



# wwPDB X-ray Structure Validation Summary Report ⓘ

Jun 12, 2024 – 11:12 PM EDT

PDB ID : 1EK9  
Title : 2.1A X-RAY STRUCTURE OF TOLC: AN INTEGRAL OUTER MEMBRANE PROTEIN AND EFFLUX PUMP COMPONENT FROM ESCHERICHIA COLI  
Authors : Koronakis, V.; Sharff, A.J.; Koronakis, E.; Luisi, B.; Hughes, C.  
Deposited on : 2000-03-07  
Resolution : 2.10 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.

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	:	1.8.5 (274361), CSD as541be (2020)
Xtriage (Phenix)	:	1.13
EDS	:	2.36.2
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)	:	2.36.2

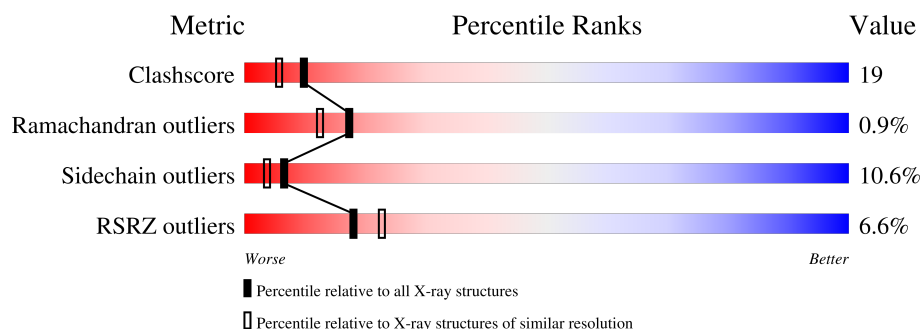
# 1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

*X-RAY DIFFRACTION*

The reported resolution of this entry is 2.10 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))
Clashscore	141614	5710 (2.10-2.10)
Ramachandran outliers	138981	5647 (2.10-2.10)
Sidechain outliers	138945	5648 (2.10-2.10)
RSRZ outliers	127900	5083 (2.10-2.10)

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	428	<div> <div>4%</div> <div>67%</div> <div>25%</div> <div>7%</div> </div>
1	B	428	<div> <div>7%</div> <div>71%</div> <div>23%</div> <div>5%</div> </div>
1	C	428	<div> <div>9%</div> <div>68%</div> <div>24%</div> <div>7%</div> </div>

## 2 Entry composition

There are 2 unique types of molecules in this entry. The entry contains 11426 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 OUTER MEMBRANE PROTEIN TOLC.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	428	Total	C	N	O	Se	0	0	0
			3306	2038	586	677	5			
1	B	428	Total	C	N	O	Se	0	0	0
			3306	2038	586	677	5			
1	C	428	Total	C	N	O	Se	0	0	0
			3306	2038	586	677	5			

There are 15 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	4	MSE	MET	MODIFIED RESIDUE	UNP P02930
A	78	MSE	MET	MODIFIED RESIDUE	UNP P02930
A	279	MSE	MET	MODIFIED RESIDUE	UNP P02930
A	297	MSE	MET	MODIFIED RESIDUE	UNP P02930
A	358	MSE	MET	MODIFIED RESIDUE	UNP P02930
B	4	MSE	MET	MODIFIED RESIDUE	UNP P02930
B	78	MSE	MET	MODIFIED RESIDUE	UNP P02930
B	279	MSE	MET	MODIFIED RESIDUE	UNP P02930
B	297	MSE	MET	MODIFIED RESIDUE	UNP P02930
B	358	MSE	MET	MODIFIED RESIDUE	UNP P02930
C	4	MSE	MET	MODIFIED RESIDUE	UNP P02930
C	78	MSE	MET	MODIFIED RESIDUE	UNP P02930
C	279	MSE	MET	MODIFIED RESIDUE	UNP P02930
C	297	MSE	MET	MODIFIED RESIDUE	UNP P02930
C	358	MSE	MET	MODIFIED RESIDUE	UNP P02930

- Molecule 2 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
2	A	442	Total	O	0	0
			442	442		
2	B	558	Total	O	0	0
			558	558		

*Continued on next page...*

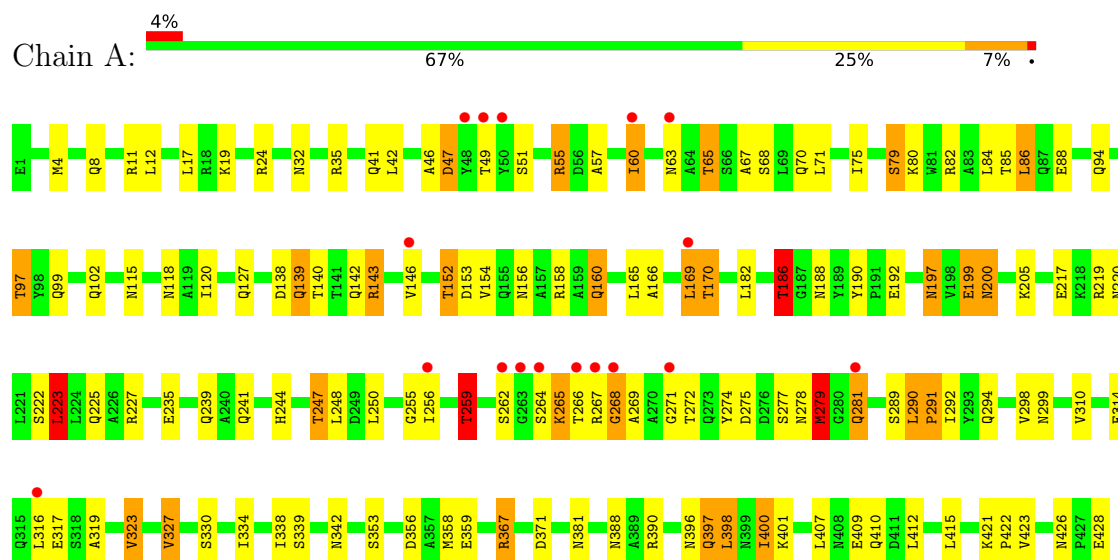
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Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
2	C	508	Total 508	O 508	0	0

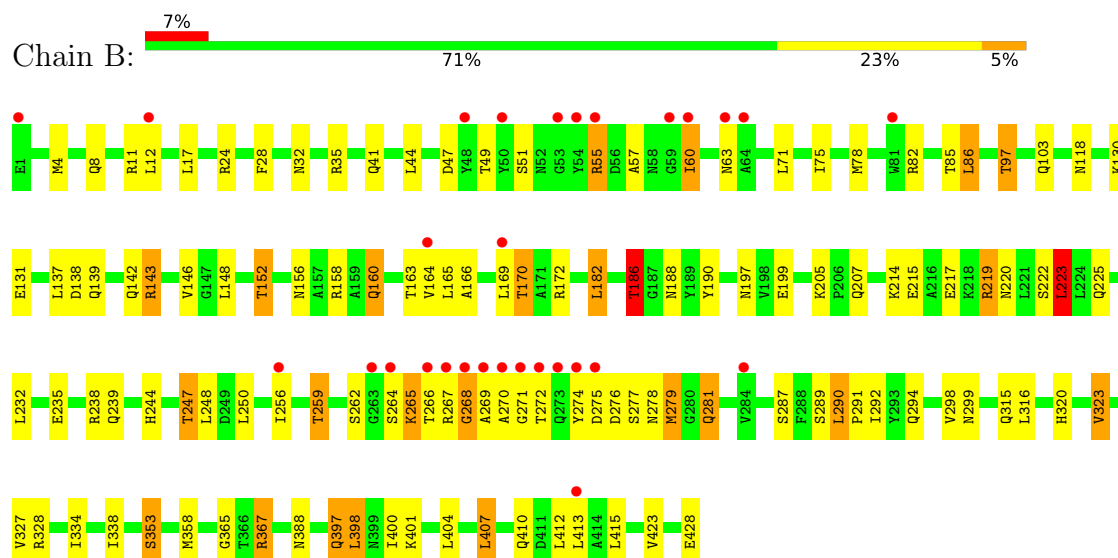
### 3 Residue-property plots [i](#)

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: OUTER MEMBRANE PROTEIN TOLC

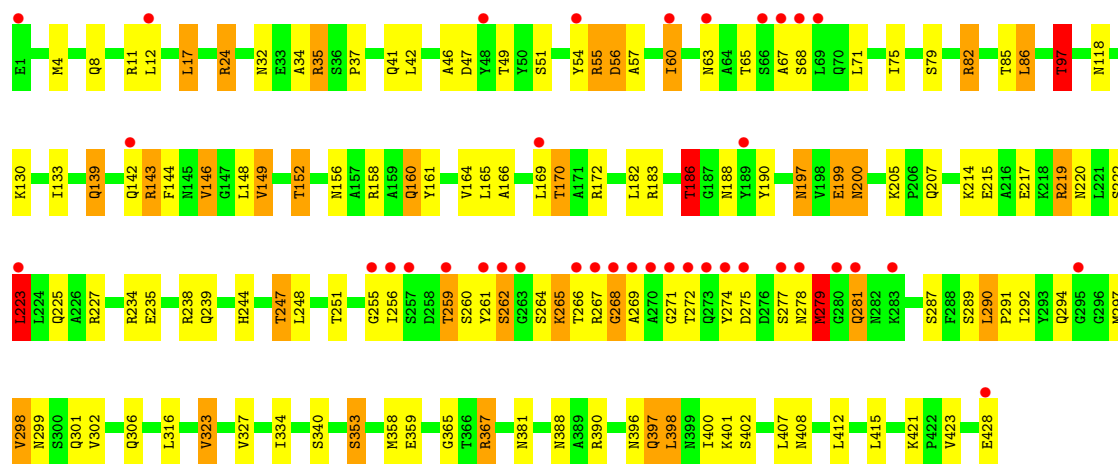


#### • Molecule 1: OUTER MEMBRANE PROTEIN TOLC



#### • Molecule 1: OUTER MEMBRANE PROTEIN TOLC





## 4 Data and refinement statistics

Property	Value	Source
Space group	H 3	Depositor
Cell constants a, b, c, $\alpha$ , $\beta$ , $\gamma$	265.05Å 265.05Å 95.96Å 90.00° 90.00° 120.00°	Depositor
Resolution (Å)	20.00 – 2.10 132.52 – 2.10	Depositor EDS
% Data completeness (in resolution range)	(Not available) (20.00-2.10) 99.6 (132.52-2.10)	Depositor EDS
$R_{merge}$	0.06	Depositor
$R_{sym}$	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ <sup>1</sup>	2.19 (at 2.10Å)	Xtriage
Refinement program	BUSTER-TNT	Depositor
R, $R_{free}$	0.208 , 0.257 0.223 , (Not available)	Depositor DCC
$R_{free}$ test set	No test flags present.	wwPDB-VP
Wilson B-factor (Å <sup>2</sup> )	37.6	Xtriage
Anisotropy	0.024	Xtriage
Bulk solvent $k_{sol}$ (e/Å <sup>3</sup> ), $B_{sol}$ (Å <sup>2</sup> )	0.38 , 79.6	EDS
L-test for twinning <sup>2</sup>	$\langle  L  \rangle = 0.49$ , $\langle L^2 \rangle = 0.32$	Xtriage
Estimated twinning fraction	0.000 for h,-h-k,-l	Xtriage
$F_o, F_c$ correlation	0.94	EDS
Total number of atoms	11426	wwPDB-VP
Average B, all atoms (Å <sup>2</sup> )	50.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 4.11% 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

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	0.85	1/3342 (0.0%)	1.27	20/4530 (0.4%)
1	B	0.87	1/3342 (0.0%)	1.19	17/4530 (0.4%)
1	C	0.88	0/3342	1.26	28/4530 (0.6%)
All	All	0.86	2/10026 (0.0%)	1.24	65/13590 (0.5%)

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	2
1	C	0	5
All	All	0	7

All (2) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	A	353	SER	CB-OG	-5.97	1.34	1.42
1	B	353	SER	CB-OG	-5.54	1.35	1.42

The worst 5 of 65 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	C	367	ARG	NE-CZ-NH1	-21.04	109.78	120.30
1	A	367	ARG	NE-CZ-NH1	-19.04	110.78	120.30
1	B	143	ARG	NE-CZ-NH1	17.25	128.92	120.30
1	A	367	ARG	NE-CZ-NH2	17.23	128.91	120.30
1	B	367	ARG	NE-CZ-NH1	-14.76	112.92	120.30

There are no chirality outliers.

5 of 7 planarity outliers are listed below:



Mol	Chain	Res	Type	Group
1	A	314	GLU	Mainchain
1	A	317	GLU	Mainchain
1	C	144	PHE	Mainchain
1	C	34	ALA	Mainchain
1	C	97	THR	Mainchain

## 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	3306	0	3256	135	0
1	B	3306	0	3256	131	0
1	C	3306	0	3256	145	0
2	A	442	0	0	40	2
2	B	558	0	0	45	1
2	C	508	0	0	54	1
All	All	11426	0	9768	377	2

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 19.

The worst 5 of 377 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:156:ASN:HD21	1:C:367:ARG:NH1	1.34	1.23
1:B:423:VAL:HB	2:B:703:HOH:O	1.40	1.19
1:A:156:ASN:HD21	1:B:367:ARG:NH1	1.42	1.17
1:C:423:VAL:HB	2:C:624:HOH:O	1.42	1.16
1:A:367:ARG:NH1	1:C:156:ASN:HD21	1.46	1.14

All (2) 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:773:HOH:O	2:C:709:HOH:O[9_554]	2.11	0.09
2:A:683:HOH:O	2:B:797:HOH:O[9_554]	2.15	0.05

## 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	426/428 (100%)	403 (95%)	19 (4%)	4 (1%)	17	12
1	B	426/428 (100%)	403 (95%)	19 (4%)	4 (1%)	17	12
1	C	426/428 (100%)	397 (93%)	25 (6%)	4 (1%)	17	12
All	All	1278/1284 (100%)	1203 (94%)	63 (5%)	12 (1%)	17	12

5 of 12 Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	B	259	THR
1	B	279	MSE
1	A	259	THR
1	C	259	THR
1	C	279	MSE

### 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	358/353 (101%)	316 (88%)	42 (12%)	5	3
1	B	358/353 (101%)	325 (91%)	33 (9%)	9	6
1	C	358/353 (101%)	319 (89%)	39 (11%)	6	3
All	All	1074/1059 (101%)	960 (89%)	114 (11%)	6	4

5 of 114 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	B	223	LEU
1	C	398	LEU
1	B	398	LEU
1	C	397	GLN
1	C	262	SER

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. 5 of 87 such sidechains are listed below:

Mol	Chain	Res	Type
1	B	417	ASN
1	C	197	ASN
1	C	41	GLN
1	C	139	GLN
1	C	225	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 monosaccharides 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 [i](#)

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	423/428 (98%)	0.44	17 (4%) 38 44	25, 48, 81, 84	0
1	B	423/428 (98%)	0.75	29 (6%) 16 21	24, 47, 81, 84	0
1	C	423/428 (98%)	0.75	38 (8%) 9 12	24, 47, 81, 84	0
All	All	1269/1284 (98%)	0.65	84 (6%) 18 23	24, 47, 81, 84	0

The worst 5 of 84 RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	C	269	ALA	11.0
1	B	270	ALA	10.8
1	C	270	ALA	10.3
1	B	269	ALA	10.2
1	C	268	GLY	9.6

### 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](#)

There are no ligands in this entry.

## 6.5 Other polymers [i](#)

There are no such residues in this entry.