



wwPDB X-ray Structure Validation Summary Report

Apr 18, 2014 – 10:47 AM EDT

PDB ID : 4B7G
Title : Structure of a bacterial catalase
Authors : Gumiero, A.; Walsh, M.
Deposited on : 2012-08-20
Resolution : 1.90 Å(reported)

This is a wwPDB validation summary report for a publicly released PDB entry.

We welcome your comments at validation@mail.wwpdb.org

A user guide is available at <http://wwpdb.org/ValidationPDFNotes.html>

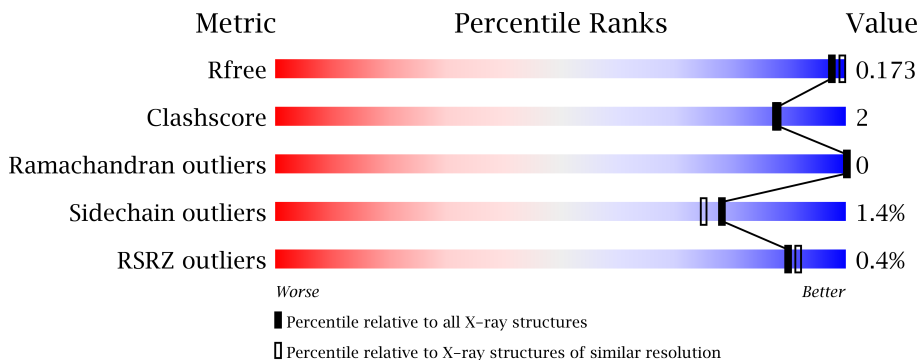
The following versions of software and data (see [references](#)) were used in the production of this report:

MolProbity : 4.02b-467
Mogul : 1.16 November 2013
Xtriage (Phenix) : dev-1439
EDS : stable22978
Percentile statistics : 21963
Refmac : 5.8.0049
CCP4 : 6.3.0 (Settle)
Ideal geometry (proteins) : Engh & Huber (2001)
Ideal geometry (DNA, RNA) : Parkinson et. al. (1996)
Validation Pipeline (wwPDB-VP) : stable22978

1 Overall quality at a glance

The reported resolution of this entry is 1.90 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}	66092	3684 (1.90-1.90)
Clashscore	79885	4465 (1.90-1.90)
Ramachandran outliers	78287	4413 (1.90-1.90)
Sidechain outliers	78261	4414 (1.90-1.90)
RSRZ outliers	66119	3686 (1.90-1.90)

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 ≥ 3 , 2, 1 and 0 types of geometric quality criteria. The upper red bar (where present) indicates the fraction of residues that have poor fit to the electron density.

Mol	Chain	Length	Quality of chain
1	A	515	
1	B	515	
1	C	515	
1	D	515	

The following table lists non-polymeric compounds that are outliers for geometric or electron-density-fit criteria:

Mol	Type	Chain	Res	Geometry	Electron density
3	NDP	A	1518	-	X
3	NDP	B	1517	-	X
3	NDP	C	1517[A]	-	X
3	NDP	C	1517[B]	-	X

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Mol	Type	Chain	Res	Geometry	Electron density
3	NDP	D	1517[A]	-	X
3	NDP	D	1517[B]	-	X

2 Entry composition

There are 5 unique types of molecules in this entry. The entry contains 19488 atoms, of which 0 are hydrogen and 0 are deuterium.

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 CATALASE.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	513	Total	C	N	O	S	0	8	0
			4178	2628	732	809	9			
1	B	514	Total	C	N	O	S	0	7	0
			4182	2628	736	809	9			
1	C	513	Total	C	N	O	S	0	5	0
			4160	2616	735	800	9			
1	D	514	Total	C	N	O	S	0	4	0
			4163	2617	735	802	9			

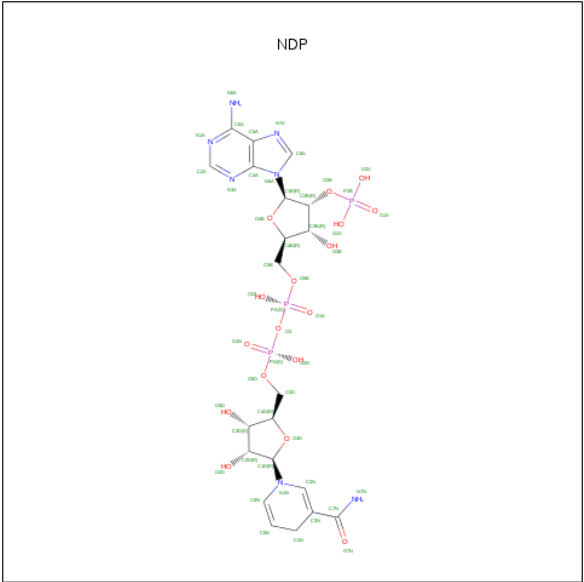
There are 4 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	327	ILE	LEU	CONFLICT	UNP Q6M8A6
B	327	ILE	LEU	CONFLICT	UNP Q6M8A6
C	327	ILE	LEU	CONFLICT	UNP Q6M8A6
D	327	ILE	LEU	CONFLICT	UNP Q6M8A6

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

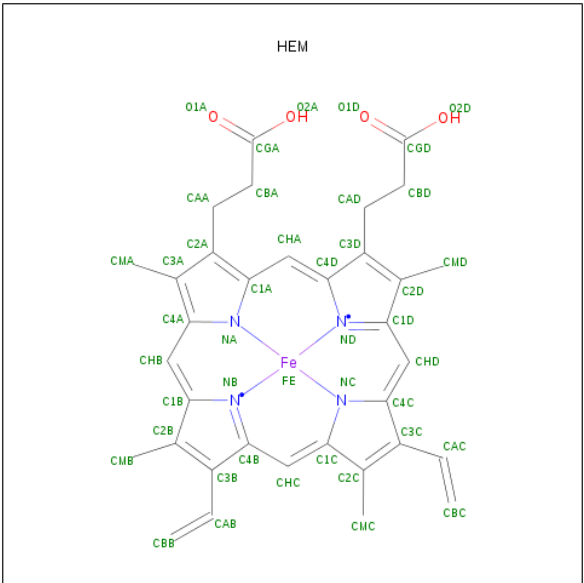
Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
2	B	1	Total	Cl	0	0
			1	1		
2	A	1	Total	Cl	0	0
			1	1		

- Molecule 3 is NADPH DIHYDRO-NICOTINAMIDE-ADENINE-DINUCLEOTIDEPHOSPHATE (three-letter code: NDP) (formula: C₂₁H₃₀N₇O₁₇P₃).



Mol	Chain	Residues	Atoms					ZeroOcc	AltConf
3	A	1	Total	C	N	O	P	0	0
			48	21	7	17	3		
3	B	1	Total	C	N	O	P	0	0
			48	21	7	17	3		
3	C	1	Total	C	N	O	P	0	1
			96	42	14	34	6		
3	D	1	Total	C	N	O	P	0	1
			96	42	14	34	6		

- Molecule 4 is PROTOPORPHYRIN IX CONTAINING FE (three-letter code: HEM) (formula: $C_{34}H_{32}FeN_4O_4$).



Mol	Chain	Residues	Atoms					ZeroOcc	AltConf
4	A	1	Total 43	C 34	Fe 1	N 4	O 4	0	0
4	B	1	Total 43	C 34	Fe 1	N 4	O 4	0	0
4	C	1	Total 43	C 34	Fe 1	N 4	O 4	0	0
4	D	1	Total 43	C 34	Fe 1	N 4	O 4	0	0

- Molecule 5 is water.

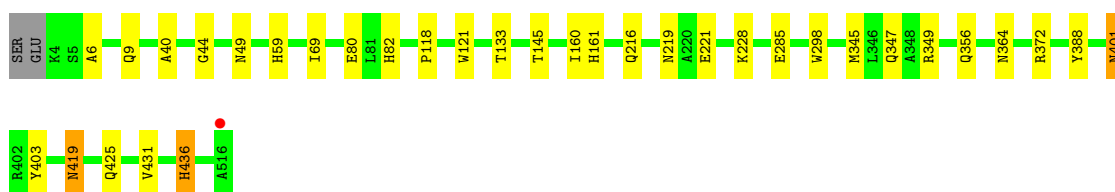
Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
5	A	709	Total 709	O 709	0	0
5	B	591	Total 591	O 591	0	0
5	C	555	Total 555	O 555	0	0
5	D	488	Total 488	O 488	0	0

3 Residue-property plots

These plots are drawn for all protein, RNA and DNA chains in the entry. The first graphic for a chain summarises the proportions of errors 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.

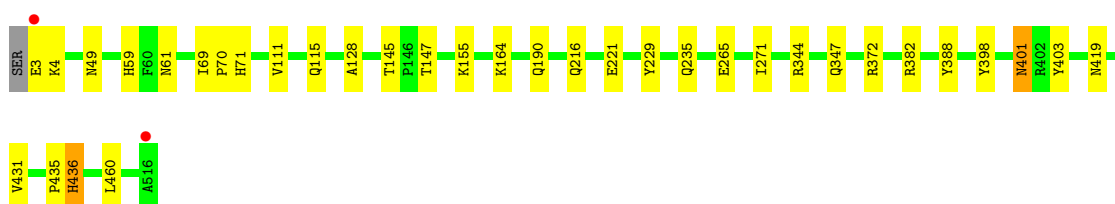
• Molecule 1: CATALASE

Chain A: 



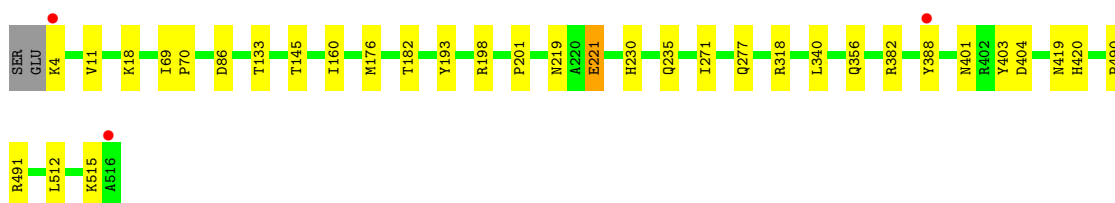
• Molecule 1: CATALASE

Chain B: 



• Molecule 1: CATALASE

Chain C: 



• Molecule 1: CATALASE

Chain D: 



4 Data and refinement statistics

Property	Value	Source
Space group	P 63	Depositor
Cell constants a, b, c, α , β , γ	151.75Å 151.75Å 157.68Å 90.00° 90.00° 120.00°	Depositor
Resolution (Å)	48.80 – 1.90 48.80 – 1.90	Depositor EDS
% Data completeness (in resolution range)	99.5 (48.80-1.90) 99.5 (48.80-1.90)	Depositor EDS
R_{merge}	0.12	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	1.92 (at 1.90Å)	Xtriage
Refinement program	PHENIX (PHENIX.REFINE: 1.8_1069)	Depositor
R, R_{free}	0.133 , 0.174 0.132 , 0.173	Depositor DCC
R_{free} test set	8064 reflections (5.02%)	DCC
Wilson B-factor (Å ²)	19.3	Xtriage
Anisotropy	0.141	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.32 , 31.8	EDS
Estimated twinning fraction	0.027 for h,-h-k,-l	Xtriage
L-test for twinning	$\langle L \rangle = 0.50$, $\langle L^2 \rangle = 0.33$	Xtriage
Outliers	0 of 160760 reflections	Xtriage
F_o, F_c correlation	0.97	EDS
Total number of atoms	19488	wwPDB-VP
Average B, all atoms (Å ²)	18.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 1.98% of the height of the origin peak. No significant pseudotranslation is detected.*

¹Intensities estimated from amplitudes.

5 Model quality ⓘ

5.1 Standard geometry ⓘ

Bond lengths and bond angles in the following residue types are not validated in this section: HEM, CL, NDP

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	0.47	4/4318 (0.1%)	0.56	1/5866 (0.0%)
1	B	0.47	3/4313 (0.1%)	0.56	2/5859 (0.0%)
1	C	0.47	3/4291 (0.1%)	0.55	0/5829
1	D	0.46	1/4291 (0.0%)	0.54	0/5829
All	All	0.47	11/17213 (0.1%)	0.55	3/23383 (0.0%)

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

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	C	419	ASN	C-N	-14.13	1.01	1.34
1	D	419	ASN	C-N	-13.70	1.02	1.34
1	A	419	ASN	C-N	-10.22	1.10	1.34
1	A	436	HIS	C-N	-8.94	1.17	1.33
1	B	419	ASN	C-N	-8.85	1.13	1.34

All (3) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	B	229	TYR	C-N-CA	6.33	137.52	121.70
1	B	229	TYR	O-C-N	-6.29	112.64	122.70
1	A	161	HIS	O-C-N	-6.27	112.67	122.70

There are no chirality outliers.

There are no planarity outliers.

5.2 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 hydrogens

added by MolProbity. The Clashes column lists the number of clashes within the asymmetric unit, and the number in parentheses is this value normalized per 1000 atoms of the molecule in the chain. The Symm-Clashes column gives symmetry related clashes, in the same way as for the Clashes column.

Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
1	A	4178	0	3922	23	0
1	B	4182	0	3921	27	0
1	C	4160	0	3912	21	0
1	D	4163	0	3912	17	0
2	A	1	0	0	0	0
2	B	1	0	0	0	0
3	A	48	0	26	0	0
3	B	48	0	26	1	0
3	C	96	0	52	4	0
3	D	96	0	52	3	0
4	A	43	0	30	0	0
4	B	43	0	30	1	0
4	C	43	0	30	0	0
4	D	43	0	30	0	0
5	A	709	0	0	5	0
5	B	591	0	0	4	0
5	C	555	0	0	3	0
5	D	488	0	0	6	0
All	All	19488	0	15943	79	0

Clashscore is defined as the number of clashes calculated for the entry per 1000 atoms (including hydrogens) of the entry. The overall clashscore for this entry is 2.

The worst 5 of 79 close contacts within the same asymmetric unit are listed below.

Atom-1	Atom-2	Distance(Å)	Clash(Å)
1:B:401:ASN:HD22	1:B:403:TYR:H	1.15	0.93
1:B:216:GLN:HE22	1:B:431:VAL:H	1.08	0.91
1:D:216:GLN:HE22	1:D:431:VAL:H	1.17	0.89
1:A:401:ASN:HD22	1:A:403:TYR:H	1.14	0.89
1:C:69:ILE:H	1:C:356:GLN:HE22	1.15	0.88

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	519/515 (101%)	499 (96%)	20 (4%)	0	100	100
1	B	519/515 (101%)	499 (96%)	20 (4%)	0	100	100
1	C	516/515 (100%)	493 (96%)	23 (4%)	0	100	100
1	D	516/515 (100%)	494 (96%)	22 (4%)	0	100	100
All	All	2070/2060 (100%)	1985 (96%)	85 (4%)	0	100	100

There are no Ramachandran outliers to report.

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	442/436 (101%)	437 (99%)	5 (1%)	84	82
1	B	441/436 (101%)	435 (99%)	6 (1%)	78	75
1	C	439/436 (101%)	431 (98%)	8 (2%)	71	66
1	D	439/436 (101%)	434 (99%)	5 (1%)	84	82
All	All	1761/1744 (101%)	1737 (99%)	24 (1%)	78	75

5 of 24 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	B	401	ASN
1	C	145	THR
1	D	340	LEU
1	C	4	LYS
1	C	133	THR

Some sidechains can be flipped to improve hydrogen bonding and reduce clashes. 5 of 53 such sidechains are listed below:

Mol	Chain	Res	Type
1	B	216	GLN
1	B	436	HIS
1	D	216	GLN
1	B	230	HIS
1	B	286	ASN

5.3.3 RNA ⓘ

There are no RNA chains in this entry.

5.4 Non-standard residues in protein, DNA, RNA chains ⓘ

There are no non-standard protein/DNA/RNA residues in this entry.

5.5 Carbohydrates ⓘ

There are no carbohydrates in this entry.

5.6 Ligand geometry ⓘ

Of 12 ligands modelled in this entry, 2 are monoatomic - leaving 10 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	NDP	A	1518	-	52,52,52	1.42	5 (9%)	80,80,80	1.63	8 (10%)
4	HEM	A	3000	1,5	42,50,50	3.41	14 (33%)	27,82,82	1.70	5 (18%)
3	NDP	B	1517	-	52,52,52	1.43	5 (9%)	80,80,80	1.69	6 (7%)
4	HEM	B	3001	1,5	42,50,50	3.49	14 (33%)	27,82,82	1.76	7 (25%)
3	NDP	C	1517[A]	-	52,52,52	1.38	5 (9%)	80,80,80	1.70	8 (10%)
3	NDP	C	1517[B]	-	52,52,52	1.39	5 (9%)	80,80,80	1.69	8 (10%)

Mol	Type	Chain	Res	Link	Bond lengths			Bond angles		
					Counts	RMSZ	# Z > 2	Counts	RMSZ	# Z > 2
4	HEM	C	3002	1,5	42,50,50	3.51	14 (33%)	27,82,82	1.63	6 (22%)
3	NDP	D	1517[A]	-	52,52,52	1.39	5 (9%)	80,80,80	1.69	6 (7%)
3	NDP	D	1517[B]	-	52,52,52	1.44	5 (9%)	80,80,80	1.69	8 (10%)
4	HEM	D	3003	1,5	42,50,50	3.55	15 (35%)	27,82,82	1.63	4 (14%)

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
3	NDP	A	1518	-	-	0/35/77/77	0/5/5/5
4	HEM	A	3000	1,5	-	0/14/114/114	0/0/8/8
3	NDP	B	1517	-	-	0/35/77/77	0/5/5/5
4	HEM	B	3001	1,5	-	0/14/114/114	0/0/8/8
3	NDP	C	1517[A]	-	-	0/35/77/77	0/5/5/5
3	NDP	C	1517[B]	-	-	0/35/77/77	0/5/5/5
4	HEM	C	3002	1,5	-	0/14/114/114	0/0/8/8
3	NDP	D	1517[A]	-	-	0/35/77/77	0/5/5/5
3	NDP	D	1517[B]	-	-	0/35/77/77	0/5/5/5
4	HEM	D	3003	1,5	-	0/14/114/114	0/0/8/8

The worst 5 of 87 bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
4	C	3002	HEM	C3C-C2C	-13.68	1.34	1.45
4	D	3003	HEM	C3C-C2C	-13.14	1.35	1.45
4	B	3001	HEM	C3C-C2C	-12.95	1.35	1.45
4	A	3000	HEM	C3C-C2C	-12.22	1.35	1.45
4	D	3003	HEM	C3B-C2B	-11.43	1.34	1.45

The worst 5 of 66 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
3	B	1517	NDP	N3A-C2A-N1A	-9.98	120.11	128.89
3	D	1517[A]	NDP	N3A-C2A-N1A	-9.97	120.11	128.89
3	D	1517[B]	NDP	N3A-C2A-N1A	-9.86	120.21	128.89
3	C	1517[B]	NDP	N3A-C2A-N1A	-9.66	120.39	128.89
3	C	1517[A]	NDP	N3A-C2A-N1A	-9.60	120.44	128.89

There are no chirality outliers.

There are no torsion outliers.

There are no ring outliers.

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, 95th 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 ²)	Q<0.9
1	A	513/515 (99%)	-0.72	1 (0%) 93 94	11, 16, 25, 74	0
1	B	514/515 (99%)	-0.63	2 (0%) 90 91	11, 17, 28, 70	0
1	C	513/515 (99%)	-0.73	3 (0%) 86 88	11, 16, 26, 67	0
1	D	514/515 (99%)	-0.73	2 (0%) 90 91	11, 16, 26, 78	0
All	All	2054/2060 (99%)	-0.70	8 (0%) 90 91	11, 16, 27, 78	0

The worst 5 of 8 RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	516	ALA	8.7
1	B	516	ALA	7.3
1	B	3	GLU	5.6
1	C	516	ALA	4.2
1	D	516	ALA	3.6

6.2 Non-standard residues in protein, DNA, RNA chains ⓘ

There are no non-standard protein/DNA/RNA residues in this entry.

6.3 Carbohydrates ⓘ

There are no carbohydrates in this entry.

6.4 Ligands ⓘ

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. LLDF column lists the quality of electron density of the group with respect to its neighbouring residues in protein, DNA or RNA chains. The B-factors column lists the minimum, median, 95th 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	RSR	LLDF	B-factors(\AA^2)	Q<0.9
3	NDP	C	1517[B]	48/48	0.24	11.28	28,39,49,54	48
3	NDP	C	1517[A]	48/48	0.24	11.27	23,39,49,54	48
3	NDP	D	1517[A]	48/48	0.18	6.52	26,34,42,45	48
3	NDP	D	1517[B]	48/48	0.18	6.49	24,35,42,46	48
3	NDP	B	1517	48/48	0.16	6.29	27,33,41,44	0
3	NDP	A	1518	48/48	0.14	5.87	21,29,34,38	0
4	HEM	A	3000	43/43	0.09	0.41	10,13,16,18	0
4	HEM	D	3003	43/43	0.09	0.26	7,13,17,17	0
4	HEM	B	3001	43/43	0.10	0.10	10,14,17,18	0
4	HEM	C	3002	43/43	0.07	-0.12	10,13,16,17	0
2	CL	A	1517	1/1	0.06	-5.82	18,18,18,18	0
2	CL	B	1518	1/1	0.06	-5.95	16,16,16,16	0

6.5 Other polymers ⓘ

There are no such residues in this entry.