



# Full wwPDB X-ray Structure Validation Report ⓘ

May 16, 2020 – 11:16 pm BST

PDB ID : 5XCB  
Title : X-ray structure of domains D1 and D2 of Clostridium perfringens pili protein CppA  
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Deposited on : 2017-03-22  
Resolution : 2.14 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.

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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 : 2.11  
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) : 2.11

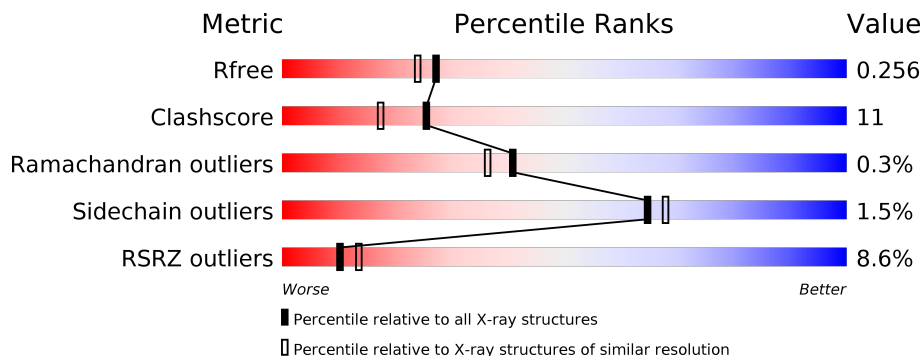
# 1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

*X-RAY DIFFRACTION*

The reported resolution of this entry is 2.14 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	2523 (2.16-2.12)
Clashscore	141614	2653 (2.16-2.12)
Ramachandran outliers	138981	2618 (2.16-2.12)
Sidechain outliers	138945	2617 (2.16-2.12)
RSRZ outliers	127900	2485 (2.16-2.12)

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 on 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	325	

## 2 Entry composition i

There are 2 unique types of molecules in this entry. The entry contains 2525 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 Probable surface protein.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
1	A	303	2375	1496	382	494	3	0	0	0

There are 17 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	13	MET	-	expression tag	UNP Q8XP10
A	14	ASN	-	expression tag	UNP Q8XP10
A	15	HIS	-	expression tag	UNP Q8XP10
A	16	LYS	-	expression tag	UNP Q8XP10
A	17	VAL	-	expression tag	UNP Q8XP10
A	18	HIS	-	expression tag	UNP Q8XP10
A	19	HIS	-	expression tag	UNP Q8XP10
A	20	HIS	-	expression tag	UNP Q8XP10
A	21	HIS	-	expression tag	UNP Q8XP10
A	22	HIS	-	expression tag	UNP Q8XP10
A	23	HIS	-	expression tag	UNP Q8XP10
A	24	ILE	-	expression tag	UNP Q8XP10
A	25	GLU	-	expression tag	UNP Q8XP10
A	26	GLY	-	expression tag	UNP Q8XP10
A	27	ARG	-	expression tag	UNP Q8XP10
A	28	HIS	-	expression tag	UNP Q8XP10
A	29	MET	-	expression tag	UNP Q8XP10

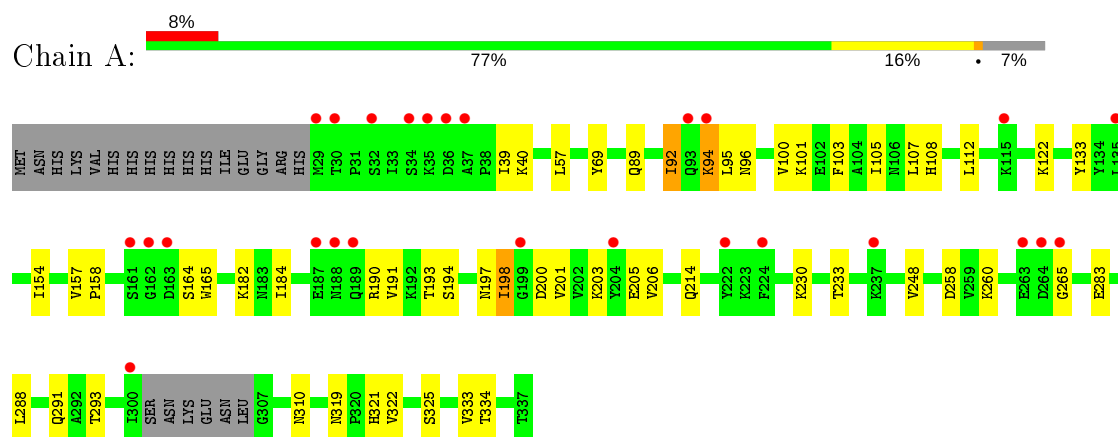
- Molecule 2 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
2	A	150	Total	O	0	0
			150	150		

### 3 Residue-property plots

These plots are drawn for all protein, RNA and DNA 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 ( $\text{RSRZ} > 2$ ). 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: Probable surface protein



## 4 Data and refinement statistics

Property	Value	Source
Space group	C 2 2 2	Depositor
Cell constants a, b, c, $\alpha$ , $\beta$ , $\gamma$	90.40Å 141.33Å 61.48Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	18.76 – 2.14 18.76 – 2.14	Depositor EDS
% Data completeness (in resolution range)	99.7 (18.76-2.14) 99.9 (18.76-2.14)	Depositor EDS
$R_{merge}$	0.05	Depositor
$R_{sym}$	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ <sup>1</sup>	4.16 (at 2.15Å)	Xtrriage
Refinement program	REFMAC 5.8.0158	Depositor
R, $R_{free}$	0.211 , 0.251 0.217 , 0.256	Depositor DCC
$R_{free}$ test set	1129 reflections (5.11%)	wwPDB-VP
Wilson B-factor (Å <sup>2</sup> )	39.1	Xtrriage
Anisotropy	0.055	Xtrriage
Bulk solvent $k_{sol}$ (e/Å <sup>3</sup> ), $B_{sol}$ (Å <sup>2</sup> )	0.38 , 56.2	EDS
L-test for twinning <sup>2</sup>	$\langle  L  \rangle = 0.46$ , $\langle L^2 \rangle = 0.30$	Xtrriage
Estimated twinning fraction	No twinning to report.	Xtrriage
$F_o, F_c$ correlation	0.95	EDS
Total number of atoms	2525	wwPDB-VP
Average B, all atoms (Å <sup>2</sup> )	48.0	wwPDB-VP

Xtrriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 5.81% 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	0.46	0/2413	0.57	0/3264

There are no bond length outliers.

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	2375	0	2342	50	0
2	A	150	0	0	9	1
All	All	2525	0	2342	50	1

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 11.

All (50) 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:198:ILE:H	1:A:198:ILE:HD12	1.11	1.15
1:A:198:ILE:H	1:A:198:ILE:CD1	1.80	0.95
1:A:40:LYS:HE3	2:A:515:HOH:O	1.65	0.94
1:A:198:ILE:N	1:A:198:ILE:HD12	1.82	0.93

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:201:VAL:HG22	1:A:293:THR:HG22	1.67	0.76
1:A:283:GLU:HG2	2:A:435:HOH:O	1.88	0.74
1:A:184:ILE:HD13	1:A:194:SER:HB2	1.71	0.72
1:A:203:LYS:HE2	1:A:291:GLN:OE1	1.88	0.72
1:A:96:ASN:O	1:A:100:VAL:HG23	1.91	0.70
1:A:92:ILE:HD12	1:A:103:PHE:CZ	2.27	0.69
1:A:100:VAL:HG13	1:A:154:ILE:HD12	1.76	0.67
1:A:122:LYS:HE2	2:A:546:HOH:O	1.95	0.66
1:A:92:ILE:HG21	1:A:133:TYR:CE2	2.32	0.65
1:A:233:THR:HG22	2:A:439:HOH:O	1.96	0.64
1:A:322:VAL:HG23	1:A:325:SER:HB2	1.81	0.61
1:A:206:VAL:HB	1:A:288:LEU:HB2	1.83	0.60
1:A:92:ILE:HD12	1:A:103:PHE:CE1	2.36	0.60
1:A:92:ILE:CD1	1:A:103:PHE:CE1	2.85	0.60
1:A:39:ILE:HG12	1:A:39:ILE:O	2.03	0.58
1:A:101:LYS:O	1:A:105:ILE:HD13	2.04	0.57
1:A:322:VAL:HG23	1:A:325:SER:CB	2.35	0.56
1:A:92:ILE:CG2	1:A:133:TYR:CE2	2.89	0.56
1:A:203:LYS:HG2	1:A:291:GLN:HG2	1.87	0.55
1:A:201:VAL:HG22	1:A:293:THR:CG2	2.34	0.55
1:A:190:ARG:NE	1:A:205:GLU:OE2	2.37	0.53
1:A:260:LYS:CE	2:A:500:HOH:O	2.57	0.53
1:A:319:ASN:HB3	1:A:322:VAL:HG22	1.94	0.50
1:A:197:ASN:O	1:A:200:ASP:HB2	2.11	0.50
1:A:40:LYS:CE	2:A:515:HOH:O	2.40	0.48
1:A:193:THR:HA	1:A:334:THR:O	2.12	0.48
1:A:158:PRO:HG2	1:A:165:TRP:CE3	2.50	0.47
1:A:283:GLU:CG	2:A:435:HOH:O	2.55	0.47
1:A:108:HIS:CE1	2:A:499:HOH:O	2.68	0.46
1:A:230:LYS:HA	1:A:265:GLY:O	2.16	0.46
1:A:214:GLN:CD	1:A:321:HIS:HE1	2.18	0.46
1:A:108:HIS:CE1	1:A:112:LEU:HD11	2.52	0.45
1:A:260:LYS:HE2	2:A:500:HOH:O	2.16	0.45
1:A:182:LYS:HE2	1:A:310:ASN:HB3	1.58	0.44
1:A:57:LEU:HD22	1:A:107:LEU:HD22	1.99	0.44
1:A:100:VAL:CG1	1:A:154:ILE:HD12	2.44	0.44
1:A:258:ASP:OD2	1:A:260:LYS:HE3	2.18	0.44
1:A:322:VAL:CG2	1:A:325:SER:HB2	2.45	0.44
1:A:157:VAL:HA	1:A:158:PRO:HA	1.88	0.43
1:A:184:ILE:HB	1:A:191:VAL:HG23	2.00	0.43
1:A:69:TYR:O	1:A:89:GLN:NE2	2.52	0.43

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:248:VAL:HG13	1:A:248:VAL:O	2.19	0.43
1:A:182:LYS:HE2	1:A:333:VAL:HG22	2.01	0.41
1:A:100:VAL:HG13	1:A:154:ILE:CD1	2.47	0.41
1:A:94:LYS:C	1:A:94:LYS:HD2	2.40	0.41
1:A:184:ILE:HG21	1:A:194:SER:HB2	2.03	0.41

All (1) 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)
2:A:447:HOH:O	2:A:447:HOH:O 4_566	2.18	0.02

## 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	299/325 (92%)	290 (97%)	8 (3%)	1 (0%)	41 36

All (1) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	92	ILE

### 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	270/291 (93%)	266 (98%)	4 (2%)	65 68

All (4) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	94	LYS
1	A	95	LEU
1	A	164	SER
1	A	198	ILE

Some sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (4) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	93	GLN
1	A	125	GLN
1	A	159	GLN
1	A	321	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 carbohydrates 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

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	303/325 (93%)	0.44	26 (8%) <b>10</b> <b>13</b>	26, 45, 79, 99	0

All (26) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	29	MET	8.0
1	A	36	ASP	6.6
1	A	300	ILE	5.4
1	A	162	GLY	4.3
1	A	35	LYS	4.3
1	A	30	THR	4.1
1	A	187	GLU	3.4
1	A	188	ASN	3.3
1	A	263	GLU	3.0
1	A	93	GLN	3.0
1	A	163	ASP	2.9
1	A	161	SER	2.8
1	A	189	GLN	2.8
1	A	115	LYS	2.7
1	A	199	GLY	2.7
1	A	37	ALA	2.6
1	A	204	TYR	2.6
1	A	94	LYS	2.4
1	A	265	GLY	2.4
1	A	224	PHE	2.2
1	A	135	LEU	2.2
1	A	222	TYR	2.2
1	A	32	SER	2.2
1	A	237	LYS	2.1
1	A	264	ASP	2.1
1	A	34	SER	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 carbohydrates 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.