



# wwPDB X-ray Structure Validation Summary Report ⓘ

Mar 5, 2026 – 01:25 AM UTC

PDB ID : 5FDF / pdb\_00005fdf  
Title : Crystal structure of the monoclinic form of Thermotoga maritima Acetyl Esterase TM0077 (apo structure) at 1.76 Angstrom resolution  
Authors : Manoj, N.; Singh, M.K.  
Deposited on : 2015-12-16  
Resolution : 1.76 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	:	4-5-2 with Phenix2.0
Mogul	:	2022.3.0, CSD as543be (2022)
Xtriage (Phenix)	:	2.0
EDS	:	3.0
Percentile statistics	:	20250101.v01 (using entries in the PDB archive January 1st 2025)
CCP4	:	9.0.010 (Gargrove)
Density-Fitness	:	1.0.12
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, RNA)	:	Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP)	:	2.49

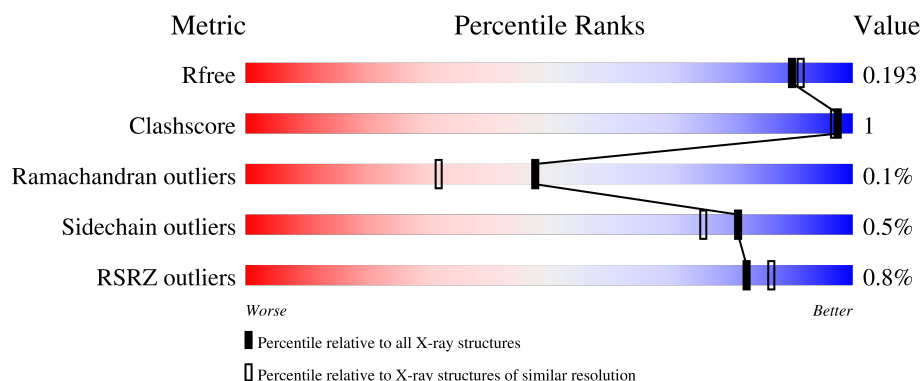
# 1 Overall quality at a glance ⓘ

The following experimental techniques were used to determine the structure:

## *X-RAY DIFFRACTION*

The reported resolution of this entry is 1.76 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))
$R_{free}$	180053	3183 (1.76-1.76)
Clashscore	190562	3299 (1.76-1.76)
Ramachandran outliers	187476	3274 (1.76-1.76)
Sidechain outliers	187428	3274 (1.76-1.76)
RSRZ outliers	180081	3183 (1.76-1.76)

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	337	<div> <div>91%</div> <div>5%</div> </div>
1	B	337	<div> <div>91%</div> <div>5%</div> </div>
1	C	337	<div> <div>91%</div> <div>5%</div> </div>
1	D	337	<div> <div>91%</div> <div>5%</div> </div>
1	E	337	<div> <div>92%</div> <div>5%</div> </div>

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Mol	Chain	Length	Quality of chain
1	F	337	 92% • 5%

The following table lists non-polymeric compounds, carbohydrate monomers and non-standard residues in protein, DNA, RNA chains that are outliers for geometric or electron-density-fit criteria:

Mol	Type	Chain	Res	Chirality	Geometry	Clashes	Electron density
3	ACT	C	401	-	-	X	-

## 2 Entry composition

There are 4 unique types of molecules in this entry. The entry contains 16780 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 Cephalosporin-C deacetylase.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	319	Total	C	N	O	S	0	0	0
			2516	1636	410	460	10			
1	B	320	Total	C	N	O	S	0	2	0
			2572	1675	431	456	10			
1	C	320	Total	C	N	O	S	0	2	0
			2541	1654	418	459	10			
1	D	319	Total	C	N	O	S	0	2	0
			2541	1654	422	455	10			
1	E	320	Total	C	N	O	S	0	2	0
			2576	1675	429	462	10			
1	F	320	Total	C	N	O	S	0	2	0
			2542	1653	421	458	10			

There are 72 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	-11	MET	-	initiating methionine	UNP Q9WXT2
A	-10	GLY	-	expression tag	UNP Q9WXT2
A	-9	SER	-	expression tag	UNP Q9WXT2
A	-8	ASP	-	expression tag	UNP Q9WXT2
A	-7	LYS	-	expression tag	UNP Q9WXT2
A	-6	ILE	-	expression tag	UNP Q9WXT2
A	-5	HIS	-	expression tag	UNP Q9WXT2
A	-4	HIS	-	expression tag	UNP Q9WXT2
A	-3	HIS	-	expression tag	UNP Q9WXT2
A	-2	HIS	-	expression tag	UNP Q9WXT2
A	-1	HIS	-	expression tag	UNP Q9WXT2
A	0	HIS	-	expression tag	UNP Q9WXT2
B	-11	MET	-	initiating methionine	UNP Q9WXT2
B	-10	GLY	-	expression tag	UNP Q9WXT2
B	-9	SER	-	expression tag	UNP Q9WXT2
B	-8	ASP	-	expression tag	UNP Q9WXT2
B	-7	LYS	-	expression tag	UNP Q9WXT2

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Chain	Residue	Modelled	Actual	Comment	Reference
B	-6	ILE	-	expression tag	UNP Q9WXT2
B	-5	HIS	-	expression tag	UNP Q9WXT2
B	-4	HIS	-	expression tag	UNP Q9WXT2
B	-3	HIS	-	expression tag	UNP Q9WXT2
B	-2	HIS	-	expression tag	UNP Q9WXT2
B	-1	HIS	-	expression tag	UNP Q9WXT2
B	0	HIS	-	expression tag	UNP Q9WXT2
C	-11	MET	-	initiating methionine	UNP Q9WXT2
C	-10	GLY	-	expression tag	UNP Q9WXT2
C	-9	SER	-	expression tag	UNP Q9WXT2
C	-8	ASP	-	expression tag	UNP Q9WXT2
C	-7	LYS	-	expression tag	UNP Q9WXT2
C	-6	ILE	-	expression tag	UNP Q9WXT2
C	-5	HIS	-	expression tag	UNP Q9WXT2
C	-4	HIS	-	expression tag	UNP Q9WXT2
C	-3	HIS	-	expression tag	UNP Q9WXT2
C	-2	HIS	-	expression tag	UNP Q9WXT2
C	-1	HIS	-	expression tag	UNP Q9WXT2
C	0	HIS	-	expression tag	UNP Q9WXT2
D	-11	MET	-	initiating methionine	UNP Q9WXT2
D	-10	GLY	-	expression tag	UNP Q9WXT2
D	-9	SER	-	expression tag	UNP Q9WXT2
D	-8	ASP	-	expression tag	UNP Q9WXT2
D	-7	LYS	-	expression tag	UNP Q9WXT2
D	-6	ILE	-	expression tag	UNP Q9WXT2
D	-5	HIS	-	expression tag	UNP Q9WXT2
D	-4	HIS	-	expression tag	UNP Q9WXT2
D	-3	HIS	-	expression tag	UNP Q9WXT2
D	-2	HIS	-	expression tag	UNP Q9WXT2
D	-1	HIS	-	expression tag	UNP Q9WXT2
D	0	HIS	-	expression tag	UNP Q9WXT2
E	-11	MET	-	initiating methionine	UNP Q9WXT2
E	-10	GLY	-	expression tag	UNP Q9WXT2
E	-9	SER	-	expression tag	UNP Q9WXT2
E	-8	ASP	-	expression tag	UNP Q9WXT2
E	-7	LYS	-	expression tag	UNP Q9WXT2
E	-6	ILE	-	expression tag	UNP Q9WXT2
E	-5	HIS	-	expression tag	UNP Q9WXT2
E	-4	HIS	-	expression tag	UNP Q9WXT2
E	-3	HIS	-	expression tag	UNP Q9WXT2
E	-2	HIS	-	expression tag	UNP Q9WXT2
E	-1	HIS	-	expression tag	UNP Q9WXT2

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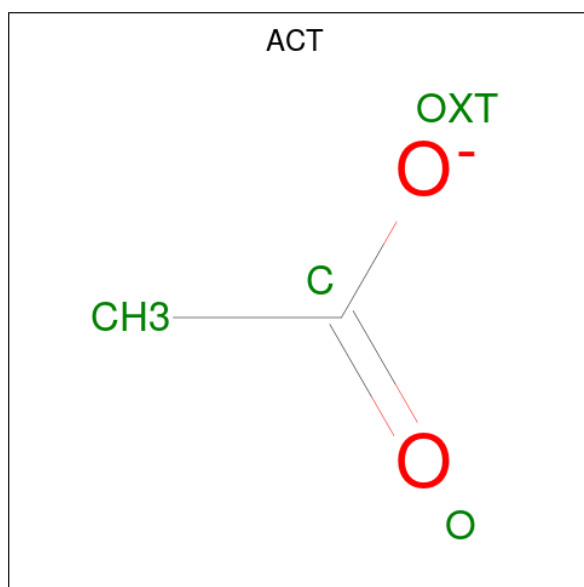
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Chain	Residue	Modelled	Actual	Comment	Reference
E	0	HIS	-	expression tag	UNP Q9WXT2
F	-11	MET	-	initiating methionine	UNP Q9WXT2
F	-10	GLY	-	expression tag	UNP Q9WXT2
F	-9	SER	-	expression tag	UNP Q9WXT2
F	-8	ASP	-	expression tag	UNP Q9WXT2
F	-7	LYS	-	expression tag	UNP Q9WXT2
F	-6	ILE	-	expression tag	UNP Q9WXT2
F	-5	HIS	-	expression tag	UNP Q9WXT2
F	-4	HIS	-	expression tag	UNP Q9WXT2
F	-3	HIS	-	expression tag	UNP Q9WXT2
F	-2	HIS	-	expression tag	UNP Q9WXT2
F	-1	HIS	-	expression tag	UNP Q9WXT2
F	0	HIS	-	expression tag	UNP Q9WXT2

- Molecule 2 is CHLORIDE ION (CCD ID: CL) (formula: Cl).

Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
2	B	1	Total Cl 1 1	0	0

- Molecule 3 is ACETATE ION (CCD ID: ACT) (formula: C<sub>2</sub>H<sub>3</sub>O<sub>2</sub>).



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

- Molecule 4 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
4	A	213	Total 213	O 213	0	0
4	B	253	Total 253	O 253	0	0
4	C	255	Total 255	O 255	0	0
4	D	230	Total 230	O 230	0	0
4	E	282	Total 282	O 282	0	0
4	F	254	Total 254	O 254	0	0

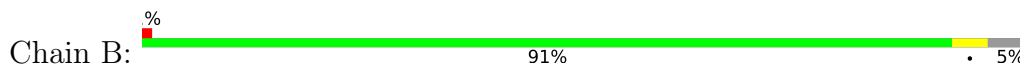
### 3 Residue-property plots [i](#)

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: Cephalosporin-C deacetylase



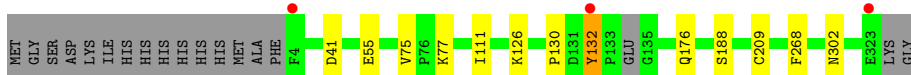
- Molecule 1: Cephalosporin-C deacetylase



- Molecule 1: Cephalosporin-C deacetylase



- Molecule 1: Cephalosporin-C deacetylase



- Molecule 1: Cephalosporin-C deacetylase



- Molecule 1: Cephalosporin-C deacetylase



Chain F: 

92%

• 5%

MET	GLY	SER	ASP	LYS	ILE	HIS	HIS	HIS	HIS	HIS	HIS	MET	ALA	PHE	F4	L74	E79	N93	P106	Y110	G123	P142	G143	A262	A290	E323	LYS	GLY
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## 4 Data and refinement statistics

Property	Value	Source
Space group	P 1 21 1	Depositor
Cell constants a, b, c, $\alpha$ , $\beta$ , $\gamma$	89.76Å 116.20Å 103.29Å 90.00° 109.97° 90.00°	Depositor
Resolution (Å)	39.96 – 1.76 39.96 – 1.76	Depositor EDS
% Data completeness (in resolution range)	98.8 (39.96-1.76) 98.8 (39.96-1.76)	Depositor EDS
$R_{merge}$	0.12	Depositor
$R_{sym}$	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ <sup>1</sup>	1.85 (at 1.76Å)	Xtriage
Refinement program	REFMAC 5.8.0103	Depositor
R, $R_{free}$	0.160 , 0.195 (Not available) , 0.193	Depositor DCC
$R_{free}$ test set	9696 reflections (4.93%)	wwPDB-VP
Wilson B-factor (Å <sup>2</sup> )	18.3	Xtriage
Anisotropy	0.060	Xtriage
Bulk solvent $k_{sol}$ (e/Å <sup>3</sup> ), $B_{sol}$ (Å <sup>2</sup> )	0.33 , 36.4	EDS
L-test for twinning <sup>2</sup>	$\langle  L  \rangle = 0.48$ , $\langle L^2 \rangle = 0.31$	Xtriage
Estimated twinning fraction	No twinning to report.	Xtriage
$F_o, F_c$ correlation	0.96	EDS
Total number of atoms	16780	wwPDB-VP
Average B, all atoms (Å <sup>2</sup> )	22.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 3.87% 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: CL, ACT

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	1.21	2/2594 (0.1%)	1.11	5/3532 (0.1%)
1	B	1.24	4/2655 (0.2%)	1.08	4/3604 (0.1%)
1	C	1.23	0/2627	1.15	6/3576 (0.2%)
1	D	1.20	2/2623 (0.1%)	1.06	3/3567 (0.1%)
1	E	1.25	3/2659 (0.1%)	1.10	5/3611 (0.1%)
1	F	1.22	0/2625	1.07	1/3574 (0.0%)
All	All	1.23	11/15783 (0.1%)	1.10	24/21464 (0.1%)

The worst 5 of 11 bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	D	188	SER	C-O	-6.16	1.19	1.24
1	B	6	LEU	C-O	-5.94	1.17	1.24
1	B	80	GLU	CA-C	5.87	1.59	1.52
1	D	111	ILE	C-O	-5.75	1.17	1.24
1	B	263	LYS	N-CA	5.29	1.52	1.45

The worst 5 of 24 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	C	49	SER	N-CA-C	-8.51	97.70	109.95
1	C	47	MET	CB-CG-SD	-7.25	90.96	112.70
1	C	80	GLU	N-CA-C	7.14	120.74	110.24
1	E	103	LEU	N-CA-C	6.05	120.39	112.89
1	A	135	GLY	CA-C-N	-6.00	113.50	119.99

There are no chirality outliers.

There are no planarity outliers.

## 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	2516	0	2360	4	0
1	B	2572	0	2482	5	0
1	C	2541	0	2403	4	0
1	D	2541	0	2413	5	0
1	E	2576	0	2472	2	0
1	F	2542	0	2398	5	0
2	B	1	0	0	0	0
3	C	4	0	3	3	0
4	A	213	0	0	1	0
4	B	253	0	0	1	0
4	C	255	0	0	1	0
4	D	230	0	0	1	0
4	E	282	0	0	1	0
4	F	254	0	0	0	0
All	All	16780	0	14531	24	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 1.

The worst 5 of 24 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:E:55:GLU:OE1	4:E:401:HOH:O	2.13	0.65
1:B:302[A]:ASN:CG	1:B:303:HIS:N	2.50	0.64
1:D:176:GLN:HG3	4:D:489:HOH:O	2.04	0.57
1:A:34:GLU:OE2	1:A:65:ARG:NH1	2.42	0.52
1:C:49:SER:HB2	4:C:505:HOH:O	2.10	0.52

There are no symmetry-related clashes.

### 5.3 Torsion angles

#### 5.3.1 Protein backbone

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	315/337 (94%)	308 (98%)	7 (2%)	0	100	100
1	B	320/337 (95%)	310 (97%)	10 (3%)	0	100	100
1	C	320/337 (95%)	308 (96%)	12 (4%)	0	100	100
1	D	317/337 (94%)	308 (97%)	7 (2%)	2 (1%)	21	8
1	E	320/337 (95%)	311 (97%)	9 (3%)	0	100	100
1	F	320/337 (95%)	307 (96%)	13 (4%)	0	100	100
All	All	1912/2022 (95%)	1852 (97%)	58 (3%)	2 (0%)	48	32

All (2) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	D	302[A]	ASN
1	D	302[B]	ASN

#### 5.3.2 Protein sidechains

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	29/285 (10%)	29 (100%)	0	100	100
1	B	3/285 (1%)	3 (100%)	0	100	100
1	C	194/285 (68%)	193 (100%)	1 (0%)	81	75
1	D	191/285 (67%)	190 (100%)	1 (0%)	81	75
1	E	187/285 (66%)	186 (100%)	1 (0%)	81	75

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Mol	Chain	Analysed	Rotameric	Outliers	Percentiles	
1	F	257/285 (90%)	256 (100%)	1 (0%)	84	80
All	All	861/1710 (50%)	857 (100%)	4 (0%)	81	75

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

Mol	Chain	Res	Type
1	C	218	ARG
1	D	132	TYR
1	E	30	GLU
1	F	74	LEU

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (3) such sidechains are listed below:

Mol	Chain	Res	Type
1	D	50	HIS
1	E	222	GLN
1	F	140	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 oligosaccharides in this entry.

## 5.6 Ligand geometry [i](#)

Of 2 ligands modelled in this entry, 1 is monoatomic - leaving 1 for Mogul analysis.

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	$\# Z  > 2$
3	ACT	C	401	-	3,3,3	1.26	0	3,3,3	1.27	0

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 3 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
3	C	401	ACT	3	0

## 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	319/337 (94%)	-0.15	4 (1%) 75 81	14, 21, 34, 47	0
1	B	320/337 (94%)	-0.27	2 (0%) 85 89	10, 19, 33, 56	2 (0%)
1	C	320/337 (94%)	-0.16	5 (1%) 70 77	11, 20, 36, 57	2 (0%)
1	D	319/337 (94%)	-0.23	3 (0%) 81 86	10, 20, 35, 48	2 (0%)
1	E	320/337 (94%)	-0.37	1 (0%) 90 92	8, 17, 31, 47	2 (0%)
1	F	320/337 (94%)	-0.24	0 100 100	9, 19, 33, 52	2 (0%)
All	All	1918/2022 (94%)	-0.24	15 (0%) 82 86	8, 19, 34, 57	10 (0%)

The worst 5 of 15 RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	C	47	MET	2.9
1	C	79	GLU	2.9
1	A	132	TYR	2.6
1	B	135	GLY	2.6
1	B	323	GLU	2.5

### 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 oligosaccharides 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
3	ACT	C	401	4/4	0.85	0.16	26,29,40,40	0
2	CL	B	401	1/1	0.98	0.08	34,34,34,34	0

## 6.5 Other polymers [i](#)

There are no such residues in this entry.