



# wwPDB X-ray Structure Validation Summary Report ⓘ

Oct 26, 2023 – 02:53 AM EDT

PDB ID : 3G5I  
Title : Crystal Structure of the E.coli RihA pyrimidine nucleosidase bound to a iminoribitol-based inhibitor  
Authors : Garau, G.; Muzzolini, L.; Tornaghi, P.; Degano, M.  
Deposited on : 2009-02-05  
Resolution : 2.10 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  
Mogul : 1.8.5 (274361), CSD as541be (2020)  
Xtriage (Phenix) : 1.13  
EDS : 2.36  
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) : 2.36

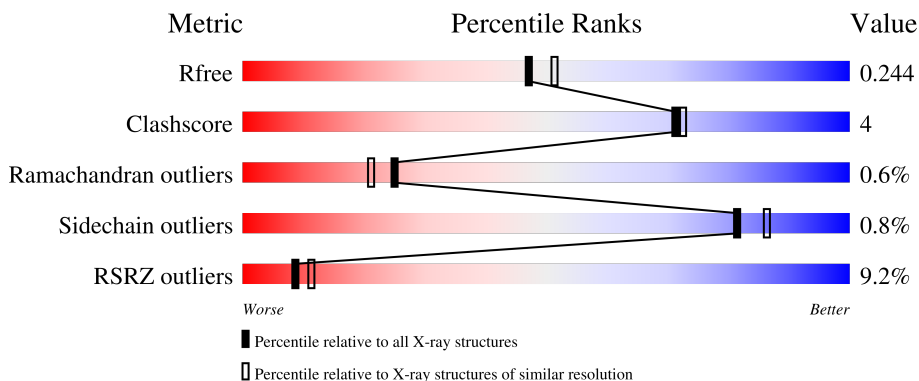
# 1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

*X-RAY DIFFRACTION*

The reported resolution of this entry is 2.10 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	5197 (2.10-2.10)
Clashscore	141614	5710 (2.10-2.10)
Ramachandran outliers	138981	5647 (2.10-2.10)
Sidechain outliers	138945	5648 (2.10-2.10)
RSRZ outliers	127900	5083 (2.10-2.10)

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	312	 5% 88% 8% ..
1	B	312	 11% 87% 7% 5%
1	C	312	 10% 87% 7% 6%
1	D	312	 9% 90% 7% ..

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
2	BME	A	1102	-	X	X	-

## 2 Entry composition

There are 5 unique types of molecules in this entry. The entry contains 9716 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.

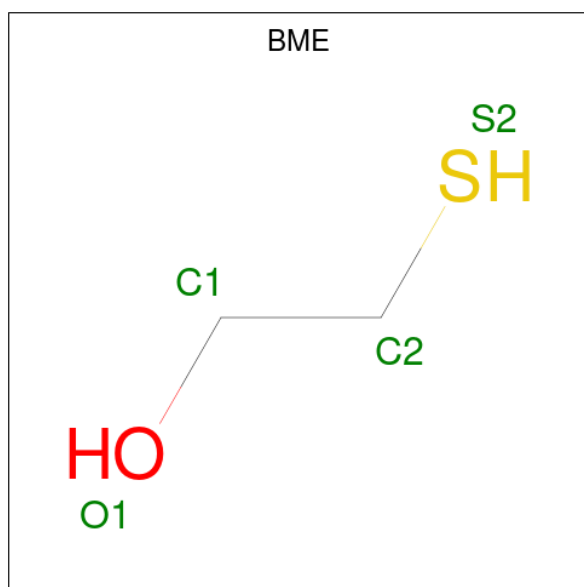
- Molecule 1 is a protein called Pyrimidine-specific ribonucleoside hydrolase rihA.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
1	A	305	2325	1488	387	439	11	0	1	0
1	B	295	2246	1440	374	421	11	0	0	0
1	C	293	2230	1427	372	420	11	0	0	0
1	D	304	2334	1495	388	440	11	0	2	0

There are 8 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	0	GLY	-	expression tag	UNP P41409
A	1	SER	-	expression tag	UNP P41409
B	0	GLY	-	expression tag	UNP P41409
B	1	SER	-	expression tag	UNP P41409
C	0	GLY	-	expression tag	UNP P41409
C	1	SER	-	expression tag	UNP P41409
D	0	GLY	-	expression tag	UNP P41409
D	1	SER	-	expression tag	UNP P41409

- Molecule 2 is BETA-MERCAPTOETHANOL (three-letter code: BME) (formula: C<sub>2</sub>H<sub>6</sub>OS).

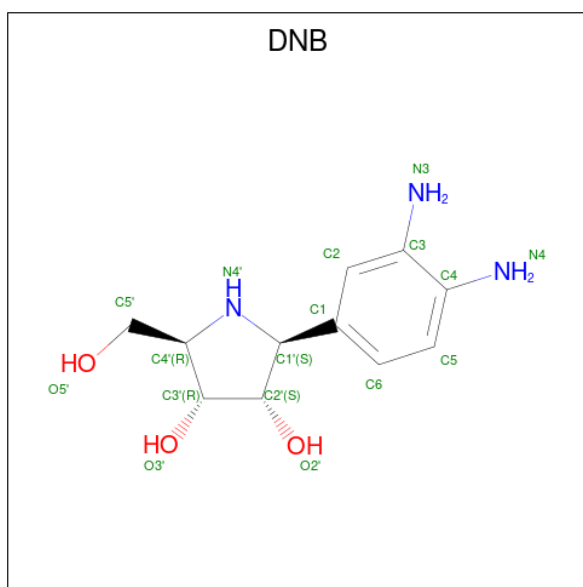


Mol	Chain	Residues	Atoms				ZeroOcc	AltConf
2	A	1	Total	C	O	S	0	0
			4	2	1	1		

- Molecule 3 is CALCIUM ION (three-letter code: CA) (formula: Ca).

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
3	A	1	Total	Ca	0	0
			1	1		
3	B	1	Total	Ca	0	0
			1	1		
3	C	1	Total	Ca	0	0
			1	1		
3	D	1	Total	Ca	0	0
			1	1		

- Molecule 4 is (2S,3S,4R,5R)-2-(3,4-diaminophenyl)-5-(hydroxymethyl)pyrrolidine-3,4-diol (three-letter code: DNB) (formula: C<sub>11</sub>H<sub>17</sub>N<sub>3</sub>O<sub>3</sub>).



Mol	Chain	Residues	Atoms			ZeroOcc	AltConf	
4	A	1	Total	C	N	O	0	0
			16	11	2	3		
4	B	1	Total	C	N	O	0	0
			16	11	2	3		
4	C	1	Total	C	N	O	0	0
			15	11	1	3		
4	D	1	Total	C	N	O	0	0
			16	11	2	3		

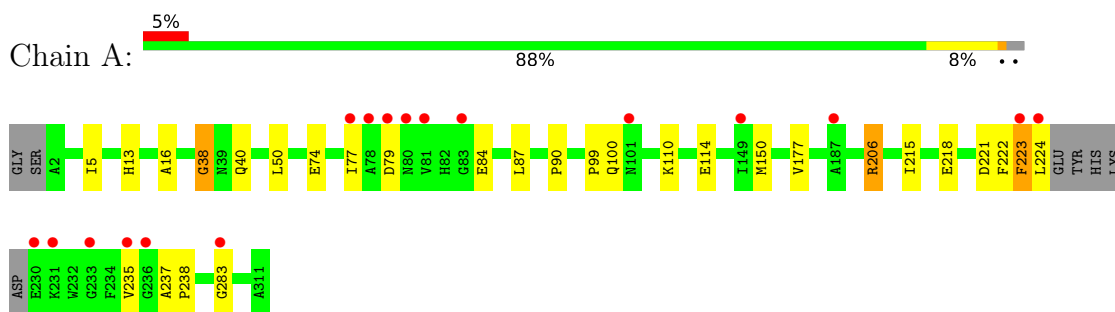
- Molecule 5 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
5	A	141	Total	O	0	0
			141	141		
5	B	115	Total	O	0	0
			115	115		
5	C	132	Total	O	0	0
			132	132		
5	D	122	Total	O	0	0
			122	122		

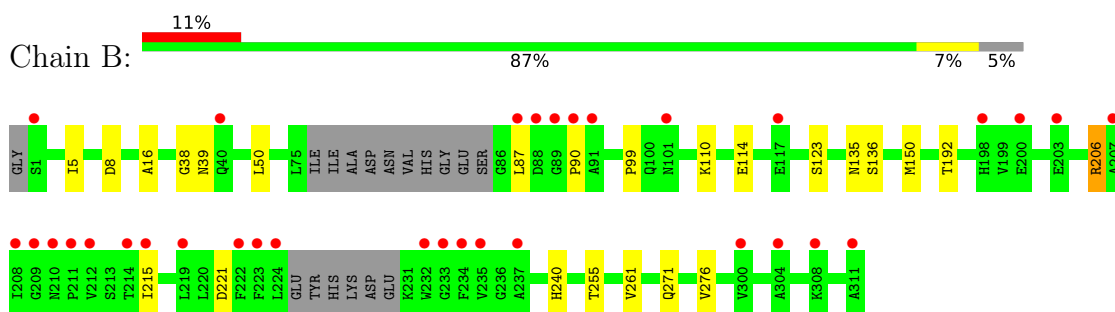
### 3 Residue-property plots [i](#)

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.

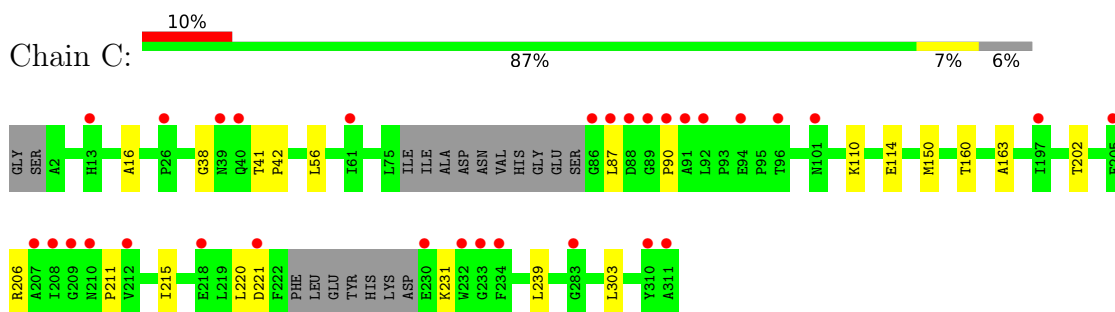
- Molecule 1: Pyrimidine-specific ribonucleoside hydrolase rihA



- Molecule 1: Pyrimidine-specific ribonucleoside hydrolase rihA

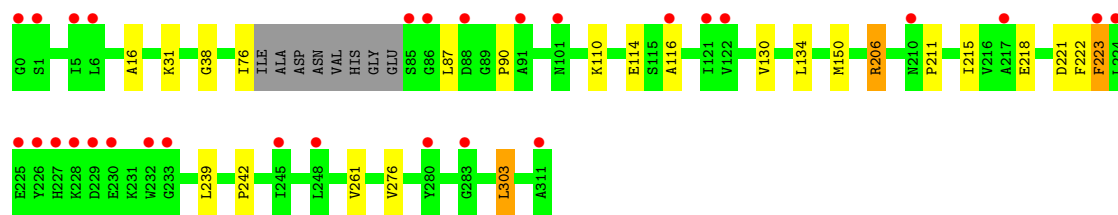


- Molecule 1: Pyrimidine-specific ribonucleoside hydrolase rihA



- Molecule 1: Pyrimidine-specific ribonucleoside hydrolase rihA







## 4 Data and refinement statistics

Property	Value	Source
Space group	P 1 21 1	Depositor
Cell constants a, b, c, $\alpha$ , $\beta$ , $\gamma$	84.35Å 82.91Å 93.87Å 90.00° 112.15° 90.00°	Depositor
Resolution (Å)	37.50 – 2.10 37.50 – 2.10	Depositor EDS
% Data completeness (in resolution range)	98.0 (37.50-2.10) 98.0 (37.50-2.10)	Depositor EDS
$R_{merge}$	(Not available)	Depositor
$R_{sym}$	0.12	Depositor
$\langle I/\sigma(I) \rangle$ <sup>1</sup>	3.24 (at 2.10Å)	Xtrriage
Refinement program	REFMAC 5.2.0019	Depositor
R, $R_{free}$	0.203 , 0.241 0.206 , 0.244	Depositor DCC
$R_{free}$ test set	3453 reflections (5.03%)	wwPDB-VP
Wilson B-factor (Å <sup>2</sup> )	18.7	Xtrriage
Anisotropy	1.052	Xtrriage
Bulk solvent $k_{sol}$ (e/Å <sup>3</sup> ), $B_{sol}$ (Å <sup>2</sup> )	0.36 , 50.5	EDS
L-test for twinning <sup>2</sup>	$\langle  L  \rangle = 0.51$ , $\langle L^2 \rangle = 0.34$	Xtrriage
Estimated twinning fraction	No twinning to report.	Xtrriage
$F_o, F_c$ correlation	0.93	EDS
Total number of atoms	9716	wwPDB-VP
Average B, all atoms (Å <sup>2</sup> )	29.0	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 41.70 % 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 2.2714e-04. 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

Bond lengths and bond angles in the following residue types are not validated in this section: BME, CA, DNB

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	0.90	1/2378 (0.0%)	0.80	2/3249 (0.1%)
1	B	0.83	3/2294 (0.1%)	0.76	2/3133 (0.1%)
1	C	0.84	0/2277	0.76	0/3110
1	D	0.79	0/2392	0.79	3/3266 (0.1%)
All	All	0.84	4/9341 (0.0%)	0.78	7/12758 (0.1%)

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

All (4) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	B	135	ASN	CG-OD1	-6.24	1.10	1.24
1	B	135	ASN	CG-ND2	-5.91	1.18	1.32
1	A	177	VAL	CB-CG2	5.18	1.63	1.52
1	B	136	SER	CB-OG	-5.17	1.35	1.42

The worst 5 of 7 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	D	206	ARG	NE-CZ-NH2	-8.76	115.92	120.30
1	D	303	LEU	CA-CB-CG	8.15	134.05	115.30
1	D	206	ARG	NE-CZ-NH1	7.39	123.99	120.30
1	A	206	ARG	NE-CZ-NH2	-6.54	117.03	120.30
1	B	206	ARG	NE-CZ-NH2	-6.52	117.04	120.30

There are no chirality outliers.

All (1) planarity outliers are listed below:

Mol	Chain	Res	Type	Group
1	A	283	GLY	Peptide

## 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	2325	0	2340	24	0
1	B	2246	0	2270	12	0
1	C	2230	0	2248	13	0
1	D	2334	0	2348	13	0
2	A	4	0	0	6	0
3	A	1	0	0	0	0
3	B	1	0	0	0	0
3	C	1	0	0	0	0
3	D	1	0	0	0	0
4	A	16	0	14	1	0
4	B	16	0	13	2	0
4	C	15	0	11	0	0
4	D	16	0	14	1	0
5	A	141	0	0	2	0
5	B	115	0	0	2	0
5	C	132	0	0	3	0
5	D	122	0	0	1	0
All	All	9716	0	9258	65	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 4.

The worst 5 of 65 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:A:13:HIS:HB2	1:A:223:PHE:CZ	2.05	0.91
1:A:13:HIS:HB2	1:A:223:PHE:CE2	2.07	0.89
1:B:206:ARG:NH2	1:B:221:ASP:OD2	2.11	0.82

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:206:ARG:NH2	1:A:221:ASP:OD2	2.26	0.68
1:C:110:LYS:O	1:C:114:GLU:HG2	1.94	0.67

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	302/312 (97%)	293 (97%)	6 (2%)	3 (1%)	15 11
1	B	289/312 (93%)	283 (98%)	5 (2%)	1 (0%)	41 41
1	C	287/312 (92%)	280 (98%)	6 (2%)	1 (0%)	41 41
1	D	302/312 (97%)	292 (97%)	8 (3%)	2 (1%)	22 18
All	All	1180/1248 (95%)	1148 (97%)	25 (2%)	7 (1%)	25 21

5 of 7 Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	223	PHE
1	D	223	PHE
1	A	79	ASP
1	C	38	GLY
1	D	38	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	253/258 (98%)	252 (100%)	1 (0%)	91	94
1	B	244/258 (95%)	242 (99%)	2 (1%)	81	86
1	C	242/258 (94%)	240 (99%)	2 (1%)	81	86
1	D	254/258 (98%)	251 (99%)	3 (1%)	71	77
All	All	993/1032 (96%)	985 (99%)	8 (1%)	81	86

5 of 8 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	D	303	LEU
1	D	150	MET
1	C	303	LEU
1	C	150	MET
1	D	76	ILE

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

Mol	Chain	Res	Type
1	A	57	ASN
1	B	135	ASN

### 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 9 ligands modelled in this entry, 4 are monoatomic - leaving 5 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
4	DNB	A	502	3	17,17,18	0.99	0	19,24,26	1.80	5 (26%)
4	DNB	D	502	3	17,17,18	1.21	3 (17%)	19,24,26	2.67	6 (31%)
4	DNB	C	502	3	16,16,18	1.15	1 (6%)	17,22,26	2.67	5 (29%)
2	BME	A	1102	1	3,3,3	4.88	3 (100%)	1,2,2	2.80	1 (100%)
4	DNB	B	502	3	17,17,18	1.15	1 (5%)	19,24,26	1.96	3 (15%)

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
4	DNB	A	502	3	-	4/6/22/22	0/2/2/2
4	DNB	D	502	3	-	4/6/22/22	0/2/2/2
4	DNB	C	502	3	-	5/6/22/22	0/2/2/2
2	BME	A	1102	1	-	1/1/1/1	-
4	DNB	B	502	3	-	2/6/22/22	0/2/2/2

The worst 5 of 8 bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
2	A	1102	BME	C2-S2	-6.10	1.59	1.80
2	A	1102	BME	C2-C1	-5.46	1.12	1.50
4	D	502	DNB	C4'-N4'	-2.77	1.44	1.48
4	C	502	DNB	C1-C1'	-2.30	1.48	1.52
4	B	502	DNB	C1-C1'	-2.24	1.49	1.52

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

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
4	D	502	DNB	C1-C1'-N4'	-8.83	99.69	113.12
4	C	502	DNB	C1-C1'-N4'	-8.74	99.83	113.12
4	B	502	DNB	C1-C1'-N4'	-6.33	103.49	113.12
4	D	502	DNB	C2-C1-C1'	-4.09	113.61	120.49

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Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
4	A	502	DNB	C1-C1'-N4'	-4.06	106.95	113.12

There are no chirality outliers.

5 of 16 torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
4	A	502	DNB	C6-C1-C1'-C2'
4	A	502	DNB	C2-C1-C1'-C2'
4	B	502	DNB	C6-C1-C1'-C2'
4	B	502	DNB	C2-C1-C1'-C2'
4	C	502	DNB	C6-C1-C1'-C2'

There are no ring outliers.

4 monomers are involved in 10 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
4	A	502	DNB	1	0
4	D	502	DNB	1	0
2	A	1102	BME	6	0
4	B	502	DNB	2	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	305/312 (97%)	0.52	17 (5%) 24 29	21, 28, 52, 67	0
1	B	295/312 (94%)	0.73	33 (11%) 5 6	21, 27, 41, 58	0
1	C	293/312 (93%)	0.82	31 (10%) 6 7	21, 27, 40, 62	0
1	D	304/312 (97%)	0.69	29 (9%) 8 10	21, 28, 48, 79	0
All	All	1197/1248 (95%)	0.69	110 (9%) 9 11	21, 27, 47, 79	0

The worst 5 of 110 RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	78	ALA	7.7
1	D	226	TYR	7.3
1	D	229	ASP	7.0
1	C	86	GLY	6.8
1	B	222	PHE	6.6

### 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	BME	A	1102	4/4	0.68	0.31	59,60,60,61	0
4	DNB	C	502	15/17	0.83	0.22	23,34,41,41	15
4	DNB	B	502	16/17	0.85	0.17	16,27,33,33	16
4	DNB	A	502	16/17	0.90	0.14	16,29,38,39	0
4	DNB	D	502	16/17	0.90	0.17	30,40,45,46	0
3	CA	A	501	1/1	0.99	0.04	16,16,16,16	0
3	CA	B	501	1/1	0.99	0.05	19,19,19,19	0
3	CA	C	501	1/1	0.99	0.06	19,19,19,19	0
3	CA	D	501	1/1	0.99	0.06	20,20,20,20	0

## 6.5 Other polymers [i](#)

There are no such residues in this entry.