



# wwPDB X-ray Structure Validation Summary Report ⓘ

Mar 5, 2026 – 10:32 AM UTC

PDB ID : 5J21 / pdb\_00005j21  
Title : Structure of Bacillus NanoRNase A (WT)  
Authors : Schmier, B.J.; Malhotra, A.; Neltersa, C.M.  
Deposited on : 2016-03-29  
Resolution : 2.00 Å(reported)

This is a wwPDB X-ray Structure Validation Summary Report for a publicly released PDB entry.

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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  
Xtrriage (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

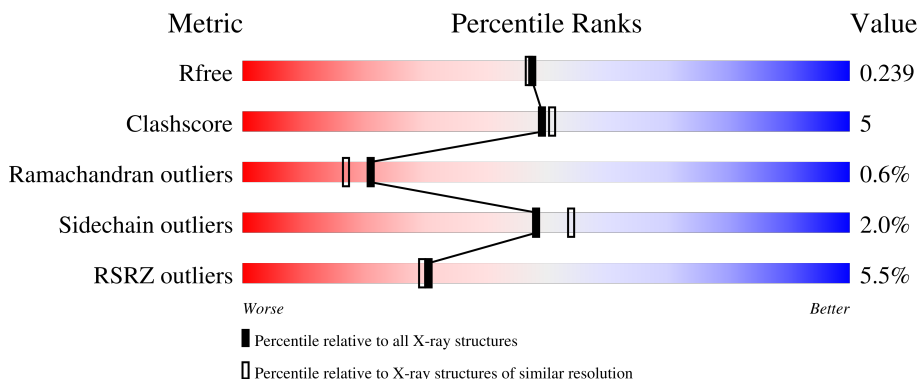
# 1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

*X-RAY DIFFRACTION*

The reported resolution of this entry is 2.00 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	10052 (2.00-2.00)
Clashscore	190562	11152 (2.00-2.00)
Ramachandran outliers	187476	11031 (2.00-2.00)
Sidechain outliers	187428	11029 (2.00-2.00)
RSRZ outliers	180081	10067 (2.00-2.00)

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	333	 13% 77% 14% •• 6%
1	B	333	 2% 79% 14% • 6%
1	C	333	 3% 77% 17% • 5%
1	D	333	 2% 82% 12% • 5%

## 2 Entry composition [i](#)

There are 2 unique types of molecules in this entry. The entry contains 10432 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 Bifunctional oligoribonuclease and PAP phosphatase NrnA.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
1	A	312	Total 2405	C 1537	N 393	O 468	S 7	47	0	0
1	B	314	Total 2425	C 1546	N 402	O 470	S 7	7	0	0
1	C	315	Total 2466	C 1569	N 409	O 481	S 7	3	0	0
1	D	315	Total 2452	C 1562	N 408	O 475	S 7	6	0	0

There are 80 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	-20	MET	-	initiating methionine	UNP O34600
A	-19	GLY	-	expression tag	UNP O34600
A	-18	SER	-	expression tag	UNP O34600
A	-17	SER	-	expression tag	UNP O34600
A	-16	HIS	-	expression tag	UNP O34600
A	-15	HIS	-	expression tag	UNP O34600
A	-14	HIS	-	expression tag	UNP O34600
A	-13	HIS	-	expression tag	UNP O34600
A	-12	HIS	-	expression tag	UNP O34600
A	-11	HIS	-	expression tag	UNP O34600
A	-10	GLU	-	expression tag	UNP O34600
A	-9	ASN	-	expression tag	UNP O34600
A	-8	LEU	-	expression tag	UNP O34600
A	-7	TYR	-	expression tag	UNP O34600
A	-6	PHE	-	expression tag	UNP O34600
A	-5	GLN	-	expression tag	UNP O34600
A	-4	SER	-	expression tag	UNP O34600
A	-3	MET	-	expression tag	UNP O34600
A	-2	ALA	-	expression tag	UNP O34600
A	-1	SER	-	expression tag	UNP O34600
B	-20	MET	-	initiating methionine	UNP O34600

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Chain	Residue	Modelled	Actual	Comment	Reference
B	-19	GLY	-	expression tag	UNP O34600
B	-18	SER	-	expression tag	UNP O34600
B	-17	SER	-	expression tag	UNP O34600
B	-16	HIS	-	expression tag	UNP O34600
B	-15	HIS	-	expression tag	UNP O34600
B	-14	HIS	-	expression tag	UNP O34600
B	-13	HIS	-	expression tag	UNP O34600
B	-12	HIS	-	expression tag	UNP O34600
B	-11	HIS	-	expression tag	UNP O34600
B	-10	GLU	-	expression tag	UNP O34600
B	-9	ASN	-	expression tag	UNP O34600
B	-8	LEU	-	expression tag	UNP O34600
B	-7	TYR	-	expression tag	UNP O34600
B	-6	PHE	-	expression tag	UNP O34600
B	-5	GLN	-	expression tag	UNP O34600
B	-4	SER	-	expression tag	UNP O34600
B	-3	MET	-	expression tag	UNP O34600
B	-2	ALA	-	expression tag	UNP O34600
B	-1	SER	-	expression tag	UNP O34600
C	-20	MET	-	initiating methionine	UNP O34600
C	-19	GLY	-	expression tag	UNP O34600
C	-18	SER	-	expression tag	UNP O34600
C	-17	SER	-	expression tag	UNP O34600
C	-16	HIS	-	expression tag	UNP O34600
C	-15	HIS	-	expression tag	UNP O34600
C	-14	HIS	-	expression tag	UNP O34600
C	-13	HIS	-	expression tag	UNP O34600
C	-12	HIS	-	expression tag	UNP O34600
C	-11	HIS	-	expression tag	UNP O34600
C	-10	GLU	-	expression tag	UNP O34600
C	-9	ASN	-	expression tag	UNP O34600
C	-8	LEU	-	expression tag	UNP O34600
C	-7	TYR	-	expression tag	UNP O34600
C	-6	PHE	-	expression tag	UNP O34600
C	-5	GLN	-	expression tag	UNP O34600
C	-4	SER	-	expression tag	UNP O34600
C	-3	MET	-	expression tag	UNP O34600
C	-2	ALA	-	expression tag	UNP O34600
C	-1	SER	-	expression tag	UNP O34600
D	-20	MET	-	initiating methionine	UNP O34600
D	-19	GLY	-	expression tag	UNP O34600
D	-18	SER	-	expression tag	UNP O34600

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Chain	Residue	Modelled	Actual	Comment	Reference
D	-17	SER	-	expression tag	UNP O34600
D	-16	HIS	-	expression tag	UNP O34600
D	-15	HIS	-	expression tag	UNP O34600
D	-14	HIS	-	expression tag	UNP O34600
D	-13	HIS	-	expression tag	UNP O34600
D	-12	HIS	-	expression tag	UNP O34600
D	-11	HIS	-	expression tag	UNP O34600
D	-10	GLU	-	expression tag	UNP O34600
D	-9	ASN	-	expression tag	UNP O34600
D	-8	LEU	-	expression tag	UNP O34600
D	-7	TYR	-	expression tag	UNP O34600
D	-6	PHE	-	expression tag	UNP O34600
D	-5	GLN	-	expression tag	UNP O34600
D	-4	SER	-	expression tag	UNP O34600
D	-3	MET	-	expression tag	UNP O34600
D	-2	ALA	-	expression tag	UNP O34600
D	-1	SER	-	expression tag	UNP O34600

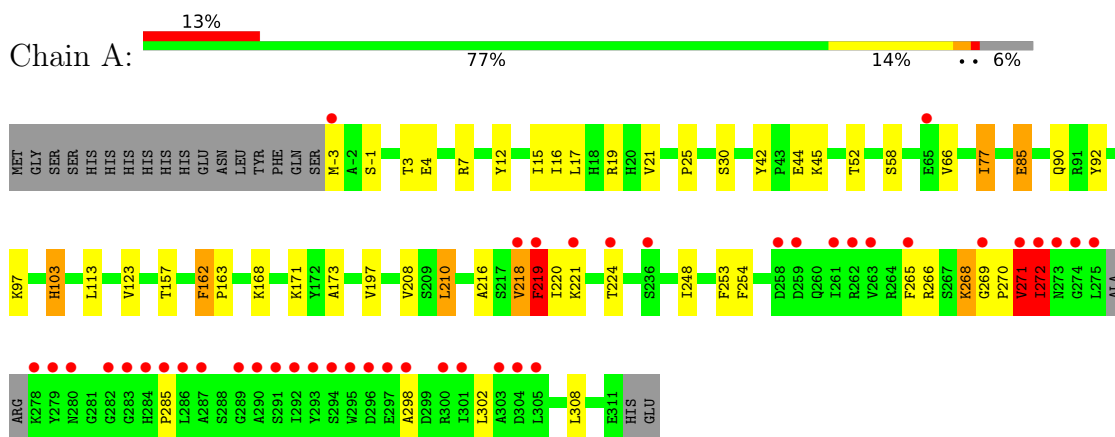
- Molecule 2 is water.

Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
2	A	140	Total O 140 140	0	0
2	B	172	Total O 172 172	0	0
2	C	187	Total O 187 187	0	0
2	D	185	Total O 185 185	0	0

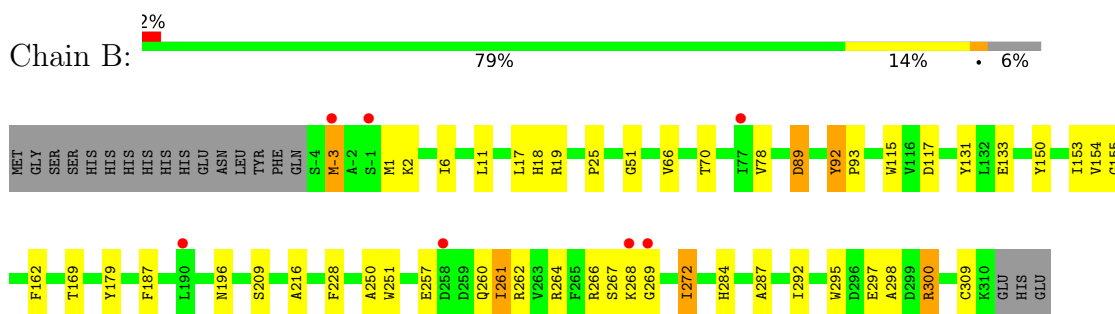
### 3 Residue-property plots [i](#)

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.

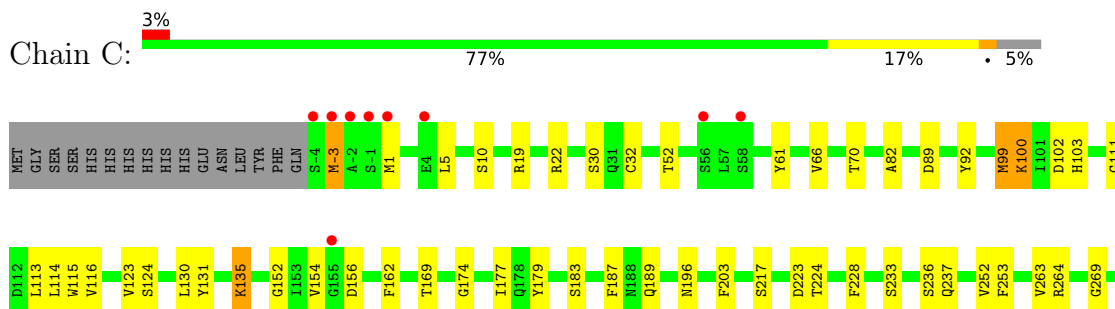
- Molecule 1: Bifunctional oligoribonuclease and PAP phosphatase NrnA

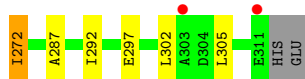


- Molecule 1: Bifunctional oligoribonuclease and PAP phosphatase NrnA

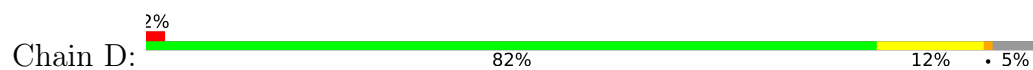


- Molecule 1: Bifunctional oligoribonuclease and PAP phosphatase NrnA





- Molecule 1: Bifunctional oligoribonuclease and PAP phosphatase NrnA



## 4 Data and refinement statistics

Property	Value	Source
Space group	P 1 21 1	Depositor
Cell constants a, b, c, $\alpha$ , $\beta$ , $\gamma$	50.62Å 121.25Å 123.39Å 90.00° 91.31° 90.00°	Depositor
Resolution (Å)	46.44 – 2.00 46.44 – 2.00	Depositor EDS
% Data completeness (in resolution range)	98.3 (46.44-2.00) 98.3 (46.44-2.00)	Depositor EDS
$R_{merge}$	0.06	Depositor
$R_{sym}$	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ <sup>1</sup>	6.13 (at 2.00Å)	Xtrriage
Refinement program	REFMAC 5.5.0109	Depositor
R, $R_{free}$	0.180 , 0.232 0.194 , 0.239	Depositor DCC
$R_{free}$ test set	4943 reflections (4.93%)	wwPDB-VP
Wilson B-factor (Å <sup>2</sup> )	28.6	Xtrriage
Anisotropy	0.030	Xtrriage
Bulk solvent $k_{sol}$ (e/Å <sup>3</sup> ), $B_{sol}$ (Å <sup>2</sup> )	0.35 , 37.5	EDS
L-test for twinning <sup>2</sup>	$\langle  L  \rangle = 0.50$ , $\langle L^2 \rangle = 0.34$	Xtrriage
Estimated twinning fraction	0.000 for -h,l,k 0.006 for -h,-l,-k 0.029 for h,-k,-l	Xtrriage
$F_o, F_c$ correlation	0.95	EDS
Total number of atoms	10432	wwPDB-VP
Average B, all atoms (Å <sup>2</sup> )	32.0	wwPDB-VP

Xtrriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 3.74% 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

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	1.45	12/2457 (0.5%)	1.24	11/3336 (0.3%)
1	B	1.43	7/2478 (0.3%)	1.25	14/3368 (0.4%)
1	C	1.42	10/2519 (0.4%)	1.22	11/3417 (0.3%)
1	D	1.46	7/2505 (0.3%)	1.28	6/3400 (0.2%)
All	All	1.44	36/9959 (0.4%)	1.25	42/13521 (0.3%)

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	1
1	B	0	1
1	D	0	1
All	All	0	3

The worst 5 of 36 bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	A	271	VAL	C-N	10.43	1.44	1.33
1	D	153	ILE	C-N	9.69	1.46	1.33
1	C	272	ILE	CA-CB	8.96	1.64	1.54
1	D	21	VAL	CA-CB	8.75	1.62	1.54
1	D	208	VAL	CA-CB	8.54	1.63	1.54

The worst 5 of 42 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	B	-3	MET	N-CA-C	-8.63	101.36	112.23
1	D	88	ASP	N-CA-C	8.51	123.91	108.17
1	A	16	ILE	CA-C-N	-8.42	111.38	123.00
1	A	16	ILE	C-N-CA	-8.42	111.38	123.00

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Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	B	51	GLY	N-CA-C	-8.08	102.34	111.63

There are no chirality outliers.

All (3) planarity outliers are listed below:

Mol	Chain	Res	Type	Group
1	A	219	PHE	Mainchain
1	B	300	ARG	Sidechain
1	D	300	ARG	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	2405	0	2322	26	0
1	B	2425	0	2347	27	0
1	C	2466	0	2409	30	0
1	D	2452	0	2390	20	0
2	A	140	0	0	0	0
2	B	172	0	0	1	0
2	C	187	0	0	1	0
2	D	185	0	0	1	0
All	All	10432	0	9468	103	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 5.

The worst 5 of 103 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:-3:MET:HA	1:D:1:MET:HE3	1.42	0.99
1:D:-3:MET:HE1	1:D:117:ASP:CG	1.96	0.90
1:C:1:MET:HE2	1:C:115:TRP:HA	1.59	0.82
1:C:99:MET:HE2	1:C:113:LEU:HD11	1.72	0.71
1:B:-3:MET:HE3	1:B:115:TRP:HE1	1.58	0.68

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	308/333 (92%)	296 (96%)	11 (4%)	1 (0%)	36	35
1	B	312/333 (94%)	299 (96%)	11 (4%)	2 (1%)	21	17
1	C	313/333 (94%)	306 (98%)	5 (2%)	2 (1%)	21	17
1	D	313/333 (94%)	306 (98%)	5 (2%)	2 (1%)	21	17
All	All	1246/1332 (94%)	1207 (97%)	32 (3%)	7 (1%)	21	17

5 of 7 Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	D	89	ASP
1	B	269	GLY
1	B	89	ASP
1	C	89	ASP
1	A	269	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	254/287 (88%)	245 (96%)	9 (4%)	32	32
1	B	257/287 (90%)	256 (100%)	1 (0%)	84	89
1	C	266/287 (93%)	260 (98%)	6 (2%)	44	49

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Mol	Chain	Analysed	Rotameric	Outliers	Percentiles
1	D	262/287 (91%)	257 (98%)	5 (2%)	50 56
All	All	1039/1148 (90%)	1018 (98%)	21 (2%)	48 54

5 of 21 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	C	253	PHE
1	D	66	VAL
1	D	242	LEU
1	D	156	ASP
1	D	-3	MET

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. 5 of 11 such sidechains are listed below:

Mol	Chain	Res	Type
1	D	46	ASN
1	D	68	ASN
1	D	201	ASN
1	D	84	GLN
1	C	178	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](#)

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	311/333 (93%)	0.54	43 (13%) 6 6	5, 31, 62, 81	23 (7%)
1	B	314/333 (94%)	0.07	7 (2%) 62 61	18, 31, 45, 54	3 (0%)
1	C	315/333 (94%)	0.07	11 (3%) 47 46	16, 28, 41, 54	3 (0%)
1	D	315/333 (94%)	0.00	8 (2%) 58 58	19, 29, 42, 52	4 (1%)
All	All	1255/1332 (94%)	0.17	69 (5%) 30 29	5, 30, 47, 81	33 (2%)

The worst 5 of 69 RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	291	SER	14.8
1	A	292	ILE	9.0
1	A	282	GLY	7.2
1	A	295	TRP	6.9
1	C	-4	SER	6.5

### 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](#)

There are no ligands in this entry.

## 6.5 Other polymers [i](#)

There are no such residues in this entry.