



# Full wwPDB X-ray Structure Validation Report ⓘ

Mar 13, 2018 – 07:57 pm GMT

PDB ID : 5KF9  
Title : X-ray structure of a glucosamine N-Acetyltransferase from *Clostridium acetobutylicum* in complex with N-acetylglucosamine  
Authors : Dopkins, B.J.; Thoden, J.B.; Holden, H.M.; Tipton, P.A.  
Deposited on : 2016-06-12  
Resolution : 1.49 Å(reported)

This is a Full wwPDB X-ray Structure Validation 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  
Mogul : 1.7.3 (157068), CSD as539be (2018)  
Xtriage (Phenix) : 1.13  
EDS : trunk31020  
Percentile statistics : 20171227.v01 (using entries in the PDB archive December 27th 2017)  
Refmac : 5.8.0158  
CCP4 : 7.0 (Gargrove)  
Ideal geometry (proteins) : Engh & Huber (2001)  
Ideal geometry (DNA, RNA) : Parkinson et al. (1996)  
Validation Pipeline (wwPDB-VP) : trunk31020

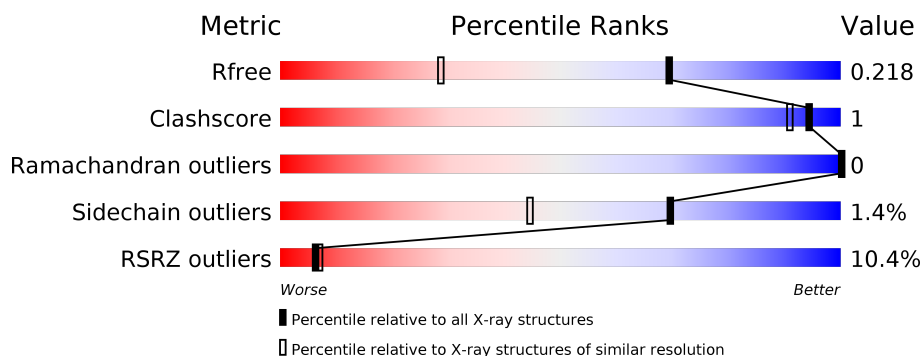
# 1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

*X-RAY DIFFRACTION*

The reported resolution of this entry is 1.49 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))
$R_{free}$	111664	2534 (1.50-1.50)
Clashscore	122126	2727 (1.50-1.50)
Ramachandran outliers	120053	2661 (1.50-1.50)
Sidechain outliers	120020	2659 (1.50-1.50)
RSRZ outliers	108989	2481 (1.50-1.50)

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. 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	328	

## 2 Entry composition [i](#)

There are 7 unique types of molecules in this entry. The entry contains 3012 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 Predicted acetyltransferase.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
1	A	317	2642	1736	430	466	10	0	6	0

There are 8 discrepancies between the modelled and reference sequences:

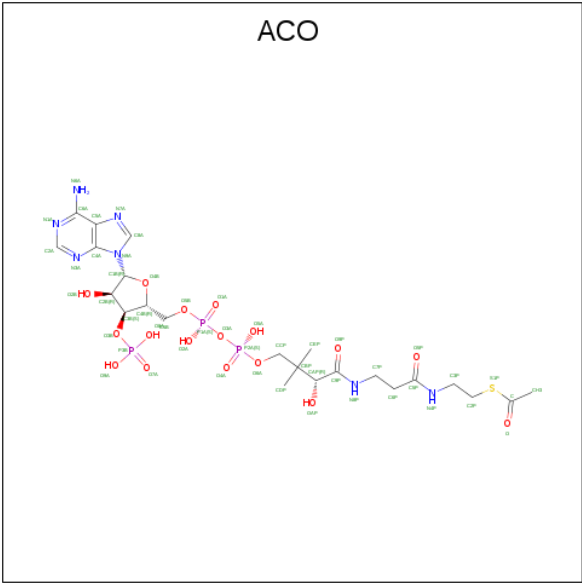
Chain	Residue	Modelled	Actual	Comment	Reference
A	321	GLY	-	expression tag	UNP Q97ML2
A	322	GLY	-	expression tag	UNP Q97ML2
A	323	HIS	-	expression tag	UNP Q97ML2
A	324	HIS	-	expression tag	UNP Q97ML2
A	325	HIS	-	expression tag	UNP Q97ML2
A	326	HIS	-	expression tag	UNP Q97ML2
A	327	HIS	-	expression tag	UNP Q97ML2
A	328	HIS	-	expression tag	UNP Q97ML2

- Molecule 2 is N-ACETYL-D-GLUCOSAMINE (three-letter code: NAG) (formula:  $C_8H_{15}NO_6$ ).



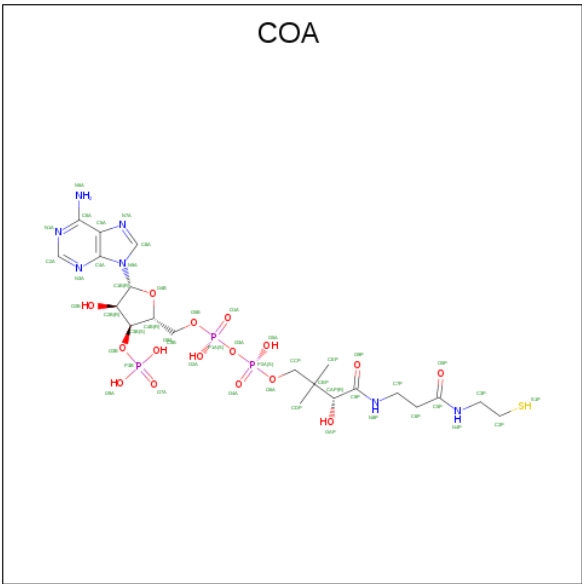
Mol	Chain	Residues	Atoms				ZeroOcc	AltConf
2	A	1	Total	C	N	O	0	0
			15	8	1	6		

- Molecule 3 is ACETYL COENZYME \*A (three-letter code: ACO) (formula: C<sub>23</sub>H<sub>38</sub>N<sub>7</sub>O<sub>17</sub>P<sub>3</sub>S).



Mol	Chain	Residues	Atoms						ZeroOcc	AltConf
3	A	1	Total	C	N	O	P	S	0	0
			51	23	7	17	3	1		

- Molecule 4 is COENZYME A (three-letter code: COA) (formula: C<sub>21</sub>H<sub>36</sub>N<sub>7</sub>O<sub>16</sub>P<sub>3</sub>S).



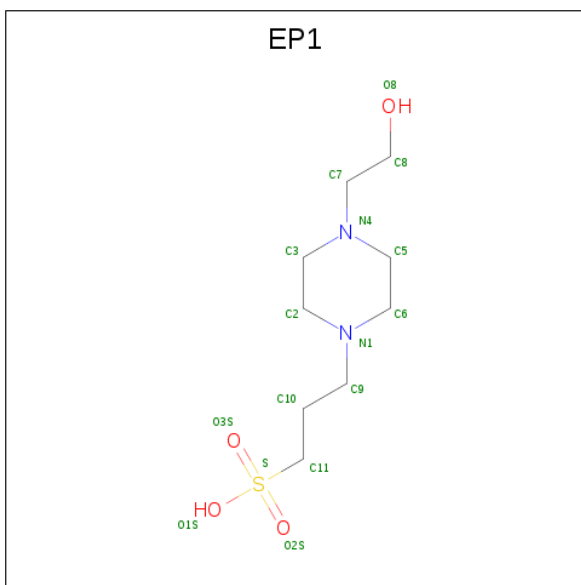
Mol	Chain	Residues	Atoms					ZeroOcc	AltConf
4	A	1	Total	C	N	O	P	0	0
			23	9	2	10	2		

- Molecule 5 is 1,2-ETHANEDIOL (three-letter code: EDO) (formula: C<sub>2</sub>H<sub>6</sub>O<sub>2</sub>).



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

- Molecule 6 is 3-[4-(2-HYDROXYETHYL)PIPERAZIN-1-YL]PROPANE-1-SULFONIC ACID (three-letter code: EP1) (formula: C<sub>9</sub>H<sub>20</sub>N<sub>2</sub>O<sub>4</sub>S).



Mol	Chain	Residues	Atoms					ZeroOcc	AltConf
6	A	1	Total	C	N	O	S	0	0
			16	9	2	4	1		

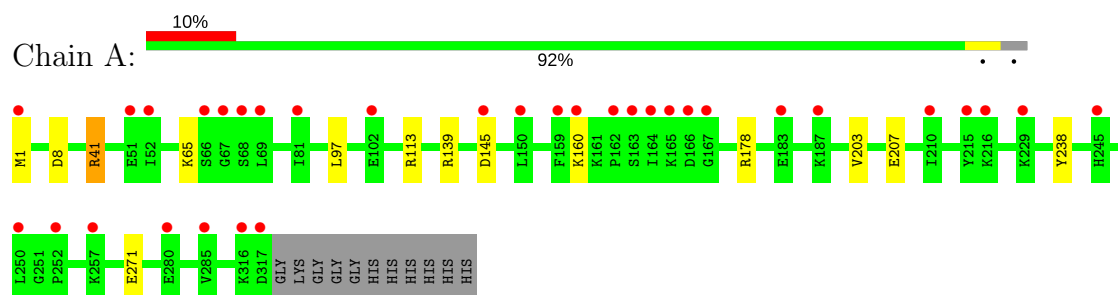
- Molecule 7 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
7	A	253	Total	O	0	0
			253	253		

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

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 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: Predicted acetyltransferase



## 4 Data and refinement statistics

Property	Value	Source
Space group	C 1 2 1	Depositor
Cell constants a, b, c, $\alpha$ , $\beta$ , $\gamma$	118.31Å 44.61Å 74.20Å 90.00° 120.90° 90.00°	Depositor
Resolution (Å)	50.00 – 1.49 28.08 – 1.49	Depositor EDS
% Data completeness (in resolution range)	98.7 (50.00-1.49) 98.8 (28.08-1.49)	Depositor EDS
$R_{merge}$	0.07	Depositor
$R_{sym}$	0.07	Depositor
$\langle I/\sigma(I) \rangle$ <sup>1</sup>	4.59 (at 1.50Å)	Xtriage
Refinement program	REFMAC 5.8.0124	Depositor
R, $R_{free}$	0.175 , 0.206 0.185 , 0.218	Depositor DCC
$R_{free}$ test set	2648 reflections (4.96%)	wwPDB-VP
Wilson B-factor (Å <sup>2</sup> )	16.2	Xtriage
Anisotropy	0.041	Xtriage
Bulk solvent $k_{sol}$ (e/Å <sup>3</sup> ), $B_{sol}$ (Å <sup>2</sup> )	0.42 , 49.9	EDS
L-test for twinning <sup>2</sup>	$\langle  L  \rangle = 0.50$ , $\langle L^2 \rangle = 0.33$	Xtriage
Estimated twinning fraction	No twinning to report.	Xtriage
$F_o, F_c$ correlation	0.96	EDS
Total number of atoms	3012	wwPDB-VP
Average B, all atoms (Å <sup>2</sup> )	21.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 6.13% 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: COA, EP1, ACO, NAG, EDO

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	0.68	0/2728	0.99	5/3667 (0.1%)

There are no bond length outliers.

All (5) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	41	ARG	NE-CZ-NH1	7.54	124.07	120.30
1	A	113	ARG	NE-CZ-NH1	6.62	123.61	120.30
1	A	113	ARG	NE-CZ-NH2	-6.09	117.26	120.30
1	A	238	TYR	CB-CG-CD1	5.66	124.40	121.00
1	A	8	ASP	CB-CG-OD2	-5.19	113.63	118.30

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	2642	0	2677	7	0
2	A	15	0	15	0	0
3	A	51	0	34	0	0
4	A	23	0	15	0	0
5	A	12	0	18	0	0
6	A	16	0	20	1	0

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Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
7	A	253	0	0	3	0
All	All	3012	0	2779	8	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.

All (8) 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)
6:A:407:EP1:O3S	7:A:501:HOH:O	2.05	0.73
1:A:41:ARG:NH2	7:A:503:HOH:O	2.22	0.72
1:A:271:GLU:OE1	7:A:502:HOH:O	2.18	0.54
1:A:97:LEU:HD23	1:A:139:ARG:CD	2.41	0.50
1:A:178:ARG:NH1	1:A:207:GLU:OE2	2.43	0.47
1:A:97:LEU:HD23	1:A:139:ARG:HD3	1.98	0.46

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	321/328 (98%)	313 (98%)	8 (2%)	0	100	100

There are no Ramachandran outliers to report.

### 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	288/291 (99%)	284 (99%)	4 (1%)	69	44

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

Mol	Chain	Res	Type
1	A	1	MET
1	A	65	LYS
1	A	145	ASP
1	A	160	LYS

Some sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (2) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	49	ASN
1	A	144	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](#)

7 ligands are modelled in this entry.

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	$\# Z  > 2$
2	NAG	A	401	-	15,15,15	0.61	0	21,21,21	1.53	4 (19%)
3	ACO	A	402	-	45,53,53	1.00	3 (6%)	56,79,79	1.66	12 (21%)
4	COA	A	403	-	18,22,50	0.79	1 (5%)	26,33,75	2.20	9 (34%)
5	EDO	A	404	-	3,3,3	0.44	0	2,2,2	0.84	0
5	EDO	A	405	-	3,3,3	0.62	0	2,2,2	0.13	0
5	EDO	A	406	-	3,3,3	0.44	0	2,2,2	0.39	0
6	EP1	A	407	-	16,16,16	2.32	2 (12%)	20,21,21	2.34	6 (30%)

In the following table, the Chirals column lists the number of chiral outliers, the number of chiral centers analysed, the number of these observed in the model and the number defined in the Chemical Component Dictionary. Similar counts are reported in the Torsion and Rings columns. '-' means no outliers of that kind were identified.

Mol	Type	Chain	Res	Link	Chirals	Torsions	Rings
2	NAG	A	401	-	-	0/6/26/26	0/1/1/1
3	ACO	A	402	-	-	0/47/67/67	0/3/3/3
4	COA	A	403	-	-	0/29/29/64	0/0/0/3
5	EDO	A	404	-	-	0/1/1/1	0/0/0/0
5	EDO	A	405	-	-	0/1/1/1	0/0/0/0
5	EDO	A	406	-	-	0/1/1/1	0/0/0/0
6	EP1	A	407	-	-	0/10/20/20	0/1/1/1

All (6) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
6	A	407	EP1	C11-S	-7.78	1.66	1.77
3	A	402	ACO	C8A-N9A	-2.93	1.33	1.36
3	A	402	ACO	C2A-N3A	2.00	1.35	1.32
4	A	403	COA	P1A-O3A	2.18	1.63	1.60
3	A	402	ACO	C5A-C4A	2.39	1.45	1.40
6	A	407	EP1	O1S-S	4.78	1.64	1.47

All (31) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
3	A	402	ACO	N3A-C2A-N1A	-6.89	122.96	128.86
4	A	403	COA	C7P-C6P-C5P	-3.56	106.50	112.23
3	A	402	ACO	C1B-N9A-C4A	-3.50	120.59	126.64

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Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
4	A	403	COA	CEP-CBP-CDP	-3.36	102.14	109.16
3	A	402	ACO	C4A-C5A-N7A	-2.74	106.76	109.41
2	A	401	NAG	O7-C7-C8	-2.71	117.17	122.07
4	A	403	COA	CDP-CBP-CAP	-2.71	104.12	108.82
4	A	403	COA	O9P-C9P-N8P	-2.56	118.13	123.05
3	A	402	ACO	O9P-C9P-N8P	-2.55	118.15	123.05
3	A	402	ACO	O8A-P3B-O3B	-2.46	94.96	105.99
3	A	402	ACO	CEP-CBP-CCP	-2.39	104.33	108.23
3	A	402	ACO	C2B-C3B-C4B	-2.28	99.22	103.26
4	A	403	COA	O5B-P1A-O1A	-2.26	101.76	110.60
4	A	403	COA	O6A-CCP-CBP	-2.26	106.91	110.55
3	A	402	ACO	O-C-S1P	-2.02	113.07	122.69
3	A	402	ACO	O6A-CCP-CBP	-2.02	107.31	110.55
4	A	403	COA	O5A-P2A-O4A	2.10	122.80	112.14
3	A	402	ACO	N6A-C6A-N1A	2.12	122.97	118.57
6	A	407	EP1	C7-N4-C5	2.29	117.22	111.24
2	A	401	NAG	O7-C7-N2	2.40	126.47	121.94
6	A	407	EP1	O1S-S-C11	2.44	109.72	105.77
3	A	402	ACO	CDP-CBP-CAP	2.48	113.12	108.82
2	A	401	NAG	C4-C3-C2	2.53	114.07	110.33
3	A	402	ACO	C2A-N1A-C6A	2.76	123.45	118.75
6	A	407	EP1	C9-N1-C2	2.89	118.77	111.24
6	A	407	EP1	O3S-S-C11	3.60	111.25	106.92
4	A	403	COA	CEP-CBP-CCP	3.68	114.24	108.23
2	A	401	NAG	C1-C2-N2	3.85	115.19	110.73
6	A	407	EP1	C5-N4-C3	4.88	119.67	108.87
6	A	407	EP1	O2S-S-C11	5.54	113.58	106.92
4	A	403	COA	CEP-CBP-CAP	6.11	119.42	108.82

There are no chirality outliers.

There are no torsion outliers.

There are no ring outliers.

1 monomer is involved in 1 short contact:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
6	A	407	EP1	1	0

## 5.7 Other polymers

There are no such residues in this entry.

## 5.8 Polymer linkage issues ⓘ

There are no chain breaks in this entry.

## 6 Fit of model and data ⓘ

### 6.1 Protein, DNA and RNA chains ⓘ

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	317/328 (96%)	0.77	33 (10%) 6 7	9, 18, 37, 64	0

All (33) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	164	ILE	10.6
1	A	159	PHE	5.1
1	A	69	LEU	4.7
1	A	317	ASP	4.4
1	A	160	LYS	4.4
1	A	165	LYS	4.4
1	A	245	HIS	3.5
1	A	163	SER	3.3
1	A	250	LEU	3.1
1	A	67	GLY	3.0
1	A	145	ASP	3.0
1	A	210	ILE	2.6
1	A	51	GLU	2.6
1	A	280	GLU	2.6
1	A	102	GLU	2.5
1	A	52	ILE	2.4
1	A	166	ASP	2.4
1	A	316	LYS	2.4
1	A	150	LEU	2.3
1	A	215	TYR	2.3
1	A	81	ILE	2.3
1	A	229	LYS	2.2
1	A	257	LYS	2.2
1	A	66	SER	2.2
1	A	167	GLY	2.2
1	A	183	GLU	2.2
1	A	285	VAL	2.1

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Mol	Chain	Res	Type	RSRZ
1	A	68[A]	SER	2.1
1	A	1	MET	2.1
1	A	216	LYS	2.1
1	A	187	LYS	2.1
1	A	252	PRO	2.1
1	A	162	PRO	2.0

## 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 carbohydrates 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
6	EP1	A	407	16/16	0.85	0.24	27,36,41,47	0
5	EDO	A	404	4/4	0.89	0.15	28,28,28,32	0
5	EDO	A	406	4/4	0.91	0.15	43,44,44,46	0
4	COA	A	403	23/48	0.93	0.13	21,26,36,39	0
3	ACO	A	402	51/51	0.95	0.10	11,14,20,22	0
5	EDO	A	405	4/4	0.95	0.08	19,19,21,22	0
2	NAG	A	401	15/15	0.96	0.12	14,16,22,22	0

## 6.5 Other polymers [i](#)

There are no such residues in this entry.