k_{sol}$ (e/Å <sup>3</sup> ), $B_{sol}$ (Å <sup>2</sup> )	0.38 , 59.8	EDS
L-test for twinning <sup>2</sup>	$\langle  L  \rangle = 0.48$ , $\langle L^2 \rangle = 0.31$	Xtriage
Estimated twinning fraction	No twinning to report.	Xtriage
$F_o, F_c$ correlation	0.94	EDS
Total number of atoms	1745	wwPDB-VP
Average B, all atoms (Å <sup>2</sup> )	56.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 5.19% 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

### 5.1 Standard geometry

Bond lengths and bond angles in the following residue types are not validated in this section: SO4

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	0.83	0/883	0.97	2/1189 (0.2%)
1	B	0.80	0/844	0.86	0/1142
All	All	0.82	0/1727	0.92	2/2331 (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	5
1	B	0	4
All	All	0	9

There are no bond length outliers.

All (2) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	528[A]	ARG	NE-CZ-NH1	6.47	123.53	120.30
1	A	528[B]	ARG	NE-CZ-NH1	6.47	123.53	120.30

There are no chirality outliers.

5 of 9 planarity outliers are listed below:

Mol	Chain	Res	Type	Group
1	A	460	PRO	Peptide
1	A	461	VAL	Peptide
1	A	477	SER	Peptide
1	A	480	GLY	Peptide

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Mol	Chain	Res	Type	Group
1	A	542	TRP	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	A	857	0	806	30	1
1	B	824	0	762	22	1
2	B	5	0	0	1	4
3	A	31	0	0	7	0
3	B	28	0	0	8	1
All	All	1745	0	1568	52	7

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 16.

The worst 5 of 52 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:479:ASN:HB3	1:A:480:GLY:HA2	1.14	1.09
1:A:479:ASN:HB3	1:A:480:GLY:CA	1.93	0.98
1:B:458:ARG:HD3	3:B:2001:HOH:O	1.70	0.91
1:A:479:ASN:CB	1:A:480:GLY:HA2	2.01	0.90
1:A:463:GLN:HG3	1:A:475:PRO:HB2	1.55	0.89

The worst 5 of 7 symmetry-related close contacts are listed below. The label for Atom-2 includes the symmetry operator and encoded unit-cell translations to be applied.

Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:482:SER:OG	1:A:482:SER:OG[10_555]	1.59	0.61
2:B:1564:SO4:O1	2:B:1564:SO4:O4[10_555]	1.68	0.52
2:B:1564:SO4:O1	2:B:1564:SO4:O3[10_555]	1.68	0.52
2:B:1564:SO4:S	2:B:1564:SO4:O3[10_555]	1.77	0.43
2:B:1564:SO4:O3	2:B:1564:SO4:O3[10_555]	1.83	0.37

## 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	105/130 (81%)	98 (93%)	3 (3%)	4 (4%)	2	1
1	B	104/130 (80%)	94 (90%)	5 (5%)	5 (5%)	2	1
All	All	209/260 (80%)	192 (92%)	8 (4%)	9 (4%)	2	1

5 of 9 Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	478	PHE
1	A	479	ASN
1	B	479	ASN
1	A	461	VAL
1	B	461	VAL

### 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	91/103 (88%)	82 (90%)	9 (10%)	6	8
1	B	86/103 (84%)	79 (92%)	7 (8%)	9	13
All	All	177/206 (86%)	161 (91%)	16 (9%)	8	10

5 of 16 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	B	551	ILE

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Mol	Chain	Res	Type
1	B	543	SER
1	A	558	VAL
1	B	482	SER
1	A	528[B]	ARG

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (1) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	540	HIS

### 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](#)

1 ligand is 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	SO4	B	1564	-	4,4,4	0.77	0	6,6,6	0.51	0

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.

1 monomer is involved in 5 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
2	B	1564	SO4	1	4

## 5.7 Other polymers

There are no such residues in this entry.

## 5.8 Polymer linkage issues

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	105/130 (80%)	0.82	16 (15%) <b>6</b> <b>7</b>	22, 49, 107, 160	3 (2%)
1	B	104/130 (80%)	0.68	17 (16%) <b>5</b> <b>6</b>	21, 50, 108, 152	0
All	All	209/260 (80%)	0.75	33 (15%) <b>6</b> <b>7</b>	21, 50, 109, 160	3 (1%)

The worst 5 of 33 RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	457	TYR	6.6
1	B	461	VAL	5.4
1	A	471[A]	ASN	5.2
1	A	460	PRO	5.2
1	B	459	THR	4.9

### 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, 95<sup>th</sup> 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	SO4	B	1564	5/5	0.98	0.14	21,34,55,98	2

## 6.5 Other polymers [i](#)

There are no such residues in this entry.