



# wwPDB X-ray Structure Validation Summary Report ⓘ

Jun 23, 2024 – 05:22 AM EDT

PDB ID : 4YQZ  
Title : Crystal Structure of a putative oxidoreductase from *Thermus Thermophilus* HB27 (TT\_P0034, TARGET EFI-513932) in its APO form  
Authors : Yadava, U.; Vetting, M.W.; Al Obaidi, N.F.; Toro, R.; Morisco, L.L.; Benach, J.; Koss, J.; Wasserman, S.R.; Attonito, J.D.; Scott Glenn, A.; Chamala, S.; Chowdhury, S.; Lafleur, J.; Love, J.; Seidel, R.D.; Whalen, K.L.; Gerlt, J.A.; Almo, S.C.; Enzyme Function Initiative (EFI)  
Deposited on : 2015-03-13  
Resolution : 1.81 Å(reported)

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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 : 2.37.1  
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)

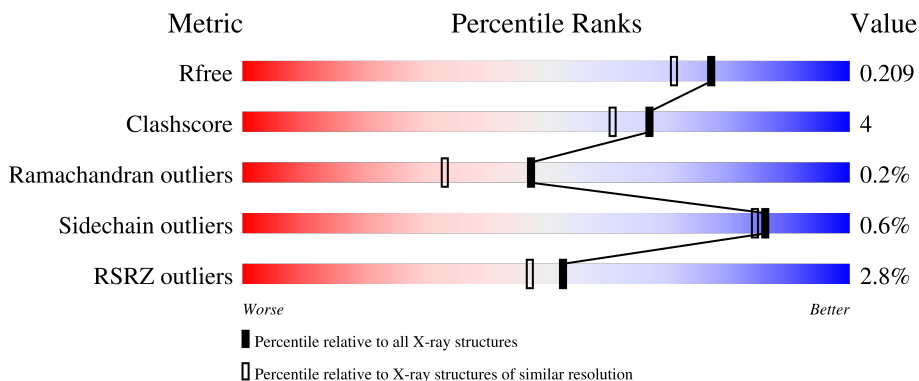
# 1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

*X-RAY DIFFRACTION*

The reported resolution of this entry is 1.81 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	5950 (1.80-1.80)
Clashscore	141614	6793 (1.80-1.80)
Ramachandran outliers	138981	6697 (1.80-1.80)
Sidechain outliers	138945	6696 (1.80-1.80)
RSRZ outliers	127900	5850 (1.80-1.80)

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	257	 83% 8% 9%
1	B	257	 83% 7% 10%
1	C	257	 82% 9% 9%
1	D	257	 84% 7% 9%

Validation Pipeline (wwPDB-VP) : 2.37.1

## 2 Entry composition [i](#)

There are 3 unique types of molecules in this entry. The entry contains 7591 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 Putative oxidoreductase.

Mol	Chain	Residues	Atoms						ZeroOcc	AltConf	Trace
			Total	C	N	O	S	Se			
1	A	234	1728	1097	307	318	1	5	0	1	0
1	B	231	1695	1080	300	309	1	5	0	0	0
1	C	234	1713	1088	303	316	1	5	0	0	0
1	D	234	1722	1094	306	316	1	5	0	0	0

There are 96 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	-22	MSE	-	expression tag	UNP Q746L9
A	-21	HIS	-	expression tag	UNP Q746L9
A	-20	HIS	-	expression tag	UNP Q746L9
A	-19	HIS	-	expression tag	UNP Q746L9
A	-18	HIS	-	expression tag	UNP Q746L9
A	-17	HIS	-	expression tag	UNP Q746L9
A	-16	HIS	-	expression tag	UNP Q746L9
A	-15	SER	-	expression tag	UNP Q746L9
A	-14	SER	-	expression tag	UNP Q746L9
A	-13	GLY	-	expression tag	UNP Q746L9
A	-12	VAL	-	expression tag	UNP Q746L9
A	-11	ASP	-	expression tag	UNP Q746L9
A	-10	LEU	-	expression tag	UNP Q746L9
A	-9	GLY	-	expression tag	UNP Q746L9
A	-8	THR	-	expression tag	UNP Q746L9
A	-7	GLU	-	expression tag	UNP Q746L9
A	-6	ASN	-	expression tag	UNP Q746L9
A	-5	LEU	-	expression tag	UNP Q746L9
A	-4	TYR	-	expression tag	UNP Q746L9
A	-3	PHE	-	expression tag	UNP Q746L9
A	-2	GLN	-	expression tag	UNP Q746L9

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Chain	Residue	Modelled	Actual	Comment	Reference
A	-1	SER	-	expression tag	UNP Q746L9
A	0	MSE	-	expression tag	UNP Q746L9
A	1	MSE	-	expression tag	UNP Q746L9
B	-22	MSE	-	expression tag	UNP Q746L9
B	-21	HIS	-	expression tag	UNP Q746L9
B	-20	HIS	-	expression tag	UNP Q746L9
B	-19	HIS	-	expression tag	UNP Q746L9
B	-18	HIS	-	expression tag	UNP Q746L9
B	-17	HIS	-	expression tag	UNP Q746L9
B	-16	HIS	-	expression tag	UNP Q746L9
B	-15	SER	-	expression tag	UNP Q746L9
B	-14	SER	-	expression tag	UNP Q746L9
B	-13	GLY	-	expression tag	UNP Q746L9
B	-12	VAL	-	expression tag	UNP Q746L9
B	-11	ASP	-	expression tag	UNP Q746L9
B	-10	LEU	-	expression tag	UNP Q746L9
B	-9	GLY	-	expression tag	UNP Q746L9
B	-8	THR	-	expression tag	UNP Q746L9
B	-7	GLU	-	expression tag	UNP Q746L9
B	-6	ASN	-	expression tag	UNP Q746L9
B	-5	LEU	-	expression tag	UNP Q746L9
B	-4	TYR	-	expression tag	UNP Q746L9
B	-3	PHE	-	expression tag	UNP Q746L9
B	-2	GLN	-	expression tag	UNP Q746L9
B	-1	SER	-	expression tag	UNP Q746L9
B	0	MSE	-	expression tag	UNP Q746L9
B	1	MSE	-	expression tag	UNP Q746L9
C	-22	MSE	-	expression tag	UNP Q746L9
C	-21	HIS	-	expression tag	UNP Q746L9
C	-20	HIS	-	expression tag	UNP Q746L9
C	-19	HIS	-	expression tag	UNP Q746L9
C	-18	HIS	-	expression tag	UNP Q746L9
C	-17	HIS	-	expression tag	UNP Q746L9
C	-16	HIS	-	expression tag	UNP Q746L9
C	-15	SER	-	expression tag	UNP Q746L9
C	-14	SER	-	expression tag	UNP Q746L9
C	-13	GLY	-	expression tag	UNP Q746L9
C	-12	VAL	-	expression tag	UNP Q746L9
C	-11	ASP	-	expression tag	UNP Q746L9
C	-10	LEU	-	expression tag	UNP Q746L9
C	-9	GLY	-	expression tag	UNP Q746L9
C	-8	THR	-	expression tag	UNP Q746L9

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Chain	Residue	Modelled	Actual	Comment	Reference
C	-7	GLU	-	expression tag	UNP Q746L9
C	-6	ASN	-	expression tag	UNP Q746L9
C	-5	LEU	-	expression tag	UNP Q746L9
C	-4	TYR	-	expression tag	UNP Q746L9
C	-3	PHE	-	expression tag	UNP Q746L9
C	-2	GLN	-	expression tag	UNP Q746L9
C	-1	SER	-	expression tag	UNP Q746L9
C	0	MSE	-	expression tag	UNP Q746L9
C	1	MSE	-	expression tag	UNP Q746L9
D	-22	MSE	-	expression tag	UNP Q746L9
D	-21	HIS	-	expression tag	UNP Q746L9
D	-20	HIS	-	expression tag	UNP Q746L9
D	-19	HIS	-	expression tag	UNP Q746L9
D	-18	HIS	-	expression tag	UNP Q746L9
D	-17	HIS	-	expression tag	UNP Q746L9
D	-16	HIS	-	expression tag	UNP Q746L9
D	-15	SER	-	expression tag	UNP Q746L9
D	-14	SER	-	expression tag	UNP Q746L9
D	-13	GLY	-	expression tag	UNP Q746L9
D	-12	VAL	-	expression tag	UNP Q746L9
D	-11	ASP	-	expression tag	UNP Q746L9
D	-10	LEU	-	expression tag	UNP Q746L9
D	-9	GLY	-	expression tag	UNP Q746L9
D	-8	THR	-	expression tag	UNP Q746L9
D	-7	GLU	-	expression tag	UNP Q746L9
D	-6	ASN	-	expression tag	UNP Q746L9
D	-5	LEU	-	expression tag	UNP Q746L9
D	-4	TYR	-	expression tag	UNP Q746L9
D	-3	PHE	-	expression tag	UNP Q746L9
D	-2	GLN	-	expression tag	UNP Q746L9
D	-1	SER	-	expression tag	UNP Q746L9
D	0	MSE	-	expression tag	UNP Q746L9
D	1	MSE	-	expression tag	UNP Q746L9

- Molecule 2 is CHLORIDE ION (three-letter code: CL) (formula: Cl).

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

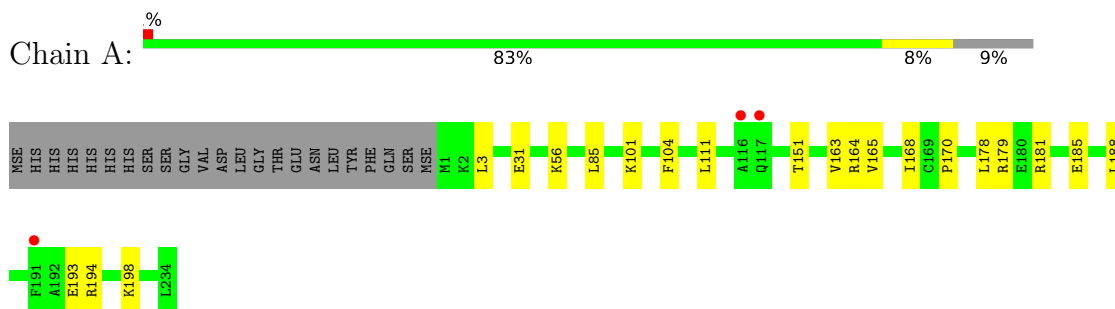
- Molecule 3 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
3	A	201	Total 202	O 202	0	1
3	B	189	Total 190	O 190	0	1
3	C	171	Total 172	O 172	0	1
3	D	166	Total 168	O 168	0	2

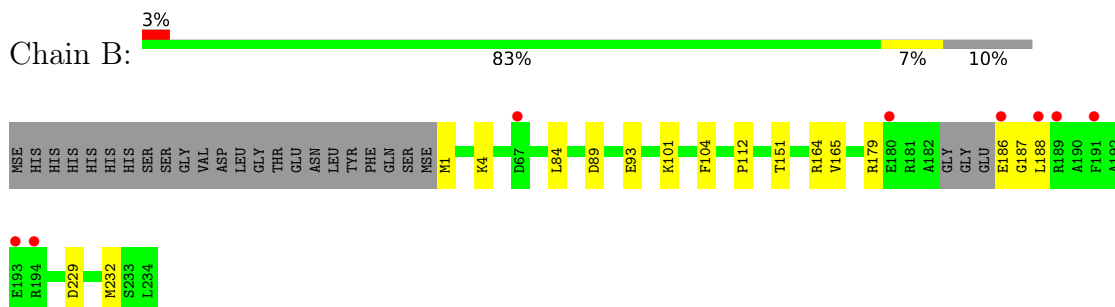
### 3 Residue-property plots [i](#)

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.

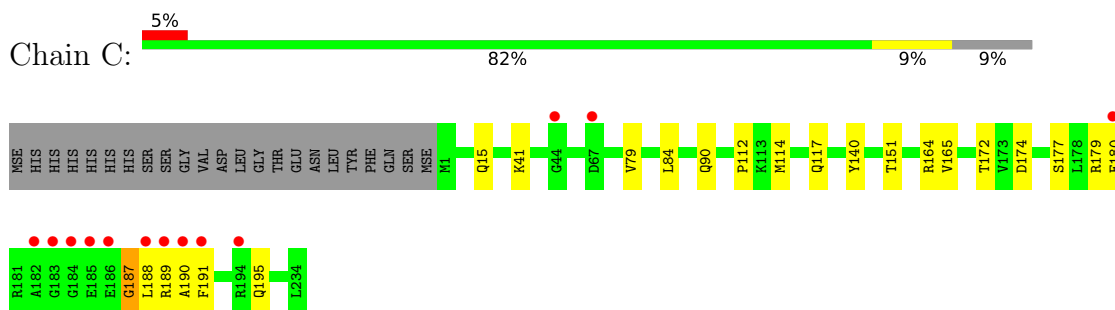
- Molecule 1: Putative oxidoreductase



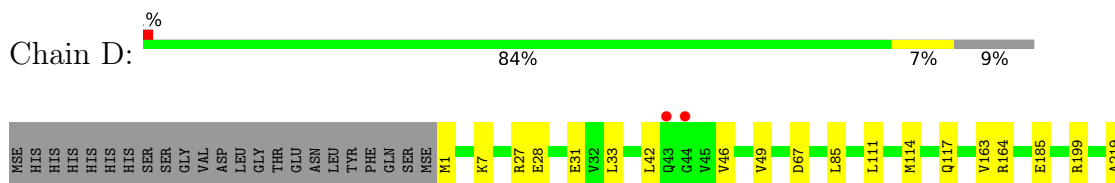
- Molecule 1: Putative oxidoreductase



- Molecule 1: Putative oxidoreductase



- Molecule 1: Putative oxidoreductase



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## 4 Data and refinement statistics

Property	Value	Source
Space group	P 1 21 1	Depositor
Cell constants a, b, c, $\alpha$ , $\beta$ , $\gamma$	76.44Å 65.75Å 85.76Å 90.00° 95.43° 90.00°	Depositor
Resolution (Å)	25.09 – 1.81 25.09 – 1.81	Depositor EDS
% Data completeness (in resolution range)	93.3 (25.09-1.81) 93.3 (25.09-1.81)	Depositor EDS
$R_{merge}$	0.07	Depositor
$R_{sym}$	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ <sup>1</sup>	6.32 (at 1.80Å)	Xtrriage
Refinement program	PHENIX (phenix.refine: 1.9_1692)	Depositor
R, $R_{free}$	0.164 , 0.209 0.165 , 0.209	Depositor DCC
$R_{free}$ test set	3638 reflections (5.02%)	wwPDB-VP
Wilson B-factor (Å <sup>2</sup> )	18.6	Xtrriage
Anisotropy	0.095	Xtrriage
Bulk solvent $k_{sol}$ (e/Å <sup>3</sup> ), $B_{sol}$ (Å <sup>2</sup> )	0.33 , 53.6	EDS
L-test for twinning <sup>2</sup>	$\langle  L  \rangle = 0.49$ , $\langle L^2 \rangle = 0.33$	Xtrriage
Estimated twinning fraction	No twinning to report.	Xtrriage
$F_o, F_c$ correlation	0.96	EDS
Total number of atoms	7591	wwPDB-VP
Average B, all atoms (Å <sup>2</sup> )	26.0	wwPDB-VP

Xtrriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 5.44% 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

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	0.38	0/1749	0.51	0/2355
1	B	0.38	0/1715	0.51	0/2310
1	C	0.38	0/1734	0.52	0/2336
1	D	0.35	0/1743	0.51	0/2347
All	All	0.37	0/6941	0.51	0/9348

There are no bond length outliers.

There are no bond angle outliers.

There are no chirality outliers.

There are no planarity outliers.

### 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	1728	0	1786	15	0
1	B	1695	0	1754	12	0
1	C	1713	0	1762	14	0
1	D	1722	0	1782	21	0
2	C	1	0	0	0	0
3	A	202	0	0	3	1
3	B	190	0	0	1	0
3	C	172	0	0	1	0
3	D	168	0	0	8	0
All	All	7591	0	7084	54	1

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 4.

The worst 5 of 54 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:D:164:ARG:HD3	1:D:219:ALA:HA	1.70	0.72
1:C:187:GLY:HA2	1:C:190:ALA:H	1.55	0.72
1:C:177:SER:O	1:C:180:GLU:HG2	1.92	0.68
1:B:179:ARG:HG2	1:B:188:LEU:HD11	1.75	0.67
1:B:186:GLU:N	1:B:187:GLY:HA3	2.12	0.65

All (1) 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)
3:A:329:HOH:O	3:A:332:HOH:O[2_656]	2.16	0.04

## 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	233/257 (91%)	225 (97%)	8 (3%)	0	100	100
1	B	227/257 (88%)	220 (97%)	7 (3%)	0	100	100
1	C	232/257 (90%)	221 (95%)	9 (4%)	2 (1%)	17	6
1	D	232/257 (90%)	227 (98%)	5 (2%)	0	100	100
All	All	924/1028 (90%)	893 (97%)	29 (3%)	2 (0%)	47	33

All (2) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	C	188	LEU

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Mol	Chain	Res	Type
1	C	187	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	168/181 (93%)	166 (99%)	2 (1%)	71	65
1	B	164/181 (91%)	163 (99%)	1 (1%)	86	84
1	C	165/181 (91%)	164 (99%)	1 (1%)	86	84
1	D	167/181 (92%)	167 (100%)	0	100	100
All	All	664/724 (92%)	660 (99%)	4 (1%)	86	84

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

Mol	Chain	Res	Type
1	A	3	LEU
1	A	164	ARG
1	B	164	ARG
1	C	164	ARG

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. There are no such sidechains identified.

### 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](#)

Of 1 ligands modelled in this entry, 1 is 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 [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	229/257 (89%)	-0.24	3 (1%) 77 74	10, 19, 45, 78	0
1	B	226/257 (87%)	-0.27	8 (3%) 44 38	10, 18, 51, 84	0
1	C	229/257 (89%)	-0.15	13 (5%) 23 19	11, 21, 61, 102	0
1	D	229/257 (89%)	-0.16	2 (0%) 84 82	13, 26, 48, 64	0
All	All	913/1028 (88%)	-0.21	26 (2%) 53 47	10, 21, 50, 102	0

The worst 5 of 26 RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	B	188	LEU	7.3
1	B	191	PHE	6.0
1	C	183	GLY	6.0
1	C	186	GLU	5.4
1	C	185	GLU	4.1

### 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 monosaccharides 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	CL	C	301	1/1	0.97	0.06	32,32,32,32	0

## 6.5 Other polymers [i](#)

There are no such residues in this entry.