



Full wwPDB X-ray Structure Validation Report ⓘ

Jan 31, 2016 – 06:33 PM GMT

PDB ID : 1BEM
Title : INTERACTION BETWEEN PROXIMAL AND DISTALS REGIONS OF
CYTOCHROME C PEROXIDASE
Authors : Kraut, M.A.M.J.
Deposited on : 1998-05-16
Resolution : 2.20 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
<http://wwpdb.org/validation/2016/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 (RC4), CSD as536be (2015)
Xtriage (Phenix) : **NOT EXECUTED**
EDS : **NOT EXECUTED**
Percentile statistics : 20151230.v01 (using entries in the PDB archive December 30th 2015)
Ideal geometry (proteins) : Engh & Huber (2001)
Ideal geometry (DNA, RNA) : Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP) : trunk26865

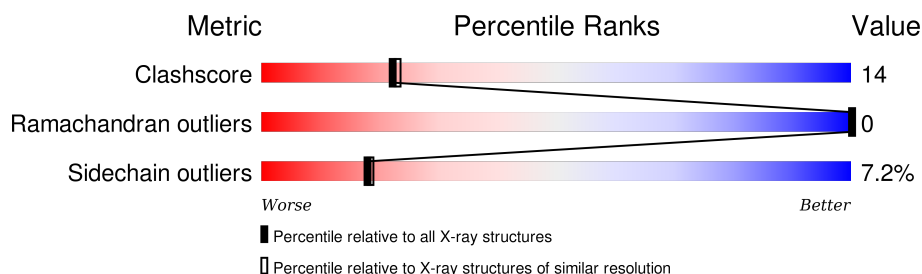
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 2.20 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))
Clashscore	102246	4477 (2.20-2.20)
Ramachandran outliers	100387	4404 (2.20-2.20)
Sidechain outliers	100360	4405 (2.20-2.20)

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.

Note EDS was not executed.

Mol	Chain	Length	Quality of chain
1	A	291	

2 Entry composition [i](#)

There are 4 unique types of molecules in this entry. The entry contains 2515 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 CYTOCHROME C PEROXIDASE.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	291	Total	C	N	O	S	0	0	0
			2304	1473	384	441	6			

There are 4 discrepancies between the modelled and reference sequences:

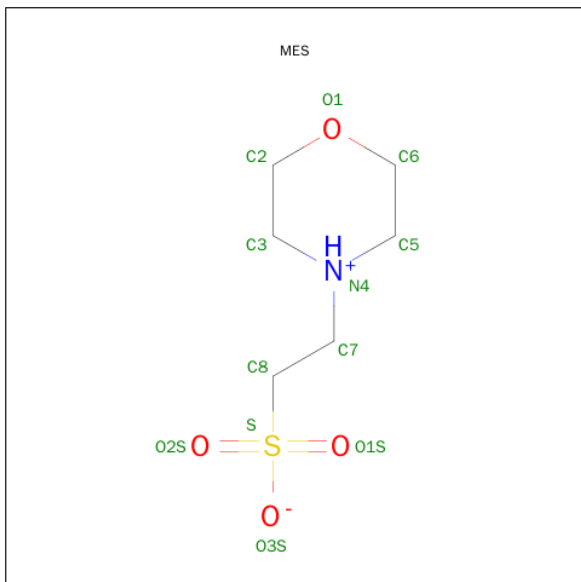
Chain	Residue	Modelled	Actual	Comment	Reference
A	53	ILE	THR	MUTATION	UNP P00431
A	152	GLY	ASP	MUTATION	UNP P00431
A	191	GLN	TRP	MUTATION	UNP P00431
A	272	ASP	ASN	MUTATION	UNP P00431

- Molecule 2 is PROTOPORPHYRIN IX CONTAINING FE (three-letter code: HEM) (formula: $C_{34}H_{32}FeN_4O_4$).



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

- Molecule 3 is 2-(N-MORPHOLINO)-ETHANESULFONIC ACID (three-letter code: MES) (formula: $C_6H_{13}NO_4S$).



Mol	Chain	Residues	Atoms					ZeroOcc	AltConf
3	A	1	Total	C	N	O	S	0	0
			12	6	1	4	1		

- Molecule 4 is water.

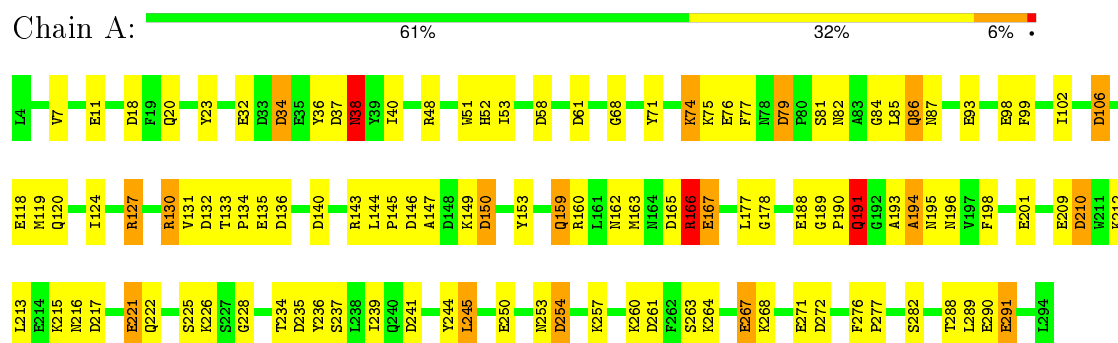
Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
4	A	156	Total	O	0	0
			156	156		

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.

Note EDS was not executed.

• Molecule 1: CYTOCHROME C PEROXIDASE



4 Data and refinement statistics

Xtriage (Phenix) and EDS were not executed - this section will therefore be incomplete.

Property	Value	Source
Space group	P 21 21 21	Depositor
Cell constants a, b, c, α , β , γ	105.10 Å 74.13 Å 45.25 Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	20.00 – 2.20	Depositor
% Data completeness (in resolution range)	90.0 (20.00-2.20)	Depositor
R_{merge}	(Not available)	Depositor
R_{sym}	(Not available)	Depositor
Refinement program	TNT	Depositor
R, R_{free}	0.179 , (Not available)	Depositor
Estimated twinning fraction	No twinning to report.	Xtriage
Total number of atoms	2515	wwPDB-VP
Average B, all atoms (Å ²)	31.0	wwPDB-VP

5 Model quality

5.1 Standard geometry

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

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	0.95	15/2367 (0.6%)	1.45	40/3207 (1.2%)

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	1	5

All (15) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	A	291	GLU	CD-OE1	6.95	1.33	1.25
1	A	290	GLU	CD-OE1	6.21	1.32	1.25
1	A	250	GLU	CD-OE2	6.15	1.32	1.25
1	A	93	GLU	CD-OE2	6.02	1.32	1.25
1	A	32	GLU	CD-OE2	6.01	1.32	1.25
1	A	201	GLU	CD-OE2	5.96	1.32	1.25
1	A	76	GLU	CD-OE1	5.96	1.32	1.25
1	A	209	GLU	CD-OE2	5.95	1.32	1.25
1	A	267	GLU	CD-OE1	5.93	1.32	1.25
1	A	188	GLU	CD-OE1	5.86	1.32	1.25
1	A	11	GLU	CD-OE1	5.52	1.31	1.25
1	A	135	GLU	CD-OE1	5.42	1.31	1.25
1	A	118	GLU	CD-OE1	5.30	1.31	1.25
1	A	167	GLU	CD-OE1	5.23	1.31	1.25
1	A	221	GLU	CD-OE1	5.09	1.31	1.25

All (40) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	130	ARG	NE-CZ-NH1	9.10	124.85	120.30
1	A	132	ASP	CB-CG-OD2	-8.05	111.05	118.30
1	A	132	ASP	CB-CG-OD1	8.03	125.53	118.30
1	A	165	ASP	CB-CG-OD2	-7.96	111.13	118.30
1	A	150	ASP	CB-CG-OD2	-7.93	111.16	118.30
1	A	130	ARG	NE-CZ-NH2	-7.44	116.58	120.30
1	A	254	ASP	CB-CG-OD2	-7.42	111.62	118.30
1	A	150	ASP	CB-CG-OD1	7.34	124.91	118.30
1	A	165	ASP	CB-CG-OD1	7.29	124.86	118.30
1	A	58	ASP	CB-CG-OD2	-7.19	111.83	118.30
1	A	261	ASP	CB-CG-OD1	6.99	124.59	118.30
1	A	58	ASP	CB-CG-OD1	6.99	124.59	118.30
1	A	166	ARG	NE-CZ-NH1	6.84	123.72	120.30
1	A	79	ASP	CB-CG-OD2	-6.81	112.17	118.30
1	A	79	ASP	CB-CG-OD1	6.81	124.43	118.30
1	A	272	ASP	CB-CG-OD2	-6.75	112.23	118.30
1	A	254	ASP	CB-CG-OD1	6.60	124.24	118.30
1	A	34	ASP	CB-CG-OD1	6.59	124.23	118.30
1	A	261	ASP	CB-CG-OD2	-6.54	112.41	118.30
1	A	106	ASP	CB-CG-OD2	-6.54	112.42	118.30
1	A	34	ASP	CB-CG-OD2	-6.43	112.51	118.30
1	A	140	ASP	CB-CG-OD2	-6.35	112.58	118.30
1	A	61	ASP	CB-CG-OD2	-6.26	112.67	118.30
1	A	160	ARG	NE-CZ-NH1	6.12	123.36	120.30
1	A	106	ASP	CB-CG-OD1	6.10	123.79	118.30
1	A	38	ASN	N-CA-CB	5.97	121.34	110.60
1	A	127	ARG	NE-CZ-NH1	5.95	123.28	120.30
1	A	272	ASP	CB-CG-OD1	5.91	123.62	118.30
1	A	235	ASP	CB-CG-OD2	-5.82	113.06	118.30
1	A	217	ASP	CB-CG-OD2	-5.79	113.09	118.30
1	A	18	ASP	CB-CG-OD1	5.72	123.45	118.30
1	A	37	ASP	CB-CG-OD2	-5.67	113.20	118.30
1	A	18	ASP	CB-CG-OD2	-5.63	113.23	118.30
1	A	140	ASP	CB-CG-OD1	5.60	123.34	118.30
1	A	146	ASP	CB-CG-OD1	-5.42	113.42	118.30
1	A	38	ASN	CA-CB-CG	-5.24	101.87	113.40
1	A	162	ASN	CA-CB-CG	-5.22	101.92	113.40
1	A	210	ASP	CB-CA-C	5.14	120.69	110.40
1	A	93	GLU	CB-CA-C	5.13	120.66	110.40
1	A	160	ARG	NE-CZ-NH2	-5.04	117.78	120.30

All (1) chirality outliers are listed below:

Mol	Chain	Res	Type	Atom
1	A	38	ASN	CA

All (5) planarity outliers are listed below:

Mol	Chain	Res	Type	Group
1	A	191	GLN	Peptide
1	A	193	ALA	Mainchain,Peptide
1	A	194	ALA	Mainchain
1	A	196	ASN	Mainchain

5.2 Too-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 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	2304	0	2154	63	0
2	A	43	0	30	1	0
3	A	12	0	13	1	0
4	A	156	0	0	8	0
All	All	2515	0	2197	63	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 14.

All (63) 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:260:LYS:HE3	4:A:731:HOH:O	1.84	0.76
1:A:254:ASP:OD2	1:A:257:LYS:HB2	1.93	0.69
1:A:144:LEU:HB3	1:A:145:PRO:HD2	1.72	0.69
1:A:84:GLY:N	1:A:86:GLN:OE1	2.29	0.65
1:A:149:LYS:HG2	1:A:153:TYR:CG	2.32	0.65
1:A:149:LYS:HG2	1:A:153:TYR:CD2	2.32	0.65
1:A:177:LEU:O	3:A:975:MES:H21	1.99	0.61
1:A:189:GLY:HA2	1:A:190:PRO:O	1.99	0.61
1:A:71:TYR:O	1:A:77:PHE:HB2	2.02	0.59
1:A:124:ILE:HD13	1:A:263:SER:HA	1.85	0.59
1:A:34:ASP:HB2	4:A:335:HOH:O	2.03	0.57

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:127:ARG:O	1:A:130:ARG:NH1	2.36	0.56
1:A:236:TYR:CE1	1:A:239:ILE:HD11	2.41	0.56
1:A:216:ASN:ND2	1:A:222:GLN:OE1	2.32	0.55
1:A:7:VAL:CG1	1:A:277:PRO:HD3	2.37	0.54
1:A:159:GLN:HA	1:A:159:GLN:NE2	2.22	0.54
1:A:163:MET:CE	1:A:268:LYS:HG2	2.37	0.54
1:A:245:LEU:HD22	1:A:245:LEU:O	2.08	0.54
1:A:143:ARG:HB2	4:A:443:HOH:O	2.09	0.53
1:A:7:VAL:HG13	1:A:277:PRO:HD3	1.89	0.53
1:A:226:LYS:HB3	4:A:625:HOH:O	2.08	0.52
1:A:163:MET:HA	1:A:167:GLU:OE1	2.11	0.50
1:A:133:THR:HB	1:A:134:PRO:HD2	1.94	0.50
1:A:38:ASN:ND2	1:A:38:ASN:O	2.40	0.50
1:A:150:ASP:O	1:A:153:TYR:HB3	2.12	0.49
1:A:166:ARG:NH1	1:A:257:LYS:HE3	2.28	0.49
1:A:191:GLN:NE2	1:A:228:GLY:HA2	2.28	0.49
1:A:48:ARG:HD3	1:A:85:LEU:HD21	1.95	0.48
1:A:189:GLY:HA2	1:A:190:PRO:C	2.33	0.48
1:A:86:GLN:H	1:A:86:GLN:CD	2.18	0.47
1:A:144:LEU:HB3	1:A:145:PRO:CD	2.44	0.47
1:A:213:LEU:HD21	1:A:221:GLU:OE1	2.14	0.47
1:A:133:THR:HB	1:A:134:PRO:CD	2.45	0.47
1:A:267:GLU:OE2	1:A:271:GLU:OE2	2.32	0.47
1:A:124:ILE:CD1	1:A:263:SER:HA	2.45	0.46
1:A:241:ASP:HB3	1:A:244:TYR:HB2	1.97	0.46
1:A:237:SER:HB3	4:A:911:HOH:O	2.14	0.46
1:A:52:HIS:HE1	1:A:81:SER:O	1.98	0.46
1:A:191:GLN:HE21	1:A:228:GLY:HA2	1.80	0.45
1:A:134:PRO:HB2	1:A:136:ASP:OD1	2.16	0.45
1:A:213:LEU:HD11	1:A:221:GLU:HB3	1.97	0.45
1:A:236:TYR:O	1:A:239:ILE:HG12	2.17	0.45
1:A:79:ASP:O	1:A:82:ASN:HB2	2.18	0.44
1:A:178:GLY:HA3	2:A:296:HEM:O2D	2.18	0.44
1:A:74:LYS:HA	1:A:74:LYS:HD3	1.35	0.43
1:A:177:LEU:HD11	1:A:198:PHE:CE1	2.54	0.43
1:A:163:MET:HE2	1:A:268:LYS:HG2	2.00	0.42
1:A:147:ALA:O	1:A:234:THR:HG23	2.19	0.42
1:A:159:GLN:HB3	4:A:738:HOH:O	2.19	0.42
1:A:98:GLU:HB3	1:A:99:PHE:CD1	2.55	0.42
1:A:99:PHE:O	1:A:102:ILE:HG22	2.20	0.42
1:A:106:ASP:OD1	1:A:130:ARG:HG3	2.20	0.41

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:40:ILE:HG12	1:A:194:ALA:HB3	2.01	0.41
1:A:119:MET:O	1:A:120:GLN:HB2	2.20	0.41
1:A:289:LEU:HD23	1:A:289:LEU:HA	1.75	0.41
1:A:276:PHE:HA	1:A:277:PRO:HD2	1.85	0.41
1:A:68:GLY:HA2	1:A:131:VAL:O	2.21	0.41
1:A:150:ASP:HB2	4:A:539:HOH:O	2.20	0.41
1:A:53:ILE:HG22	1:A:71:TYR:HB2	2.02	0.40
1:A:48:ARG:HD3	4:A:649:HOH:O	2.22	0.40
1:A:288:THR:N	1:A:291:GLU:OE1	2.46	0.40
1:A:20:GLN:O	1:A:23:TYR:HB3	2.21	0.40
1:A:36:TYR:OH	1:A:87:ASN:ND2	2.54	0.40

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	289/291 (99%)	273 (94%)	16 (6%)	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	236/249 (95%)	219 (93%)	17 (7%)	18	18

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

Mol	Chain	Res	Type
1	A	38	ASN
1	A	51	TRP
1	A	74	LYS
1	A	75	LYS
1	A	86	GLN
1	A	159	GLN
1	A	166	ARG
1	A	191	GLN
1	A	195	ASN
1	A	210	ASP
1	A	212	LYS
1	A	215	LYS
1	A	225	SER
1	A	245	LEU
1	A	253	ASN
1	A	264	LYS
1	A	282	SER

Some sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (7) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	24	ASN
1	A	87	ASN
1	A	141	ASN
1	A	159	GLN
1	A	191	GLN
1	A	208	ASN
1	A	292	GLN

5.3.3 RNA ⓘ

There are no RNA molecules 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

2 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	HEM	A	296	1,4	30,50,50	2.49	10 (33%)	24,82,82	2.93	11 (45%)
3	MES	A	975	-	11,12,12	0.82	1 (9%)	14,16,16	1.92	2 (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
2	HEM	A	296	1,4	-	0/10/54/54	0/0/8/8
3	MES	A	975	-	-	0/6/14/14	0/1/1/1

All (11) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
2	A	296	HEM	C3B-C4B	-7.22	1.45	1.51
2	A	296	HEM	C2D-C3D	-6.44	1.35	1.54
2	A	296	HEM	C3D-C4D	-4.47	1.45	1.51
2	A	296	HEM	C2C-C1C	-4.00	1.45	1.52
2	A	296	HEM	C2B-C1B	-2.11	1.45	1.51
2	A	296	HEM	FE-NC	-2.10	1.87	1.95
2	A	296	HEM	FE-NB	2.04	2.08	1.97
3	A	975	MES	C5-N4	2.10	1.52	1.46
2	A	296	HEM	FE-ND	2.42	2.10	1.97
2	A	296	HEM	CAA-C2A	2.72	1.56	1.52
2	A	296	HEM	C1C-NC	3.60	1.40	1.36

All (13) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
2	A	296	HEM	CAA-C2A-C1A	-6.20	120.27	127.01
3	A	975	MES	O1S-S-C8	-5.29	102.39	106.91
2	A	296	HEM	CMA-C3A-C4A	-3.55	122.48	128.36
2	A	296	HEM	C4B-CHC-C1C	-3.03	120.77	125.82
2	A	296	HEM	CMA-C3A-C2A	2.34	130.14	125.24
2	A	296	HEM	CAD-C3D-C4D	2.54	121.41	112.47
2	A	296	HEM	CAA-CBA-CGA	2.67	117.63	112.75
2	A	296	HEM	CMD-C2D-C3D	2.90	127.17	114.35
2	A	296	HEM	C2D-C3D-C4D	3.44	107.32	101.50
3	A	975	MES	O2S-S-C8	3.65	110.02	106.91
2	A	296	HEM	CMC-C2C-C3C	4.16	126.91	116.53
2	A	296	HEM	CMB-C2B-C3B	5.08	129.21	116.53
2	A	296	HEM	CAD-C3D-C2D	6.24	131.17	113.22

There are no chirality outliers.

There are no torsion outliers.

There are no ring outliers.

2 monomers are involved in 2 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
2	A	296	HEM	1	0
3	A	975	MES	1	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](#)

EDS was not executed - this section will therefore be empty.

6.2 Non-standard residues in protein, DNA, RNA chains [i](#)

EDS was not executed - this section will therefore be empty.

6.3 Carbohydrates [i](#)

EDS was not executed - this section will therefore be empty.

6.4 Ligands [i](#)

EDS was not executed - this section will therefore be empty.

6.5 Other polymers [i](#)

EDS was not executed - this section will therefore be empty.