



# Full wwPDB X-ray Structure Validation Report ⓘ

Nov 14, 2023 – 12:48 AM JST

PDB ID : 5YN2  
Title : Crystal structure of apo Pullulanase from *Klebsiella pneumoniae* in space group P43212  
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Deposited on : 2017-10-24  
Resolution : 2.30 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 : 4.02b-467  
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

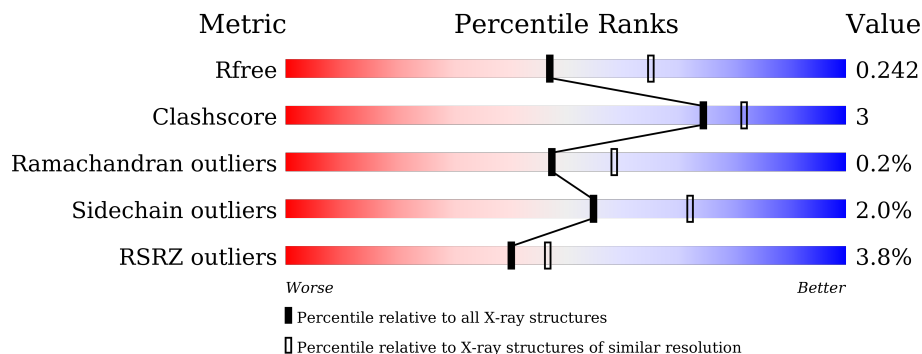
# 1 Overall quality at a glance

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))
$R_{free}$	130704	5042 (2.30-2.30)
Clashscore	141614	5643 (2.30-2.30)
Ramachandran outliers	138981	5575 (2.30-2.30)
Sidechain outliers	138945	5575 (2.30-2.30)
RSRZ outliers	127900	4938 (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	1102	

## 2 Entry composition [i](#)

There are 4 unique types of molecules in this entry. The entry contains 8510 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 PulA protein.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
1	A	1054	8089	5053	1380	1630	26	0	2	0

There is a discrepancy between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	680	LEU	GLY	conflict	UNP W9BQ28

- Molecule 2 is CALCIUM ION (three-letter code: CA) (formula: Ca).

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
2	A	4	Total	Ca	0	0
			4	4		

- Molecule 3 is MAGNESIUM ION (three-letter code: MG) (formula: Mg).

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
3	A	1	Total	Mg	0	0
			1	1		

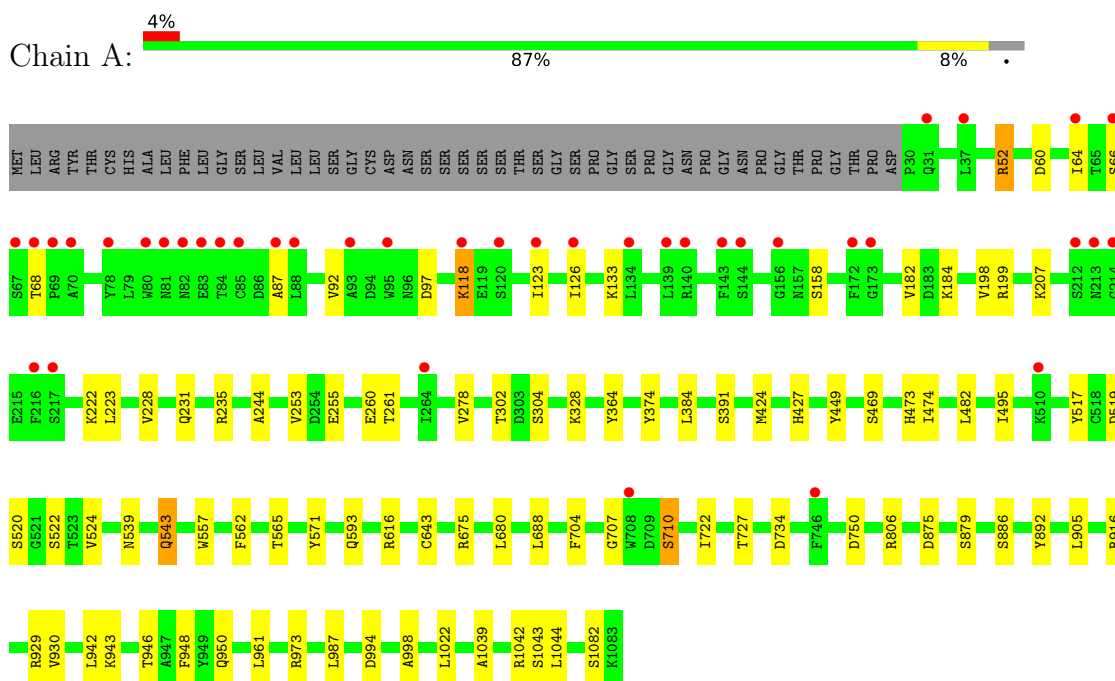
- Molecule 4 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
4	A	416	Total	O	0	0
			416	416		

### 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: Pula protein



## 4 Data and refinement statistics

Property	Value	Source
Space group	P 43 21 2	Depositor
Cell constants a, b, c, $\alpha$ , $\beta$ , $\gamma$	89.04Å 89.04Å 301.84Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	43.80 – 2.30 43.80 – 2.30	Depositor EDS
% Data completeness (in resolution range)	99.3 (43.80-2.30) 99.4 (43.80-2.30)	Depositor EDS
$R_{merge}$	0.07	Depositor
$R_{sym}$	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ <sup>1</sup>	6.19 (at 2.29Å)	Xtrriage
Refinement program	PHENIX (1.10.1_2155: ???)	Depositor
R, $R_{free}$	0.184 , 0.242 0.184 , 0.242	Depositor DCC
$R_{free}$ test set	2778 reflections (5.08%)	wwPDB-VP
Wilson B-factor (Å <sup>2</sup> )	40.8	Xtrriage
Anisotropy	0.295	Xtrriage
Bulk solvent $k_{sol}$ (e/Å <sup>3</sup> ), $B_{sol}$ (Å <sup>2</sup> )	0.33 , 41.6	EDS
L-test for twinning <sup>2</sup>	$\langle  L  \rangle = 0.50$ , $\langle L^2 \rangle = 0.34$	Xtrriage
Estimated twinning fraction	No twinning to report.	Xtrriage
$F_o, F_c$ correlation	0.96	EDS
Total number of atoms	8510	wwPDB-VP
Average B, all atoms (Å <sup>2</sup> )	46.0	wwPDB-VP

Xtrriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 2.64% 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](#)

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

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	0.43	2/8257 (0.0%)	0.58	0/11246

All (2) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	A	68	THR	C-N	11.60	1.56	1.34
1	A	539	ASN	C-N	6.75	1.47	1.34

There are no bond angle outliers.

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	8089	0	7780	51	0
2	A	4	0	0	0	0
3	A	1	0	0	0	0
4	A	416	0	0	6	0
All	All	8510	0	7780	51	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 (51) 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:680:LEU:HG	1:A:710:SER:HB3	1.35	1.04
1:A:543:GLN:HG3	1:A:916:ARG:HA	1.53	0.91
1:A:126:ILE:HD13	1:A:133:LYS:HE3	1.76	0.67
1:A:905:LEU:HD23	1:A:942:LEU:HD23	1.79	0.65
1:A:1042:ARG:NH1	4:A:1204:HOH:O	2.31	0.64
1:A:943:LYS:HE3	1:A:1042:ARG:HH22	1.65	0.62
1:A:199:ARG:HE	1:A:222:LYS:HE3	1.63	0.61
1:A:750:ASP:OD1	1:A:929:ARG:NH2	2.37	0.57
1:A:1039:ALA:HB3	1:A:1043:SER:HB2	1.87	0.55
1:A:92:VAL:HG11	1:A:97:ASP:OD2	2.09	0.52
1:A:231:GLN:N	1:A:231:GLN:OE1	2.44	0.50
1:A:52:ARG:CZ	1:A:118:LYS:HA	2.43	0.49
1:A:616:ARG:HD2	4:A:1216:HOH:O	2.12	0.49
1:A:198:VAL:HG12	1:A:223:LEU:HD12	1.95	0.49
1:A:184:LYS:HG3	1:A:253:VAL:HG21	1.95	0.49
1:A:427:HIS:HB3	1:A:474:ILE:HD13	1.95	0.48
1:A:60:ASP:O	1:A:64:ILE:HG13	2.13	0.47
1:A:517:TYR:HA	1:A:520:SER:HB3	1.95	0.47
1:A:235:ARG:NH1	4:A:1224:HOH:O	2.47	0.47
1:A:948:PHE:CD1	1:A:1044:LEU:HG	2.50	0.47
1:A:302:THR:HG23	1:A:304:SER:N	2.31	0.46
1:A:261:THR:HG22	1:A:278:VAL:HG21	1.98	0.46
1:A:943:LYS:HE3	1:A:1042:ARG:NH2	2.28	0.46
1:A:424:MET:HG3	1:A:473:HIS:CE1	2.51	0.45
1:A:930:VAL:HG22	4:A:1358:HOH:O	2.16	0.45
1:A:946:THR:O	1:A:950:GLN:HG3	2.17	0.45
1:A:557:TRP:CE3	1:A:892:TYR:HB3	2.51	0.45
1:A:255:GLU:HG3	4:A:1615:HOH:O	2.17	0.44
1:A:228:VAL:HG12	1:A:244:ALA:HB2	1.99	0.44
1:A:182:VAL:O	1:A:235:ARG:NH2	2.51	0.44
1:A:875:ASP:OD2	1:A:879:SER:HB2	2.18	0.44
1:A:384:LEU:HD23	1:A:391:SER:HA	2.00	0.44
1:A:943:LYS:HG3	1:A:1042:ARG:HH22	1.84	0.43
1:A:680:LEU:HD11	1:A:710:SER:H	1.83	0.43
1:A:199:ARG:HH21	1:A:222:LYS:HE3	1.84	0.43
1:A:734:ASP:OD1	1:A:734:ASP:N	2.45	0.43
1:A:943:LYS:HG3	1:A:1042:ARG:HH12	1.84	0.42
1:A:987:LEU:HD21	1:A:1022:LEU:HD21	2.01	0.42
1:A:961:LEU:HD11	1:A:994:ASP:HB2	2.02	0.42
1:A:260:GLU:HB2	1:A:364:TYR:CE1	2.54	0.41

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:680:LEU:H	1:A:680:LEU:CD2	2.32	0.41
1:A:973:ARG:HG2	1:A:998:ALA:HB1	2.01	0.41
1:A:469:SER:OG	1:A:950:GLN:HB3	2.19	0.41
1:A:495:ILE:HA	1:A:524:VAL:HB	2.02	0.41
1:A:722:ILE:HG12	4:A:1377:HOH:O	2.19	0.41
1:A:688:LEU:HD21	1:A:727:THR:HB	2.01	0.41
1:A:87:ALA:HB3	1:A:123:ILE:HG23	2.02	0.41
1:A:449:TYR:CZ	1:A:571:TYR:HB2	2.56	0.41
1:A:675:ARG:HA	1:A:704:PHE:O	2.22	0.40
1:A:973:ARG:NH1	1:A:994:ASP:OD1	2.53	0.40
1:A:680:LEU:HD22	1:A:707:GLY:CA	2.51	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	1054/1102 (96%)	1026 (97%)	26 (2%)	2 (0%)	47 58

All (2) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	66	SER
1	A	643	CYS

#### 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	870/907 (96%)	853 (98%)	17 (2%)	55 72

All (17) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	52	ARG
1	A	118	LYS
1	A	158	SER
1	A	207	LYS
1	A	328	LYS
1	A	374	TYR
1	A	482	LEU
1	A	519	ASP
1	A	522	SER
1	A	543	GLN
1	A	562	PHE
1	A	565	THR
1	A	593	GLN
1	A	710	SER
1	A	806	ARG
1	A	886	SER
1	A	1082	SER

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. There are no such sidechains identified.

### 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

Of 5 ligands modelled in this entry, 5 are monoatomic - leaving 0 for Mogul analysis.

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

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

### 6.1 Protein, DNA and RNA chains

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	1054/1102 (95%)	0.04	40 (3%) <span style="border: 1px solid red; padding: 2px;">40</span> <span style="border: 1px solid red; padding: 2px;">47</span>	29, 43, 71, 109	0

All (40) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	67	SER	5.0
1	A	80	TRP	4.8
1	A	84	THR	4.8
1	A	93	ALA	4.4
1	A	70	ALA	4.2
1	A	213	ASN	4.0
1	A	216	PHE	3.8
1	A	172	PHE	3.8
1	A	87	ALA	3.6
1	A	140	ARG	3.6
1	A	68	THR	3.6
1	A	143	PHE	3.3
1	A	120	SER	3.3
1	A	217	SER	3.0
1	A	118	LYS	3.0
1	A	37	LEU	2.9
1	A	746	PHE	2.9
1	A	123	ILE	2.8
1	A	85	CYS	2.8
1	A	139	LEU	2.7
1	A	95	TRP	2.6
1	A	510	LYS	2.5
1	A	708[A]	TRP	2.5
1	A	31	GLN	2.5
1	A	69	PRO	2.5
1	A	126	ILE	2.5
1	A	83	GLU	2.4

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Mol	Chain	Res	Type	RSRZ
1	A	66	SER	2.4
1	A	144	SER	2.4
1	A	156	GLY	2.3
1	A	88	LEU	2.3
1	A	212	SER	2.3
1	A	81	ASN	2.2
1	A	82	ASN	2.2
1	A	64	ILE	2.1
1	A	264	ILE	2.1
1	A	134	LEU	2.1
1	A	173	GLY	2.1
1	A	78	TYR	2.0
1	A	214	GLY	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, 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	CA	A	1103	1/1	0.93	0.04	68,68,68,68	0
2	CA	A	1104	1/1	0.93	0.09	62,62,62,62	0
3	MG	A	1105	1/1	0.98	0.09	40,40,40,40	0
2	CA	A	1102	1/1	0.99	0.14	33,33,33,33	0
2	CA	A	1101	1/1	0.99	0.13	37,37,37,37	0

## 6.5 Other polymers [i](#)

There are no such residues in this entry.