



# wwPDB X-ray Structure Validation Summary Report ⓘ

Aug 16, 2023 – 11:34 PM EDT

PDB ID : 2F2F  
Title : Crystal structure of cytolethal distending toxin (CDT) from *Actinobacillus actinomycetemcomitans*  
Authors : Yamada, T.; Komoto, J.; Saiki, K.; Konishi, K.; Takusagawa, F.  
Deposited on : 2005-11-16  
Resolution : 2.40 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  
Xtriage (Phenix) : 1.13  
EDS : 2.35  
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) : 2.35

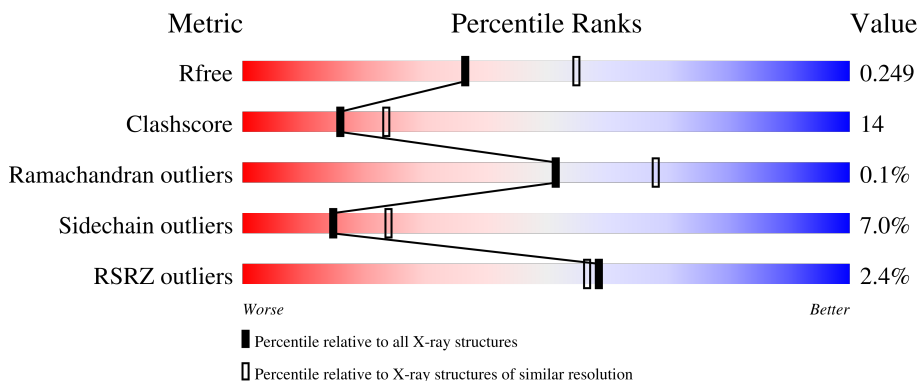
# 1 Overall quality at a glance i

The following experimental techniques were used to determine the structure:

*X-RAY DIFFRACTION*

The reported resolution of this entry is 2.40 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.



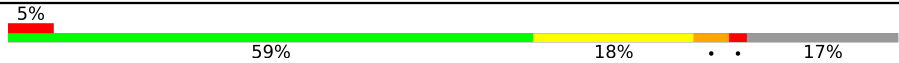
Metric	Whole archive (#Entries)	Similar resolution (#Entries, resolution range(Å))
$R_{free}$	130704	3907 (2.40-2.40)
Clashscore	141614	4398 (2.40-2.40)
Ramachandran outliers	138981	4318 (2.40-2.40)
Sidechain outliers	138945	4319 (2.40-2.40)
RSRZ outliers	127900	3811 (2.40-2.40)

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	222	<div style="display: flex; align-items: center;"> <div style="width: 5%; height: 10px; background-color: red; margin-right: 5px;"></div> <div style="width: 55%; height: 10px; background-color: green; margin-right: 5px;"></div> <div style="width: 14%; height: 10px; background-color: yellow; margin-right: 5px;"></div> <div style="width: 26%; height: 10px; background-color: grey;"></div> </div> <p style="margin-left: 5px;">55% 14% 31%</p>
1	D	222	<div style="display: flex; align-items: center;"> <div style="width: 5%; height: 10px; background-color: red; margin-right: 5px;"></div> <div style="width: 57%; height: 10px; background-color: green; margin-right: 5px;"></div> <div style="width: 12%; height: 10px; background-color: yellow; margin-right: 5px;"></div> <div style="width: 26%; height: 10px; background-color: grey;"></div> </div> <p style="margin-left: 5px;">57% 12% 31%</p>
2	B	283	<div style="display: flex; align-items: center;"> <div style="width: 5%; height: 10px; background-color: red; margin-right: 5px;"></div> <div style="width: 68%; height: 10px; background-color: green; margin-right: 5px;"></div> <div style="width: 20%; height: 10px; background-color: yellow; margin-right: 5px;"></div> <div style="width: 5%; height: 10px; background-color: orange; margin-right: 5px;"></div> <div style="width: 2%; height: 10px; background-color: grey;"></div> </div> <p style="margin-left: 5px;">68% 20% 8%</p>
2	E	283	<div style="display: flex; align-items: center;"> <div style="width: 5%; height: 10px; background-color: red; margin-right: 5px;"></div> <div style="width: 66%; height: 10px; background-color: green; margin-right: 5px;"></div> <div style="width: 23%; height: 10px; background-color: yellow; margin-right: 5px;"></div> <div style="width: 5%; height: 10px; background-color: orange; margin-right: 5px;"></div> <div style="width: 2%; height: 10px; background-color: grey;"></div> </div> <p style="margin-left: 5px;">66% 23% 8%</p>
3	C	186	<div style="display: flex; align-items: center;"> <div style="width: 5%; height: 10px; background-color: red; margin-right: 5px;"></div> <div style="width: 56%; height: 10px; background-color: green; margin-right: 5px;"></div> <div style="width: 22%; height: 10px; background-color: yellow; margin-right: 5px;"></div> <div style="width: 17%; height: 10px; background-color: grey;"></div> </div> <p style="margin-left: 5px;">56% 22% 17%</p>

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Mol	Chain	Length	Quality of chain
3	F	186	 <p>5% 59% 18% 17%</p>

## 2 Entry composition [i](#)

There are 4 unique types of molecules in this entry. The entry contains 9188 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 Cytolethal distending toxin A.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
1	A	153	1207	770	201	230	6	0	0	0
1	D	153	1207	770	201	230	6	0	0	0

- Molecule 2 is a protein called Cytolethal distending toxin B.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
2	B	261	2038	1268	378	388	4	0	0	0
2	E	261	2038	1268	378	388	4	0	0	0

There are 2 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
B	281	HIS	ARG	see remark 999	UNP Q7DK12
E	281	HIS	ARG	see remark 999	UNP Q7DK12

- Molecule 3 is a protein called cytolethal distending toxin C.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
3	C	154	1213	781	200	227	5	0	0	0
3	F	154	1213	781	200	227	5	0	0	0

There are 2 discrepancies between the modelled and reference sequences:

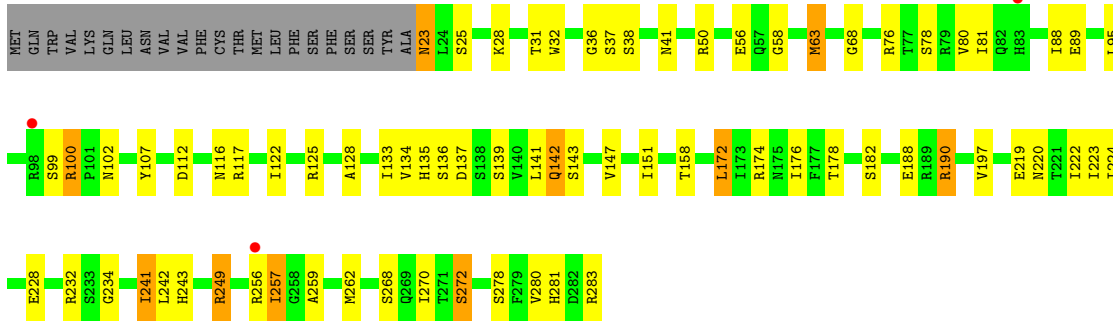
Chain	Residue	Modelled	Actual	Comment	Reference
C	172	PRO	SER	see remark 999	UNP Q7DK11
F	172	PRO	SER	see remark 999	UNP Q7DK11

- Molecule 4 is water.

Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
4	A	37	Total O 37 37	0	0
4	B	60	Total O 60 60	0	0
4	C	32	Total O 32 32	0	0
4	D	41	Total O 41 41	0	0
4	E	64	Total O 64 64	0	0
4	F	38	Total O 38 38	0	0

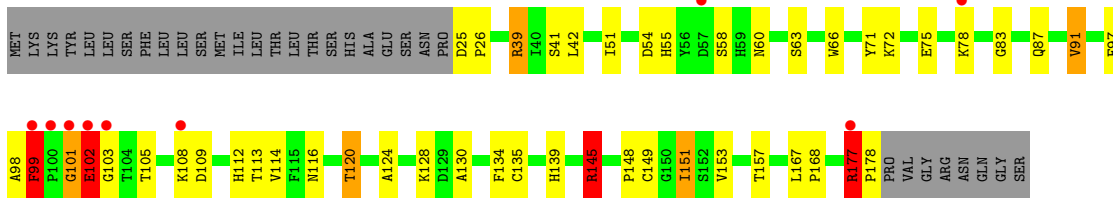


Chain E: 66% 23% 8%



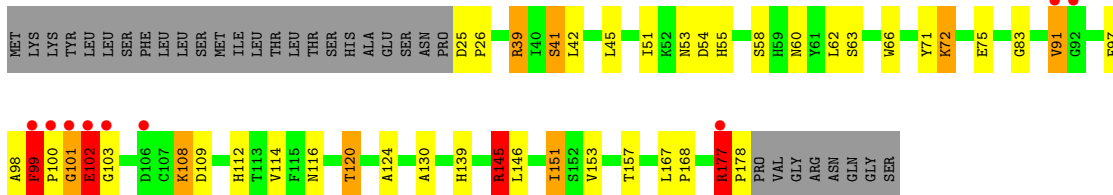
• Molecule 3: cytolethal distending toxin C

Chain C: 56% 22% 17% 5%



• Molecule 3: cytolethal distending toxin C

Chain F: 59% 18% 17% 5%



## 4 Data and refinement statistics i

Property	Value	Source
Space group	P 21 21 21	Depositor
Cell constants a, b, c, $\alpha$ , $\beta$ , $\gamma$	115.65Å 117.46Å 123.37Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	20.00 – 2.40 48.20 – 2.38	Depositor EDS
% Data completeness (in resolution range)	(Not available) (20.00-2.40) 99.5 (48.20-2.38)	Depositor EDS
$R_{merge}$	(Not available)	Depositor
$R_{sym}$	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ <sup>1</sup>	6.31 (at 2.39Å)	Xtrriage
Refinement program	CNS	Depositor
R, $R_{free}$	0.221 , 0.251 0.216 , 0.249	Depositor DCC
$R_{free}$ test set	6842 reflections (10.13%)	wwPDB-VP
Wilson B-factor (Å <sup>2</sup> )	18.5	Xtrriage
Anisotropy	1.046	Xtrriage
Bulk solvent $k_{sol}$ (e/Å <sup>3</sup> ), $B_{sol}$ (Å <sup>2</sup> )	0.36 , 43.7	EDS
L-test for twinning <sup>2</sup>	$\langle  L  \rangle = 0.49$ , $\langle L^2 \rangle = 0.32$	Xtrriage
Estimated twinning fraction	0.000 for k,h,-l	Xtrriage
$F_o, F_c$ correlation	0.94	EDS
Total number of atoms	9188	wwPDB-VP
Average B, all atoms (Å <sup>2</sup> )	11.0	wwPDB-VP

Xtrriage's analysis on translational NCS is as follows: *The analyses of the Patterson function reveals a significant off-origin peak that is 49.12 % of the origin peak, indicating pseudo-translational symmetry. The chance of finding a peak of this or larger height randomly in a structure without pseudo-translational symmetry is equal to 7.8088e-05. The detected translational NCS is most likely also responsible for the elevated intensity ratio.*

<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	0.48	0/1241	0.71	0/1696
1	D	0.48	0/1241	0.72	0/1696
2	B	0.45	0/2080	0.77	2/2828 (0.1%)
2	E	0.45	0/2080	0.78	2/2828 (0.1%)
3	C	0.53	0/1249	0.90	7/1701 (0.4%)
3	F	0.53	0/1249	0.88	9/1701 (0.5%)
All	All	0.48	0/9140	0.79	20/12450 (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
2	B	0	1
2	E	0	1
All	All	0	2

There are no bond length outliers.

The worst 5 of 20 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
3	C	99	PHE	C-N-CD	10.54	150.53	128.40
3	F	99	PHE	C-N-CD	-9.58	99.51	120.60
3	C	177	ARG	NE-CZ-NH1	8.76	124.68	120.30
2	B	190	ARG	NE-CZ-NH2	-7.46	116.57	120.30
3	F	99	PHE	N-CA-C	-7.39	91.06	111.00

There are no chirality outliers.

All (2) planarity outliers are listed below:

Mol	Chain	Res	Type	Group
2	B	107	TYR	Sidechain
2	E	107	TYR	Sidechain

## 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	1207	0	1164	34	0
1	D	1207	0	1164	23	0
2	B	2038	0	2003	55	0
2	E	2038	0	2003	57	0
3	C	1213	0	1185	48	0
3	F	1213	0	1185	54	0
4	A	37	0	0	0	0
4	B	60	0	0	1	0
4	C	32	0	0	0	0
4	D	41	0	0	0	0
4	E	64	0	0	4	0
4	F	38	0	0	1	0
All	All	9188	0	8704	249	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 14.

The worst 5 of 249 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)
3:F:177:ARG:HE	3:F:177:ARG:HA	1.11	1.08
3:F:177:ARG:HA	3:F:177:ARG:NE	1.83	0.94
3:F:25:ASP:HB3	3:F:26:PRO:CD	1.98	0.93
2:E:135:HIS:HD2	2:E:139:SER:HB2	1.34	0.92
3:C:25:ASP:HB3	3:C:26:PRO:CD	2.01	0.90

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	151/222 (68%)	145 (96%)	6 (4%)	0	100	100
1	D	151/222 (68%)	145 (96%)	6 (4%)	0	100	100
2	B	259/283 (92%)	248 (96%)	11 (4%)	0	100	100
2	E	259/283 (92%)	247 (95%)	12 (5%)	0	100	100
3	C	152/186 (82%)	147 (97%)	4 (3%)	1 (1%)	22	32
3	F	152/186 (82%)	147 (97%)	5 (3%)	0	100	100
All	All	1124/1382 (81%)	1079 (96%)	44 (4%)	1 (0%)	51	68

All (1) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
3	C	101	GLY

### 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	132/195 (68%)	130 (98%)	2 (2%)	65	80
1	D	132/195 (68%)	129 (98%)	3 (2%)	50	70
2	B	223/244 (91%)	206 (92%)	17 (8%)	13	20
2	E	223/244 (91%)	203 (91%)	20 (9%)	9	14
3	C	135/164 (82%)	121 (90%)	14 (10%)	7	10
3	F	135/164 (82%)	122 (90%)	13 (10%)	8	12

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Mol	Chain	Analysed	Rotameric	Outliers	Percentiles	
All	All	980/1206 (81%)	911 (93%)	69 (7%)	15	24

5 of 69 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
3	F	41	SER
3	F	58	SER
3	F	120	THR
3	C	78	LYS
3	C	72	LYS

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. 5 of 13 such sidechains are listed below:

Mol	Chain	Res	Type
1	D	108	GLN
2	E	41	ASN
3	F	112	HIS
2	E	135	HIS
2	E	281	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 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	153/222 (68%)	-0.32	2 (1%) 77 75	2, 8, 23, 51	0
1	D	153/222 (68%)	-0.28	2 (1%) 77 75	2, 8, 23, 47	0
2	B	261/283 (92%)	-0.34	2 (0%) 86 84	2, 6, 25, 44	0
2	E	261/283 (92%)	-0.27	3 (1%) 80 79	2, 7, 26, 44	0
3	C	154/186 (82%)	0.12	9 (5%) 23 22	3, 15, 39, 65	0
3	F	154/186 (82%)	-0.01	9 (5%) 23 22	3, 11, 33, 50	0
All	All	1136/1382 (82%)	-0.21	27 (2%) 59 57	2, 8, 29, 65	0

The worst 5 of 27 RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	71	PRO	8.8
1	D	71	PRO	8.7
1	D	72	SER	7.6
3	F	100	PRO	7.5
3	C	101	GLY	6.9

### 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.