



Full wwPDB X-ray Structure Validation Report ⓘ

Mar 8, 2018 – 09:36 pm GMT

PDB ID : 3A0G
Title : Crystal structure analysis of guinea pig oxyhemoglobin at 2.5 angstroms resolution
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Deposited on : 2009-03-17
Resolution : 2.50 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

A user guide is available at

<https://www.wwpdb.org/validation/2017/XrayValidationReportHelp>

with specific help available everywhere you see the ⓘ symbol.

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 : trunk30967
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) : trunk30967

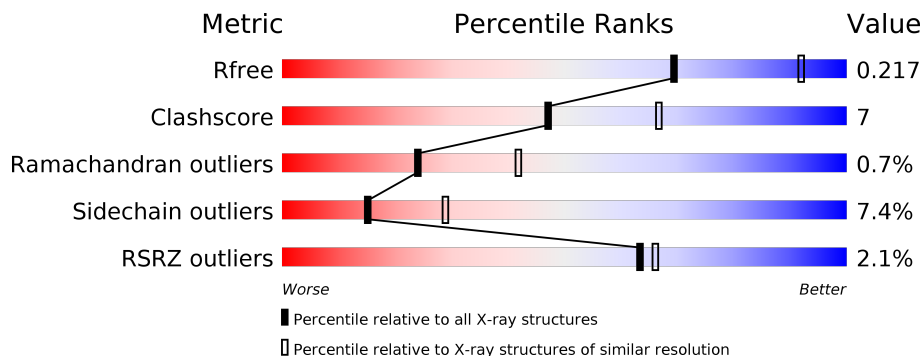
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 2.50 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	4155 (2.50-2.50)
Clashscore	122126	4827 (2.50-2.50)
Ramachandran outliers	120053	4735 (2.50-2.50)
Sidechain outliers	120020	4737 (2.50-2.50)
RSRZ outliers	108989	4058 (2.50-2.50)

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 ≥ 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	141	
2	B	146	

2 Entry composition

There are 5 unique types of molecules in this entry. The entry contains 2289 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 Hemoglobin subunit alpha.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
1	A	139	1053	673	181	197	2	0	0	0

- Molecule 2 is a protein called Hemoglobin subunit beta.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
2	B	144	1099	703	195	197	4	0	0	0

There are 3 discrepancies between the modelled and reference sequences:

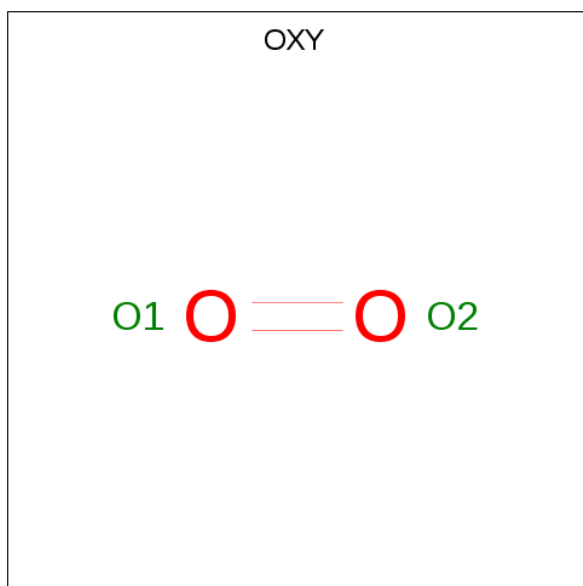
Chain	Residue	Modelled	Actual	Comment	Reference
B	110	LEU	ILE	CONFLICT	UNP P02095
B	111	THR	VAL	CONFLICT	UNP P02095
B	114	ILE	LEU	CONFLICT	UNP P02095

- Molecule 3 is PROTOPORPHYRIN IX CONTAINING FE (three-letter code: HEM) (formula: $C_{34}H_{32}FeN_4O_4$).



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

- Molecule 4 is OXYGEN MOLECULE (three-letter code: OXY) (formula: O₂).



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


- Molecule 5 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
5	A	28	Total 28	O 28	0	0
5	B	19	Total 19	O 19	0	0

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.

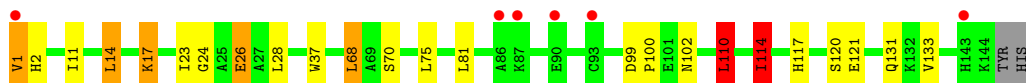
- Molecule 1: Hemoglobin subunit alpha

Chain A: 



- Molecule 2: Hemoglobin subunit beta

Chain B: 



4 Data and refinement statistics

Property	Value	Source
Space group	C 2 2 21	Depositor
Cell constants a, b, c, α , β , γ	90.37Å 84.22Å 83.26Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	28.89 – 2.50 28.89 – 2.50	Depositor EDS
% Data completeness (in resolution range)	100.0 (28.89-2.50) 99.9 (28.89-2.50)	Depositor EDS
R_{merge}	(Not available)	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	7.76 (at 2.51Å)	Xtrriage
Refinement program	REFMAC 5.2.0019	Depositor
R, R_{free}	0.159 , 0.220 0.158 , 0.217	Depositor DCC
R_{free} test set	840 reflections (7.43%)	wwPDB-VP
Wilson B-factor (Å ²)	21.8	Xtrriage
Anisotropy	0.073	Xtrriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.33 , 42.7	EDS
L-test for twinning ²	$\langle L \rangle = 0.50$, $\langle L^2 \rangle = 0.33$	Xtrriage
Estimated twinning fraction	No twinning to report.	Xtrriage
F_o, F_c correlation	0.95	EDS
Total number of atoms	2289	wwPDB-VP
Average B, all atoms (Å ²)	21.0	wwPDB-VP

Xtrriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 5.43% of the height of the origin peak. No significant pseudotranslation is detected.*

¹Intensities estimated from amplitudes.

²Theoretical 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: HEM, OXY

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	1.11	0/1079	0.99	1/1469 (0.1%)
2	B	1.16	2/1124 (0.2%)	1.11	4/1519 (0.3%)
All	All	1.13	2/2203 (0.1%)	1.05	5/2988 (0.2%)

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
2	B	0	1
All	All	0	2

All (2) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
2	B	26	GLU	CG-CD	-6.38	1.42	1.51
2	B	26	GLU	CB-CG	5.41	1.62	1.52

All (5) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed($^{\circ}$)	Ideal($^{\circ}$)
2	B	110	LEU	CB-CG-CD2	-11.77	90.99	111.00
2	B	114	ILE	CG1-CB-CG2	-9.71	90.03	111.40
2	B	68	LEU	CA-CB-CG	-9.71	92.97	115.30
1	A	50	PRO	C-N-CA	-6.11	109.47	122.30
2	B	110	LEU	CB-CG-CD1	-6.05	100.72	111.00

There are no chirality outliers.

All (2) planarity outliers are listed below:

Mol	Chain	Res	Type	Group
1	A	137	THR	Peptide
2	B	1	VAL	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	1053	0	1051	11	0
2	B	1099	0	1101	17	0
3	A	43	0	30	3	0
3	B	43	0	30	0	0
4	A	2	0	0	0	0
4	B	2	0	0	0	0
5	A	28	0	0	1	0
5	B	19	0	0	0	0
All	All	2289	0	2212	30	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 7.

All (30) 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)
3:A:201:HEM:C2C	3:A:201:HEM:CMC	1.74	1.66
1:A:138:SER:OG	1:A:139:LYS:N	1.66	1.11
2:B:26:GLU:HG3	2:B:117:HIS:NE2	1.87	0.89
2:B:11:ILE:HD13	2:B:133:VAL:HG21	1.59	0.83
1:A:39:THR:HG22	1:A:97:ASN:HD22	1.49	0.76
2:B:24:GLY:HA2	2:B:68:LEU:HD13	1.68	0.75
1:A:75:ASP:HB3	5:A:156:HOH:O	1.91	0.69
2:B:37:TRP:HE1	2:B:102:ASN:HD21	1.40	0.67
1:A:92:ARG:HH11	1:A:92:ARG:HG3	1.60	0.65
2:B:1:VAL:HG23	2:B:1:VAL:O	2.00	0.61
1:A:135:VAL:O	1:A:138:SER:HB3	2.02	0.60
2:B:11:ILE:HD13	2:B:133:VAL:CG2	2.32	0.54

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
2:B:110:LEU:O	2:B:114:ILE:HG12	2.09	0.53
1:A:65:ALA:HB1	1:A:83:LEU:HD11	1.90	0.51
1:A:30:THR:O	1:A:34:THR:HG23	2.11	0.51
1:A:103:HIS:HE1	2:B:131:GLN:OE1	1.93	0.51
2:B:114:ILE:HD13	2:B:114:ILE:HG21	1.28	0.48
2:B:1:VAL:CG2	2:B:1:VAL:O	2.62	0.47
2:B:11:ILE:CD1	2:B:133:VAL:CG2	2.93	0.46
1:A:39:THR:HG22	1:A:97:ASN:ND2	2.24	0.46
2:B:110:LEU:C	2:B:110:LEU:HD23	2.37	0.45
1:A:66:LEU:O	1:A:70:VAL:HG23	2.16	0.44
2:B:14:LEU:HA	2:B:14:LEU:HD23	1.84	0.44
3:A:201:HEM:HHD	3:A:201:HEM:HAC	1.40	0.44
2:B:99:ASP:HA	2:B:100:PRO:HD3	1.78	0.44
2:B:37:TRP:HE1	2:B:102:ASN:ND2	2.14	0.43
2:B:17:LYS:NZ	2:B:121:GLU:HG2	2.34	0.42
1:A:30:THR:O	1:A:34:THR:CG2	2.67	0.42
2:B:23:ILE:HG22	2:B:68:LEU:HD22	2.00	0.41
3:A:201:HEM:HHC	3:A:201:HEM:HAB	1.43	0.41

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	137/141 (97%)	131 (96%)	5 (4%)	1 (1%)	24	42
2	B	142/146 (97%)	135 (95%)	6 (4%)	1 (1%)	24	42
All	All	279/287 (97%)	266 (95%)	11 (4%)	2 (1%)	24	42

All (2) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	138	SER
2	B	2	HIS

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	115/117 (98%)	107 (93%)	8 (7%)	16	31
2	B	114/117 (97%)	105 (92%)	9 (8%)	13	26
All	All	229/234 (98%)	212 (93%)	17 (7%)	15	29

All (17) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	16	LYS
1	A	34	THR
1	A	50	PRO
1	A	81	SER
1	A	85	ASP
1	A	92	ARG
1	A	109	LEU
1	A	125	LEU
2	B	14	LEU
2	B	17	LYS
2	B	28	LEU
2	B	70	SER
2	B	75	LEU
2	B	81	LEU
2	B	110	LEU
2	B	114	ILE
2	B	120	SER

Some sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (5) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	97	ASN
1	A	103	HIS
2	B	102	ASN
2	B	108	ASN
2	B	139	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 carbohydrates in this entry.

5.6 Ligand geometry [i](#)

4 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
3	HEM	A	201	1,4	27,50,50	3.82	19 (70%)	17,82,82	3.76	10 (58%)
4	OXY	A	301	3	1,1,1	0.15	0	0,0,0	0.00	-
3	HEM	B	401	2,4	27,50,50	1.98	9 (33%)	17,82,82	2.25	6 (35%)
4	OXY	B	501	3	1,1,1	0.23	0	0,0,0	0.00	-

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	HEM	A	201	1,4	-	0/6/54/54	0/0/8/8
4	OXY	A	301	3	-	0/0/0/0	0/0/0/0
3	HEM	B	401	2,4	-	0/6/54/54	0/0/8/8
4	OXY	B	501	3	-	0/0/0/0	0/0/0/0

All (28) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
3	B	401	HEM	C3B-C2B	-3.40	1.35	1.40
3	A	201	HEM	C3B-C2B	-2.64	1.36	1.40
3	B	401	HEM	C3C-C2C	-2.16	1.37	1.40
3	A	201	HEM	C3C-C2C	-2.14	1.37	1.40
3	A	201	HEM	C4B-CHC	2.01	1.45	1.40
3	A	201	HEM	C4A-CHB	2.02	1.45	1.40
3	B	401	HEM	C1B-C2B	2.05	1.47	1.42
3	A	201	HEM	C1B-C2B	2.08	1.47	1.42
3	B	401	HEM	C1D-ND	2.15	1.40	1.36
3	B	401	HEM	CMD-C2D	2.40	1.56	1.51
3	B	401	HEM	CMC-C2C	2.66	1.57	1.51
3	A	201	HEM	C1C-C2C	2.82	1.49	1.42
3	B	401	HEM	C3C-CAC	3.05	1.53	1.47
3	A	201	HEM	C1A-NA	3.11	1.42	1.36
3	A	201	HEM	CBB-CAB	3.12	1.50	1.29
3	A	201	HEM	CMD-C2D	3.36	1.58	1.51
3	A	201	HEM	CBC-CAC	3.42	1.52	1.29
3	A	201	HEM	CAA-C2A	3.81	1.58	1.52
3	B	401	HEM	C3B-CAB	3.93	1.55	1.47
3	A	201	HEM	C3C-CAC	4.06	1.55	1.47
3	A	201	HEM	CAD-C3D	4.15	1.59	1.52
3	A	201	HEM	CMA-C3A	4.53	1.60	1.51
3	B	401	HEM	C3D-C2D	5.15	1.52	1.37
3	A	201	HEM	C1D-ND	5.73	1.48	1.36
3	A	201	HEM	C3B-CAB	5.77	1.59	1.47
3	A	201	HEM	C3D-C2D	6.22	1.56	1.37
3	A	201	HEM	CMB-C2B	6.48	1.66	1.51
3	A	201	HEM	CMC-C2C	9.83	1.74	1.51

All (16) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
3	A	201	HEM	CMA-C3A-C4A	-6.74	118.10	128.46
3	A	201	HEM	CBA-CAA-C2A	-6.00	101.02	112.48
3	A	201	HEM	CAA-CBA-CGA	-4.71	104.62	112.66

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Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
3	B	401	HEM	C1D-C2D-C3D	-3.90	104.28	107.00
3	A	201	HEM	CMD-C2D-C3D	-3.79	117.79	124.94
3	A	201	HEM	CBD-CAD-C3D	-3.33	106.12	112.47
3	B	401	HEM	C3C-C4C-NC	-3.16	104.98	110.94
3	B	401	HEM	CAD-CBD-CGD	-2.81	107.87	112.66
3	A	201	HEM	CAA-C2A-C3A	-2.59	121.60	129.00
3	A	201	HEM	C3C-C4C-NC	-2.56	106.12	110.94
3	B	401	HEM	CBA-CAA-C2A	-2.03	108.61	112.48
3	B	401	HEM	C4A-C3A-C2A	2.33	108.62	107.00
3	A	201	HEM	CMD-C2D-C1D	4.06	134.70	128.46
3	A	201	HEM	CMA-C3A-C2A	5.14	134.64	124.94
3	B	401	HEM	C4C-C3C-C2C	5.43	110.69	106.90
3	A	201	HEM	C4C-C3C-C2C	6.52	111.45	106.90

There are no chirality outliers.

There are no torsion outliers.

There are no ring outliers.

1 monomer is involved in 3 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
3	A	201	HEM	3	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, 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	139/141 (98%)	-0.55	0 100 100	7, 16, 28, 36	0
2	B	144/146 (98%)	-0.38	6 (4%) 36 39	9, 21, 41, 57	0
All	All	283/287 (98%)	-0.46	6 (2%) 63 66	7, 18, 37, 57	0

All (6) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
2	B	93	CYS	3.6
2	B	143	HIS	3.2
2	B	90	GLU	2.9
2	B	1	VAL	2.4
2	B	86	ALA	2.1
2	B	87	LYS	2.1

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 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, 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	RSCC	RSR	B-factors(\AA^2)	Q<0.9
3	HEM	B	401	43/43	0.97	0.10	10,17,37,40	0
3	HEM	A	201	43/43	0.97	0.10	6,12,31,35	0
4	OXY	B	501	2/2	0.99	0.11	24,24,24,26	0
4	OXY	A	301	2/2	1.00	0.12	20,20,20,27	0

6.5 Other polymers [i](#)

There are no such residues in this entry.