



# Full wwPDB X-ray Structure Validation Report ⓘ

May 21, 2020 – 01:31 pm BST

PDB ID : 5NPY  
Title : Crystal structure of Helicobacter pylori flagellar hook protein FlgE2  
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Deposited on : 2017-04-19  
Resolution : 2.29 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  
Mogul : 1.8.5 (274361), CSD as541be (2020)  
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

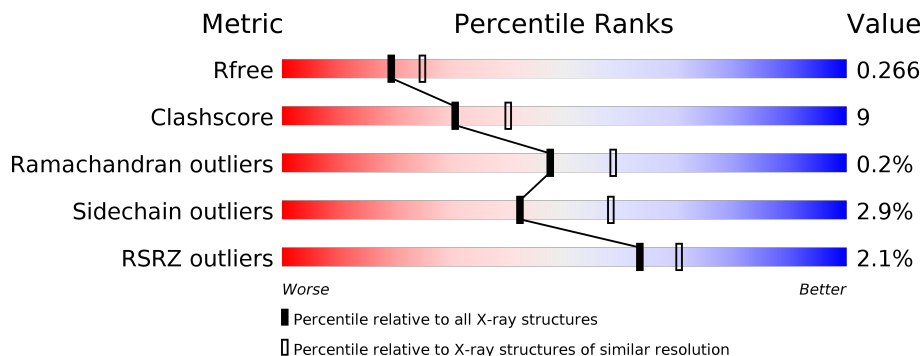
# 1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

*X-RAY DIFFRACTION*

The reported resolution of this entry is 2.29 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 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	618	

## 2 Entry composition

There are 3 unique types of molecules in this entry. The entry contains 4031 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.

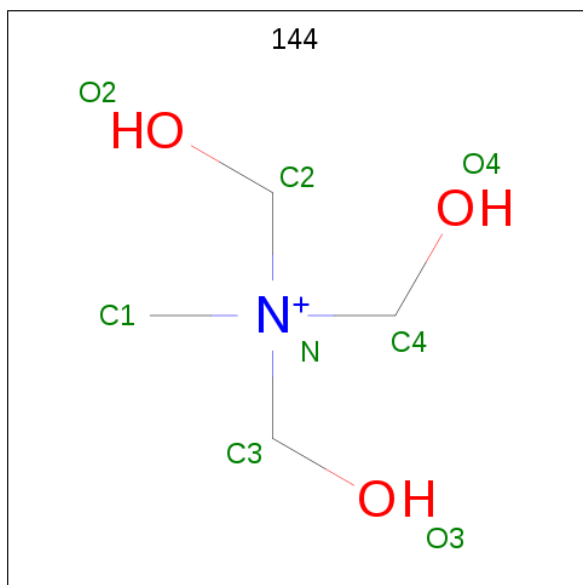
- Molecule 1 is a protein called Flagellar basal body protein.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
1	A	472	3715	2345	624	737	9	0	0	0

There are 13 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	606	GLU	-	expression tag	UNP B5Z7R4
A	607	ASN	-	expression tag	UNP B5Z7R4
A	608	LEU	-	expression tag	UNP B5Z7R4
A	609	TYR	-	expression tag	UNP B5Z7R4
A	610	PHE	-	expression tag	UNP B5Z7R4
A	611	GLN	-	expression tag	UNP B5Z7R4
A	612	SER	-	expression tag	UNP B5Z7R4
A	613	HIS	-	expression tag	UNP B5Z7R4
A	614	HIS	-	expression tag	UNP B5Z7R4
A	615	HIS	-	expression tag	UNP B5Z7R4
A	616	HIS	-	expression tag	UNP B5Z7R4
A	617	HIS	-	expression tag	UNP B5Z7R4
A	618	HIS	-	expression tag	UNP B5Z7R4

- Molecule 2 is TRIS-HYDROXYMETHYL-METHYL-AMMONIUM (three-letter code: 144) (formula: C<sub>4</sub>H<sub>12</sub>N<sub>3</sub>O<sub>3</sub>).



Mol	Chain	Residues	Atoms				ZeroOcc	AltConf
			Total	C	N	O		
2	A	1	8	4	1	3	0	0

- Molecule 3 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
			Total	O		
3	A	308	308	308	0	0



## 4 Data and refinement statistics

Property	Value	Source
Space group	P 21 21 21	Depositor
Cell constants a, b, c, $\alpha$ , $\beta$ , $\gamma$	43.21Å 49.59Å 238.26Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	48.55 – 2.29 48.55 – 2.29	Depositor EDS
% Data completeness (in resolution range)	96.7 (48.55-2.29) 96.5 (48.55-2.29)	Depositor EDS
$R_{merge}$	0.15	Depositor
$R_{sym}$	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ <sup>1</sup>	1.02 (at 2.29Å)	Xtrriage
Refinement program	PHENIX 1.10.1_2155	Depositor
R, $R_{free}$	0.188 , 0.266 0.190 , 0.266	Depositor DCC
$R_{free}$ test set	1150 reflections (4.98%)	wwPDB-VP
Wilson B-factor (Å <sup>2</sup> )	33.3	Xtrriage
Anisotropy	0.313	Xtrriage
Bulk solvent $k_{sol}$ (e/Å <sup>3</sup> ), $B_{sol}$ (Å <sup>2</sup> )	0.30 , 51.2	EDS
L-test for twinning <sup>2</sup>	$\langle  L  \rangle = 0.46$ , $\langle L^2 \rangle = 0.29$	Xtrriage
Estimated twinning fraction	No twinning to report.	Xtrriage
$F_o, F_c$ correlation	0.93	EDS
Total number of atoms	4031	wwPDB-VP
Average B, all atoms (Å <sup>2</sup> )	44.0	wwPDB-VP

Xtrriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 6.68% 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:  
144

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	0.66	3/3785 (0.1%)	0.76	10/5103 (0.2%)

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	1

All (3) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	A	112	ASP	C-N	-16.56	1.03	1.33
1	A	113	GLY	C-N	14.30	1.67	1.34
1	A	270	GLU	C-N	-10.40	1.10	1.34

All (10) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	113	GLY	O-C-N	13.01	143.52	122.70
1	A	112	ASP	O-C-N	-12.77	101.48	123.20
1	A	113	GLY	CA-C-N	-10.18	94.80	117.20
1	A	270	GLU	C-N-CA	9.62	145.75	121.70
1	A	113	GLY	C-N-CA	-7.91	101.92	121.70
1	A	270	GLU	O-C-N	-7.61	110.53	122.70
1	A	112	ASP	CA-C-N	7.08	130.36	116.20
1	A	523	LEU	CA-CB-CG	6.66	130.62	115.30
1	A	270	GLU	CA-C-N	6.06	130.53	117.20
1	A	112	ASP	C-N-CA	5.94	134.77	122.30

There are no chirality outliers.

All (1) planarity outliers are listed below:

Mol	Chain	Res	Type	Group
1	A	112	ASP	Mainchain

## 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	3715	0	3675	67	0
2	A	8	0	12	1	0
3	A	308	0	0	12	0
All	All	4031	0	3687	68	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 9.

All (68) 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:98:VAL:HG11	1:A:107:MET:HE1	1.39	1.04
1:A:323:SER:OG	1:A:337:ASN:O	1.78	1.00
1:A:113:GLY:O	3:A:801:HOH:O	1.93	0.86
1:A:99:ILE:HD11	1:A:523:LEU:HD11	1.68	0.75
1:A:92:GLN:OE1	1:A:558:ARG:NH1	2.21	0.72
1:A:202:LYS:NZ	3:A:806:HOH:O	2.23	0.72
1:A:121:PHE:HB3	1:A:523:LEU:HG	1.72	0.70
1:A:98:VAL:CG1	1:A:107:MET:HE1	2.18	0.70
2:A:701:144:O4	3:A:802:HOH:O	2.10	0.70
1:A:162:ARG:HH22	1:A:500:GLU:HG2	1.57	0.68
1:A:185:TYR:O	3:A:803:HOH:O	2.14	0.66
1:A:250:VAL:HG13	1:A:262:PHE:HB2	1.77	0.65
1:A:380:THR:HG21	1:A:399:GLU:HG3	1.79	0.65
1:A:202:LYS:NZ	3:A:809:HOH:O	2.28	0.64
1:A:112:ASP:N	1:A:112:ASP:OD2	2.26	0.64
1:A:106:GLU:H	1:A:117:LYS:HG2	1.63	0.64
1:A:491:SER:HA	1:A:501:PRO:HA	1.81	0.63

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:105:GLY:CA	1:A:117:LYS:HD3	2.29	0.62
1:A:81:MET:N	3:A:810:HOH:O	2.31	0.62
1:A:105:GLY:HA3	1:A:117:LYS:HD3	1.82	0.61
1:A:98:VAL:HG11	1:A:107:MET:CE	2.26	0.59
1:A:298:LYS:HB2	1:A:301:LYS:HD2	1.85	0.57
1:A:117:LYS:HE3	1:A:145:TYR:OH	2.04	0.57
1:A:487:ASN:HA	1:A:552:LEU:HD12	1.87	0.56
1:A:522:ASN:OD1	1:A:523:LEU:N	2.38	0.56
1:A:245:ASN:ND2	3:A:807:HOH:O	2.24	0.56
1:A:522:ASN:OD1	1:A:523:LEU:HB2	2.06	0.55
1:A:156:THR:HB	1:A:186:GLN:HG2	1.89	0.54
1:A:193:VAL:HG22	1:A:471:GLN:HG3	1.88	0.54
1:A:113:GLY:C	3:A:801:HOH:O	2.42	0.54
1:A:527:GLN:HG3	1:A:538:LEU:HD23	1.90	0.53
1:A:253:GLN:HA	1:A:259:LYS:HA	1.89	0.53
1:A:547:ASP:OD2	1:A:551:LYS:O	2.28	0.52
1:A:396:GLN:HE21	1:A:398:TRP:HE1	1.60	0.50
1:A:162:ARG:NH2	1:A:500:GLU:HG2	2.28	0.48
1:A:117:LYS:H	1:A:117:LYS:HG3	1.50	0.48
1:A:396:GLN:NE2	1:A:398:TRP:HE1	2.11	0.48
1:A:265:THR:O	1:A:275:GLN:HA	2.14	0.47
1:A:203:ASP:HB3	1:A:204:HIS:CD2	2.49	0.47
1:A:209:GLN:HB2	1:A:213:LEU:HD12	1.96	0.47
1:A:471:GLN:HG2	1:A:473:GLY:H	1.80	0.47
1:A:130:ARG:HA	1:A:135:TYR:O	2.15	0.46
1:A:208:VAL:HG23	1:A:354:ILE:HB	1.98	0.46
1:A:103:LYS:HE2	1:A:103:LYS:HB3	1.70	0.45
1:A:488:GLY:HA3	1:A:557:ILE:HD12	1.99	0.45
1:A:114:PHE:N	1:A:114:PHE:CD2	2.85	0.45
1:A:109:ILE:HB	1:A:544:LEU:HD13	1.98	0.44
1:A:121:PHE:CD2	1:A:523:LEU:HD21	2.53	0.44
1:A:222:GLU:OE2	1:A:222:GLU:N	2.36	0.44
1:A:486:GLU:HA	1:A:557:ILE:O	2.18	0.44
1:A:405:VAL:HA	1:A:412:PRO:HA	2.00	0.44
1:A:518:LYS:NZ	1:A:521:GLY:HA2	2.32	0.43
1:A:119:ASP:OD2	1:A:119:ASP:N	2.50	0.43
1:A:323:SER:CB	1:A:337:ASN:O	2.65	0.43
1:A:429:LYS:NZ	3:A:816:HOH:O	2.45	0.43
1:A:547:ASP:N	1:A:547:ASP:OD2	2.52	0.42
1:A:522:ASN:ND2	1:A:523:LEU:HD13	2.34	0.42
1:A:379:MET:HE1	3:A:1015:HOH:O	2.19	0.42

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:318:THR:HA	1:A:319:PRO:HD3	1.91	0.42
1:A:528:GLU:O	1:A:538:LEU:HD22	2.20	0.41
1:A:342:LYS:HG2	1:A:345:ILE:HG12	2.02	0.41
1:A:159:SER:HB2	1:A:185:TYR:OH	2.21	0.41
1:A:161:ALA:O	1:A:164:GLU:HG2	2.21	0.40
1:A:333:GLY:HA2	3:A:977:HOH:O	2.22	0.40
1:A:547:ASP:OD2	1:A:551:LYS:N	2.45	0.40
1:A:548:GLU:N	1:A:548:GLU:OE1	2.52	0.40
1:A:418:TRP:HB3	3:A:828:HOH:O	2.21	0.40
1:A:259:LYS:HG2	1:A:260:GLU:H	1.86	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	466/618 (75%)	435 (93%)	30 (6%)	1 (0%)	47 58

All (1) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	104	ASN

### 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	411/534 (77%)	399 (97%)	12 (3%)	42 58

All (12) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	107	MET
1	A	112	ASP
1	A	116	LYS
1	A	117	LYS
1	A	183	LEU
1	A	210	ASP
1	A	324	LEU
1	A	414	ASN
1	A	427	THR
1	A	460	SER
1	A	480	ARG
1	A	487	ASN

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

Mol	Chain	Res	Type
1	A	118	GLN

### 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](#)

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	144	A	701	-	1,7,7	0.95	0	3,9,9	0.44	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	144	A	701	-	-	0/0/9/9	-

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 1 short contact:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
2	A	701	144	1	0

## 5.7 Other polymers [i](#)

There are no such residues in this entry.

## 5.8 Polymer linkage issues [i](#)

The following chains have linkage breaks:

Mol	Chain	Number of breaks
1	A	3

All chain breaks are listed below:

Model	Chain	Residue-1	Atom-1	Residue-2	Atom-2	Distance (Å)
1	A	113:GLY	C	114:PHE	N	1.66
1	A	270:GLU	C	271:LYS	N	1.10
1	A	112:ASP	C	113:GLY	N	1.03

## 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	472/618 (76%)	-0.03	10 (2%) 63 70	16, 42, 80, 131	0

All (10) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	522	ASN	4.2
1	A	564	THR	3.8
1	A	521	GLY	3.8
1	A	118	GLN	3.5
1	A	548	GLU	3.3
1	A	182	ASP	2.6
1	A	113	GLY	2.6
1	A	104	ASN	2.5
1	A	345	ILE	2.1
1	A	173	THR	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 carbohydrates 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	144	A	701	8/8	0.87	0.17	13,33,46,53	0

## 6.5 Other polymers [i](#)

There are no such residues in this entry.