



# wwPDB X-ray Structure Validation Summary Report ⓘ

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PDB ID : 3H94  
Title : Crystal structure of the membrane fusion protein CusB from Escherichia coli  
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Deposited on : 2009-04-30  
Resolution : 3.84 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)

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

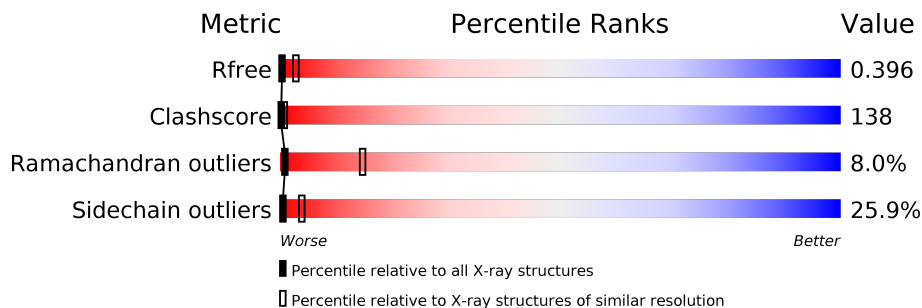
# 1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

*X-RAY DIFFRACTION*

The reported resolution of this entry is 3.84 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	1242 (4.08-3.60)
Clashscore	141614	1004 (4.04-3.64)
Ramachandran outliers	138981	1003 (4.06-3.62)
Sidechain outliers	138945	1266 (4.08-3.60)

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  $\leq 5\%$

Mol	Chain	Length	Quality of chain
1	A	407	
1	B	407	

## 2 Entry composition

There are 2 unique types of molecules in this entry. The entry contains 4550 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 Cation efflux system protein cusB.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
1	A	297	2274	1448	392	429	5	0	0	0
1	B	297	2274	1448	392	429	5	0	0	0

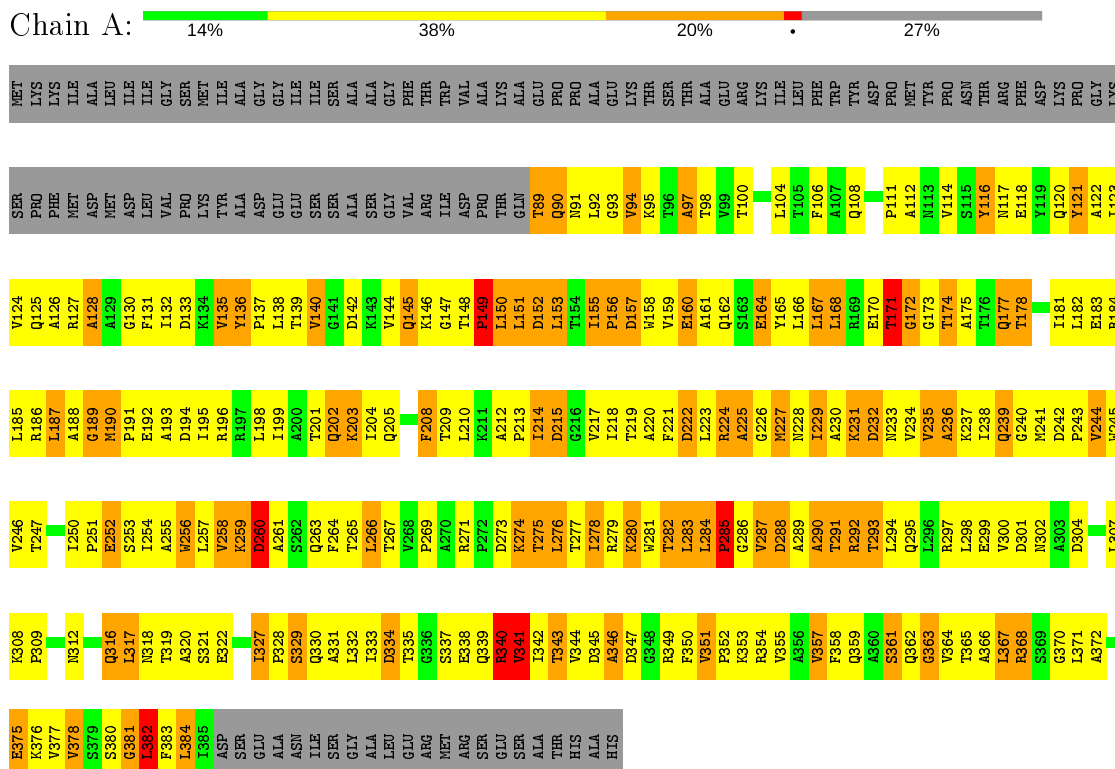
- Molecule 2 is SILVER ION (three-letter code: AG) (formula: Ag).

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
2	B	1	Total	Ag	0	0
			1	1		
2	A	1	Total	Ag	0	0
			1	1		

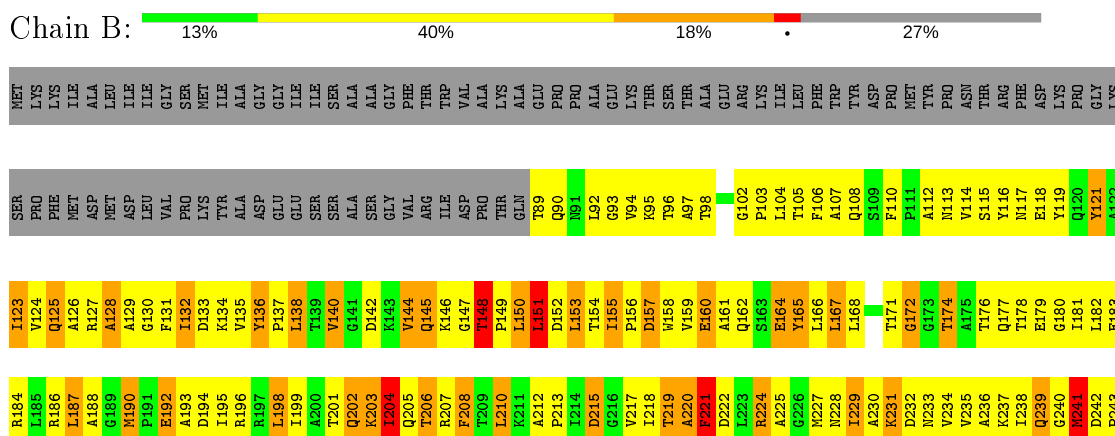
### 3 Residue-property plots

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. 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. 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: Cation efflux system protein cusB



- Molecule 1: Cation efflux system protein cusB



V244	I307	R368
W246	K308	S369
V246	P309	G370
T247	G310	L371
A248	N311	A372
A249	N312	E373
L250	A313	G374
P251	W314	E375
E252	L315	R376
S253	Q316	V377
A255	L317	V378
W256	N318	S379
L257	T319	S380
V258	A320	G381
K259	S321	L382
D260	E322	F383
	M324	I384
T265	L325	I385
L266	L326	ASP
T267	L327	SER
V268	P328	GLU
P269	S329	ALA
A270	Q330	ASN
R271	A331	ILE
P272	L332	SER
D273	L333	GLY
K274	D334	ALA
T275	T335	LEU
L276	G336	GLU
T277	S337	ARG
L278	E338	MET
R279	Q339	ARG
K280	R340	SER
W281	V341	GLU
T282	I342	ALA
L283	T343	THR
L284	V344	HIS
P285	D345	ALA
G286	A346	ALA
V287	D347	ALA
D288	G348	ALA
A289	R349	ALA
A290	F350	ALA
T291	V351	ALA
R292	P352	ALA
T293	K353	ALA
L294	R354	ALA
Q295	V355	ALA
L296		ALA
R297	F358	ALA
L298	Q359	ALA
E299	A360	ALA
V300	S361	ALA
D301	Q362	ALA
N302	G363	ALA
A303	V364	ALA
D304	T365	ALA
E305	A366	ALA
A306	L367	ALA

## 4 Data and refinement statistics

Property	Value	Source
Space group	I 2 2 2	Depositor
Cell constants a, b, c, $\alpha$ , $\beta$ , $\gamma$	85.00Å 114.42Å 259.08Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	47.20 – 3.84 47.20 – 3.71	Depositor EDS
% Data completeness (in resolution range)	87.3 (47.20-3.84) 98.1 (47.20-3.71)	Depositor EDS
$R_{merge}$	0.07	Depositor
$R_{sym}$	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ <sup>1</sup>	4.96 (at 3.66Å)	Xtrriage
Refinement program	PHENIX	Depositor
R, $R_{free}$	0.280 , 0.300 0.398 , 0.396	Depositor DCC
$R_{free}$ test set	675 reflections (4.98%)	wwPDB-VP
Wilson B-factor (Å <sup>2</sup> )	153.0	Xtrriage
Anisotropy	0.727	Xtrriage
Bulk solvent $k_{sol}$ (e/Å <sup>3</sup> ), $B_{sol}$ (Å <sup>2</sup> )	0.34 , 231.4	EDS
L-test for twinning <sup>2</sup>	$\langle  L  \rangle = 0.47$ , $\langle L^2 \rangle = 0.30$	Xtrriage
Estimated twinning fraction	No twinning to report.	Xtrriage
$F_o, F_c$ correlation	0.85	EDS
Total number of atoms	4550	wwPDB-VP
Average B, all atoms (Å <sup>2</sup> )	175.0	wwPDB-VP

Xtrriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 9.73% 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:  
AG

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	5/2313 (0.2%)	1.25	25/3152 (0.8%)
1	B	0.85	3/2313 (0.1%)	1.34	32/3152 (1.0%)
All	All	0.84	8/4626 (0.2%)	1.29	57/6304 (0.9%)

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
1	B	0	2
All	All	0	3

The worst 5 of 8 bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	A	97	ALA	C-O	-9.88	1.04	1.23
1	A	94	VAL	C-N	8.15	1.52	1.34
1	A	89	THR	C-N	7.67	1.51	1.34
1	A	149	PRO	C-N	7.35	1.50	1.34
1	A	377	VAL	C-O	-6.94	1.10	1.23

The worst 5 of 57 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	B	119	TYR	N-CA-CB	-16.57	80.77	110.60
1	A	94	VAL	O-C-N	15.20	147.02	122.70
1	A	94	VAL	CA-C-N	-14.14	86.08	117.20
1	B	323	PRO	O-C-N	-11.99	103.51	122.70

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Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	94	VAL	C-N-CA	-11.00	94.20	121.70

There are no chirality outliers.

All (3) planarity outliers are listed below:

Mol	Chain	Res	Type	Group
1	A	149	PRO	Mainchain
1	B	323	PRO	Mainchain
1	B	341	VAL	Peptide

## 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	2274	0	2341	658	0
1	B	2274	0	2341	648	0
2	A	1	0	0	0	0
2	B	1	0	0	0	0
All	All	4550	0	4682	1274	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 138.

The worst 5 of 1274 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:B:283:LEU:CD2	1:B:294:LEU:HD12	1.43	1.49
1:B:147:GLY:CA	1:B:212:ALA:HB3	1.45	1.45
1:A:92:LEU:HD13	1:A:93:GLY:N	1.32	1.41
1:B:187:LEU:HD12	1:B:188:ALA:N	1.38	1.39
1:B:244:VAL:HG21	1:B:307:LEU:CD1	1.53	1.38

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	295/407 (72%)	242 (82%)	27 (9%)	26 (9%)	1	13
1	B	295/407 (72%)	248 (84%)	26 (9%)	21 (7%)	1	17
All	All	590/814 (72%)	490 (83%)	53 (9%)	47 (8%)	1	15

5 of 47 Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	135	VAL
1	A	140	VAL
1	A	149	PRO
1	A	236	ALA
1	A	258	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	243/332 (73%)	186 (76%)	57 (24%)	1	5
1	B	243/332 (73%)	174 (72%)	69 (28%)	0	2
All	All	486/664 (73%)	360 (74%)	126 (26%)	0	4

5 of 126 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	384	LEU

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Mol	Chain	Res	Type
1	B	160	GLU
1	B	350	PHE
1	B	121	TYR
1	B	144	VAL

Some sidechains can be flipped to improve hydrogen bonding and reduce clashes. 5 of 9 such sidechains are listed below:

Mol	Chain	Res	Type
1	A	359	GLN
1	B	339	GLN
1	B	145	GLN
1	A	239	GLN
1	B	125	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](#)

Of 2 ligands modelled in this entry, 2 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 [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

### 6.1 Protein, DNA and RNA chains

Unable to reproduce the depositors R factor - this section is therefore empty.

### 6.2 Non-standard residues in protein, DNA, RNA chains

Unable to reproduce the depositors R factor - this section is therefore empty.

### 6.3 Carbohydrates

Unable to reproduce the depositors R factor - this section is therefore empty.

### 6.4 Ligands

Unable to reproduce the depositors R factor - this section is therefore empty.

### 6.5 Other polymers

Unable to reproduce the depositors R factor - this section is therefore empty.