Full wwPDB X-ray Structure Validation Report (i)

Dec 19, 2023 – 04:18 PM EST

PDB ID	:	1J0O
Title	:	High Resolution Crystal Structure of the wild type Tetraheme Cytochrome c3 from Desulfovibrio vulgaris Miyazaki F
Authors	:	Ozawa, K.; Yasukawa, F.; Kumagai, J.; Ohmura, T.; Cusanvich, M.A.; Tomimoto, Y.; Ogata, H.; Higuchi, Y.; Akutsu, H.
Deposited on	:	2002-11-19
Resolution	:	1.15 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 (i) symbol.

The types of validation reports are described at
http://www.wwpdb.org/validation/2017/FAQs#types.

The following versions of software and data (see references (1)) were used in the production of this report:

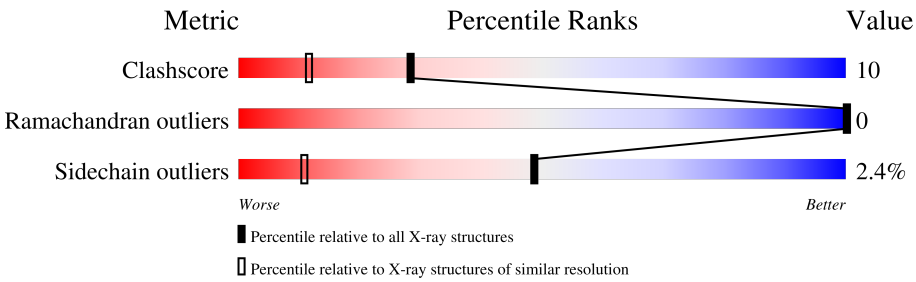
MolProbity	:	4.02b-467
Mogul	:	1.8.5 (274361), CSD as541be (2020)
Xtriage (Phenix)	:	NOT EXECUTED
EDS	:	NOT EXECUTED
buster-report	:	1.1.7 (2018)
Percentile statistics	:	20191225.v01 (using entries in the PDB archive December 25th 2019)
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, RNA)	:	Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP)	:	2.36

1 Overall quality at a glance (i)

The following experimental techniques were used to determine the structure:
X-RAY DIFFRACTION

The reported resolution of this entry is 1.15 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	141614	1537 (1.18-1.10)
Ramachandran outliers	138981	1483 (1.18-1.10)
Sidechain outliers	138945	1480 (1.18-1.10)

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 >=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 <=5%

Note EDS was not executed.

Mol	Chain	Length	Quality of chain
1	A	107	86% 12% •

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
3	EOH	A	2004	-	-	X	-
3	EOH	A	2006	-	-	X	-
3	EOH	A	2007	-	-	X	-

2 Entry composition (i)

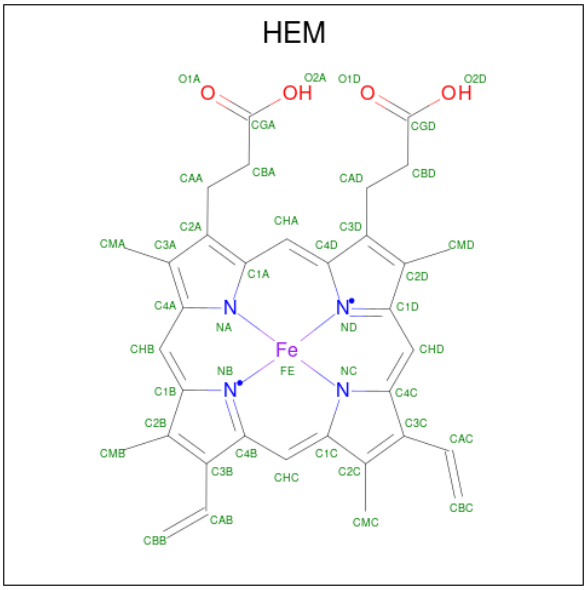
There are 4 unique types of molecules in this entry. The entry contains 1342 atoms, of which 0 are hydrogens and 0 are deuteriums.

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 c3.

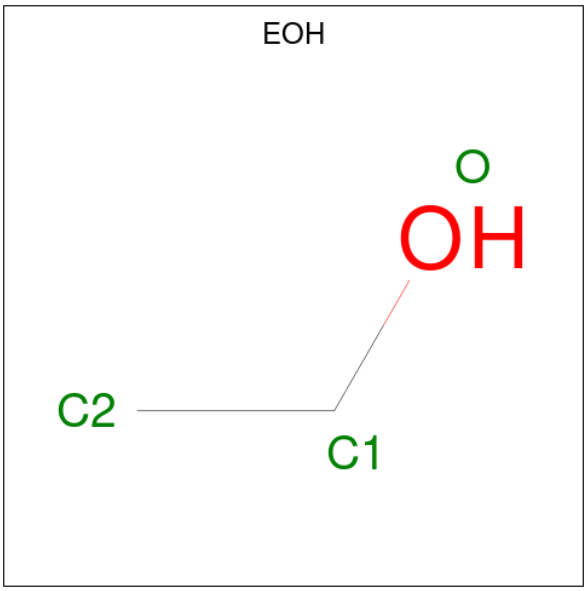
Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
1	A	107	801	489	150	151	11	0	0	0

- 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
			Total	C	Fe	N	O		
2	A	1	43	34	1	4	4	0	0
			Total	C	Fe	N	O		
2	A	1	43	34	1	4	4	0	0
			Total	C	Fe	N	O		
2	A	1	43	34	1	4	4	0	0
			Total	C	Fe	N	O		
2	A	1	43	34	1	4	4	0	0

- Molecule 3 is ETHANOL (three-letter code: EOH) (formula: C_2H_6O).



Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
			Total	C	O		
3	A	1	3	2	1	0	0
			Total	C	O		
3	A	1	3	2	1	0	0
			Total	C	O		
3	A	1	3	2	1	0	0
			Total	C	O		
3	A	1	3	2	1	0	0
			Total	C	O		
3	A	1	3	2	1	0	0
			Total	C	O		
3	A	1	3	2	1	0	0
			Total	C	O		
3	A	1	3	2	1	0	0
			Total	C	O		
3	A	1	3	2	1	0	0

- Molecule 4 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
			Total	O		
4	A	345	345	345	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. 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. 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 c3

Chain A:

4 Data and refinement statistics (i)

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

Property	Value	Source
Space group	P 21 21 21	Depositor
Cell constants a, b, c, α, β, γ	52.34Å 67.35Å 34.09Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	10.00 – 1.15	Depositor
% Data completeness (in resolution range)	89.4 (10.00-1.15)	Depositor
R_{merge}	0.06	Depositor
R_{sym}	(Not available)	Depositor
Refinement program	CNS, SHELXL-97	Depositor
R, R_{free}	0.101 , 0.167	Depositor
Estimated twinning fraction	No twinning to report.	Xtriage
Total number of atoms	1342	wwPDB-VP
Average B, all atoms (Å^2)	23.0	wwPDB-VP

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, EOH

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	0.80	1/818 (0.1%)	1.30	6/1089 (0.6%)

All (1) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	A	107	SER	C-OXT	5.11	1.33	1.23

All (6) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(^{o})	Ideal(^{o})
1	A	29	LYS	CA-CB-CG	7.48	129.85	113.40
1	A	3	LYS	CA-CB-CG	7.37	129.61	113.40
1	A	12	ASP	CB-CG-OD1	5.52	123.27	118.30
1	A	65	TYR	CB-CG-CD1	5.39	124.23	121.00
1	A	6	ALA	N-CA-CB	5.16	117.32	110.10
1	A	65	TYR	CD1-CG-CD2	-5.14	112.24	117.90

There are no chirality outliers.

There are no planarity outliers.

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	801	0	780	11	0

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Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
2	A	172	0	120	3	0
3	A	24	0	48	10	0
4	A	345	0	0	13	0
All	All	1342	0	948	19	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 10.

All (19) 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)
2:A:1001:HEM:O2D	3:A:2004:EOH:H22	1.73	0.88
3:A:2003:EOH:H12	4:A:3182:HOH:O	1.84	0.77
1:A:29:LYS:HB3	4:A:3188:HOH:O	1.85	0.76
1:A:61:SER:HB2	4:A:3045:HOH:O	1.87	0.75
3:A:2007:EOH:H22	4:A:3198:HOH:O	1.97	0.64
1:A:3:LYS:HD2	4:A:3137:HOH:O	2.00	0.61
1:A:47:ALA:H	3:A:2004:EOH:H21	1.66	0.61
1:A:94:LYS:HD2	4:A:3260:HOH:O	2.01	0.60
2:A:1001:HEM:HBA1	4:A:3307:HOH:O	2.03	0.59
1:A:10:LYS:HE2	4:A:3230:HOH:O	2.04	0.57
1:A:47:ALA:O	3:A:2007:EOH:H21	2.09	0.53
3:A:2005:EOH:H12	4:A:3131:HOH:O	2.11	0.49
1:A:95:LYS:NZ	1:A:101:LYS:O	2.48	0.47
1:A:13:LYS:NZ	4:A:3198:HOH:O	2.49	0.46
1:A:100:CYS:SG	3:A:2008:EOH:H11	2.56	0.45
1:A:72:LYS:NZ	4:A:3220:HOH:O	2.50	0.45
2:A:1004:HEM:CHB	3:A:2001:EOH:H21	2.48	0.44
3:A:2006:EOH:H21	4:A:3285:HOH:O	2.20	0.42
3:A:2006:EOH:H11	4:A:3238:HOH:O	2.21	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	105/107 (98%)	103 (98%)	2 (2%)	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	85/85 (100%)	83 (98%)	2 (2%)	49 11

All (2) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	3	LYS
1	A	29	LYS

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. There are no such sidechains identified.

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)

12 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	1004	1	41,50,50	1.37	5 (12%)	45,82,82	1.60	8 (17%)
2	HEM	A	1002	1	41,50,50	1.42	4 (9%)	45,82,82	1.74	10 (22%)
3	EOH	A	2004	-	2,2,2	0.30	0	1,1,1	0.63	0
3	EOH	A	2003	-	2,2,2	0.49	0	1,1,1	0.08	0
3	EOH	A	2006	-	2,2,2	0.52	0	1,1,1	0.54	0
2	HEM	A	1001	1	41,50,50	1.46	6 (14%)	45,82,82	2.34	17 (37%)
3	EOH	A	2008	-	2,2,2	0.50	0	1,1,1	0.03	0
3	EOH	A	2002	-	2,2,2	0.45	0	1,1,1	0.36	0
3	EOH	A	2005	-	2,2,2	0.55	0	1,1,1	0.07	0
3	EOH	A	2001	-	2,2,2	0.45	0	1,1,1	0.87	0
2	HEM	A	1003	1	41,50,50	1.41	3 (7%)	45,82,82	1.93	12 (26%)
3	EOH	A	2007	-	2,2,2	0.42	0	1,1,1	0.08	0

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	1001	1	-	5/12/54/54	-
2	HEM	A	1004	1	-	6/12/54/54	-
2	HEM	A	1002	1	-	4/12/54/54	-
2	HEM	A	1003	1	-	5/12/54/54	-

All (18) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
2	A	1002	HEM	CBB-CAB	3.97	1.50	1.30
2	A	1003	HEM	CBB-CAB	3.96	1.49	1.30

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Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
2	A	1003	HEM	C1B-NB	-3.84	1.33	1.40
2	A	1004	HEM	CBB-CAB	3.83	1.49	1.30
2	A	1001	HEM	CBB-CAB	3.70	1.48	1.30
2	A	1002	HEM	C1B-NB	-3.68	1.34	1.40
2	A	1001	HEM	O2D-CGD	-2.90	1.21	1.30
2	A	1004	HEM	C4D-ND	-2.89	1.35	1.40
2	A	1004	HEM	C1B-NB	-2.67	1.35	1.40
2	A	1002	HEM	CBC-CAC	2.66	1.46	1.29
2	A	1004	HEM	CBC-CAC	2.66	1.46	1.29
2	A	1001	HEM	CBC-CAC	2.63	1.46	1.29
2	A	1001	HEM	C4D-ND	-2.62	1.35	1.40
2	A	1002	HEM	C4D-ND	-2.61	1.35	1.40
2	A	1001	HEM	C1B-NB	-2.19	1.36	1.40
2	A	1004	HEM	O2A-CGA	-2.09	1.23	1.30
2	A	1003	HEM	FE-NB	2.05	2.07	1.96
2	A	1001	HEM	FE-NB	2.04	2.07	1.96

All (47) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(^{o})	Ideal(^{o})
2	A	1001	HEM	C4B-CHC-C1C	6.20	130.74	122.56
2	A	1001	HEM	C4D-ND-C1D	5.40	110.65	105.07
2	A	1003	HEM	C4B-CHC-C1C	5.29	129.54	122.56
2	A	1001	HEM	C4C-CHD-C1D	4.92	129.04	122.56
2	A	1002	HEM	C4C-CHD-C1D	4.91	129.04	122.56
2	A	1001	HEM	C3B-C2B-C1B	4.70	109.97	106.49
2	A	1003	HEM	C4C-CHD-C1D	4.70	128.76	122.56
2	A	1001	HEM	CMA-C3A-C4A	-4.67	121.28	128.46
2	A	1004	HEM	C2C-C3C-C4C	-4.66	103.64	106.90
2	A	1002	HEM	CAD-CBD-CGD	4.64	123.58	113.60
2	A	1004	HEM	C4B-CHC-C1C	4.29	128.22	122.56
2	A	1003	HEM	C2C-C3C-C4C	-3.93	104.15	106.90
2	A	1002	HEM	CMA-C3A-C4A	-3.83	122.58	128.46
2	A	1001	HEM	C2C-C3C-C4C	-3.59	104.39	106.90
2	A	1002	HEM	C4B-CHC-C1C	3.54	127.23	122.56
2	A	1004	HEM	C4C-CHD-C1D	3.51	127.19	122.56
2	A	1003	HEM	C1B-NB-C4B	3.47	108.65	105.07
2	A	1001	HEM	C3D-C4D-ND	-3.41	106.38	110.17
2	A	1002	HEM	C1B-NB-C4B	3.25	108.44	105.07
2	A	1004	HEM	C4D-ND-C1D	3.21	108.39	105.07
2	A	1003	HEM	CMA-C3A-C4A	-3.16	123.60	128.46
2	A	1002	HEM	CMA-C3A-C2A	3.16	130.90	124.94

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Mol	Chain	Res	Type	Atoms	Z	Observed(^{o})	Ideal(^{o})
2	A	1003	HEM	C4D-ND-C1D	3.15	108.33	105.07
2	A	1001	HEM	C1B-NB-C4B	3.10	108.28	105.07
2	A	1001	HEM	CMA-C3A-C2A	3.07	130.73	124.94
2	A	1003	HEM	O2D-CGD-CBD	3.04	123.80	114.03
2	A	1003	HEM	CMC-C2C-C3C	2.91	130.13	124.68
2	A	1001	HEM	CMC-C2C-C3C	2.91	130.12	124.68
2	A	1002	HEM	C4D-ND-C1D	2.82	107.98	105.07
2	A	1001	HEM	CMB-C2B-C1B	-2.70	120.93	125.04
2	A	1004	HEM	CBB-CAB-C3B	-2.55	114.91	127.62
2	A	1001	HEM	C4B-C3B-C2B	-2.54	105.09	107.11
2	A	1004	HEM	CMA-C3A-C4A	-2.47	124.66	128.46
2	A	1003	HEM	O1A-CGA-CBA	-2.46	115.19	123.08
2	A	1002	HEM	C2C-C3C-C4C	-2.42	105.21	106.90
2	A	1004	HEM	CHC-C4B-C3B	2.35	128.17	124.57
2	A	1002	HEM	CMC-C2C-C3C	2.30	128.98	124.68
2	A	1002	HEM	CBB-CAB-C3B	-2.27	116.33	127.62
2	A	1003	HEM	O1D-CGD-CBD	-2.24	115.89	123.08
2	A	1001	HEM	CHD-C1D-ND	2.24	126.86	124.43
2	A	1003	HEM	CBB-CAB-C3B	-2.23	116.55	127.62
2	A	1001	HEM	O1A-CGA-CBA	-2.22	115.95	123.08
2	A	1001	HEM	O2A-CGA-CBA	2.19	121.08	114.03
2	A	1001	HEM	CBB-CAB-C3B	-2.18	116.75	127.62
2	A	1003	HEM	CMA-C3A-C2A	2.11	128.92	124.94
2	A	1004	HEM	CHC-C4B-NB	-2.10	122.14	124.43
2	A	1001	HEM	C2B-C1B-NB	-2.06	107.40	109.84

There are no chirality outliers.

All (20) torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
2	A	1004	HEM	C2B-C3B-CAB-CBB
2	A	1004	HEM	C4B-C3B-CAB-CBB
2	A	1001	HEM	C2B-C3B-CAB-CBB
2	A	1002	HEM	C2B-C3B-CAB-CBB
2	A	1001	HEM	C4B-C3B-CAB-CBB
2	A	1003	HEM	C2B-C3B-CAB-CBB
2	A	1001	HEM	CAA-CBA-CGA-O1A
2	A	1003	HEM	CAA-CBA-CGA-O1A
2	A	1001	HEM	CAA-CBA-CGA-O2A
2	A	1004	HEM	CAD-CBD-CGD-O2D
2	A	1002	HEM	CAD-CBD-CGD-O1D
2	A	1003	HEM	CAA-CBA-CGA-O2A

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Mol	Chain	Res	Type	Atoms
2	A	1004	HEM	CAA-CBA-CGA-O2A
2	A	1002	HEM	C4B-C3B-CAB-CBB
2	A	1003	HEM	C4B-C3B-CAB-CBB
2	A	1004	HEM	CAD-CBD-CGD-O1D
2	A	1002	HEM	CAD-CBD-CGD-O2D
2	A	1004	HEM	CAA-CBA-CGA-O1A
2	A	1003	HEM	CAD-CBD-CGD-O1D
2	A	1001	HEM	CAD-CBD-CGD-O1D

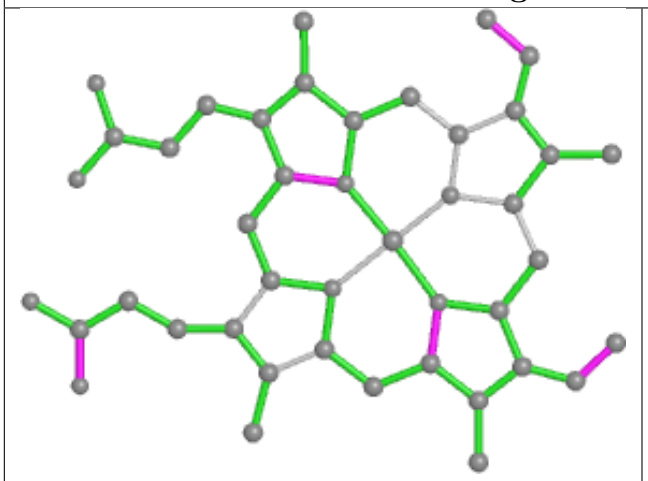
There are no ring outliers.

9 monomers are involved in 11 short contacts:

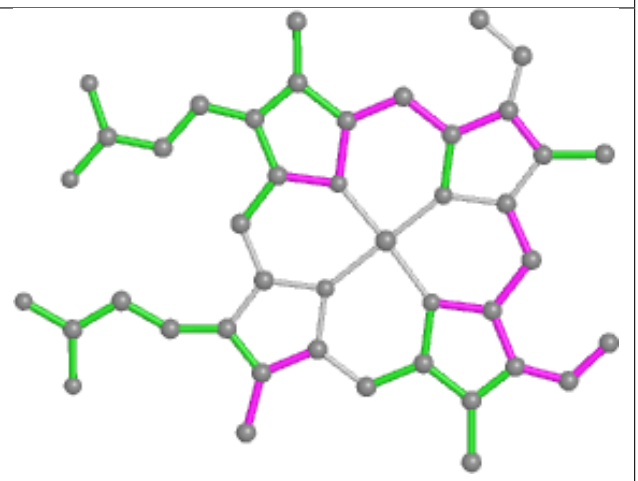
Mol	Chain	Res	Type	Clashes	Symm-Clashes
2	A	1004	HEM	1	0
3	A	2004	EOH	2	0
3	A	2003	EOH	1	0
3	A	2006	EOH	2	0
2	A	1001	HEM	2	0
3	A	2008	EOH	1	0
3	A	2005	EOH	1	0
3	A	2001	EOH	1	0
3	A	2007	EOH	2	0

The following is a two-dimensional graphical depiction of Mogul quality analysis of bond lengths, bond angles, torsion angles, and ring geometry for all instances of the Ligand of Interest. In addition, ligands with molecular weight > 250 and outliers as shown on the validation Tables will also be included. For torsion angles, if less then 5% of the Mogul distribution of torsion angles is within 10 degrees of the torsion angle in question, then that torsion angle is considered an outlier. Any bond that is central to one or more torsion angles identified as an outlier by Mogul will be highlighted in the graph. For rings, the root-mean-square deviation (RMSD) between the ring in question and similar rings identified by Mogul is calculated over all ring torsion angles. If the average RMSD is greater than 60 degrees and the minimal RMSD between the ring in question and any Mogul-identified rings is also greater than 60 degrees, then that ring is considered an outlier. The outliers are highlighted in purple. The color gray indicates Mogul did not find sufficient equivalents in the CSD to analyse the geometry.

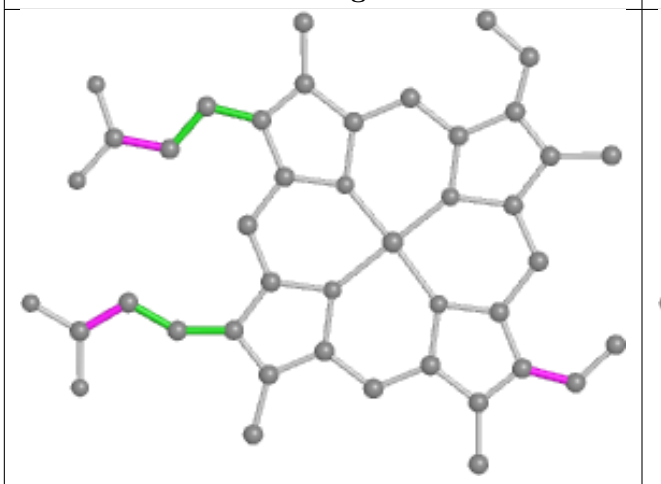
Ligand HEM A 1004



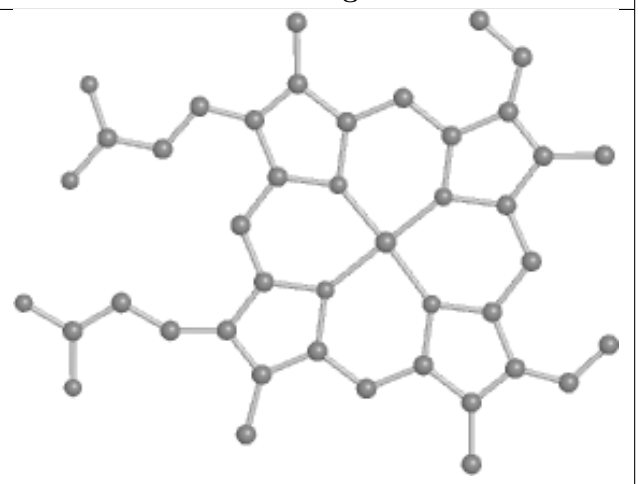
Bond lengths



Bond angles

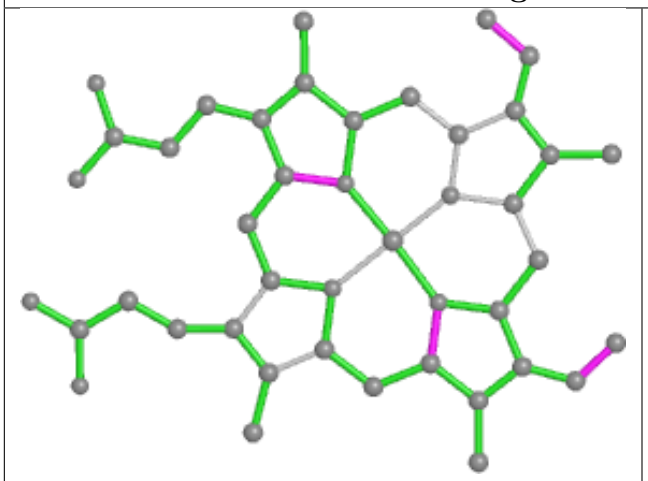


Torsions

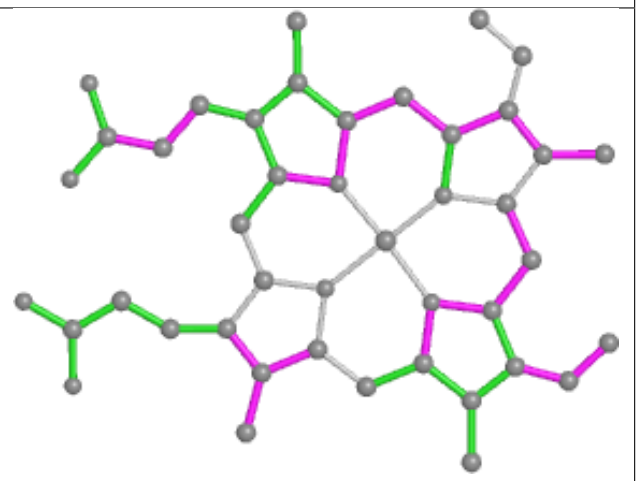


Rings

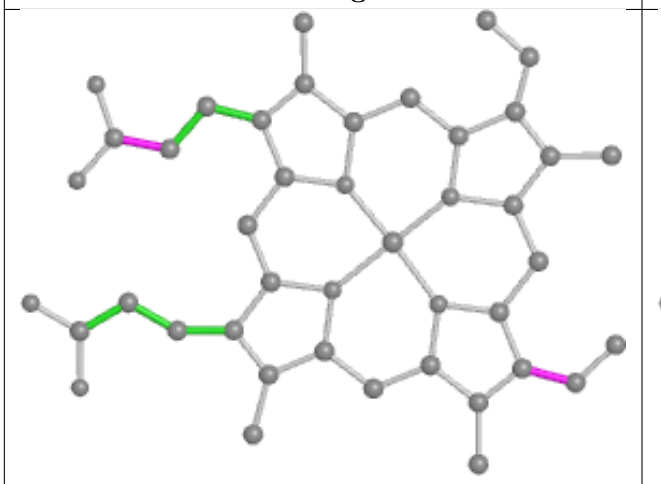
Ligand HEM A 1002



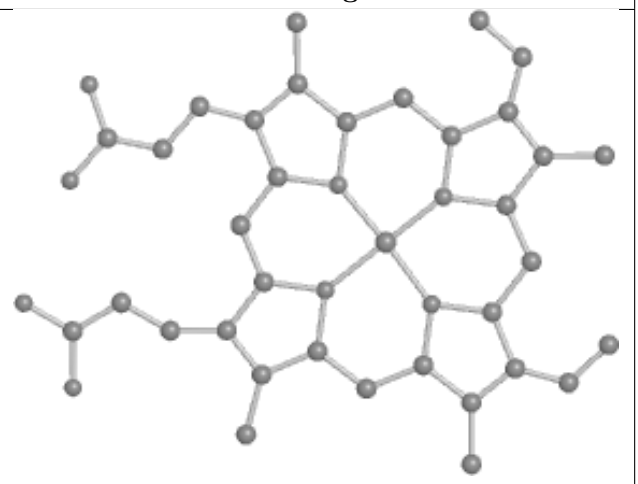
Bond lengths



Bond angles

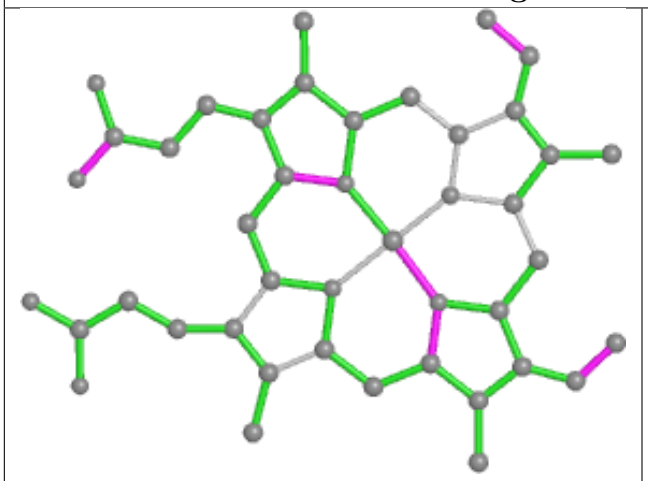


Torsions

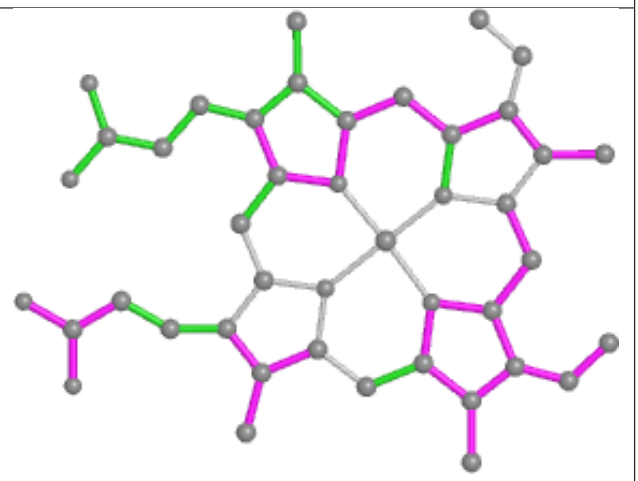


Rings

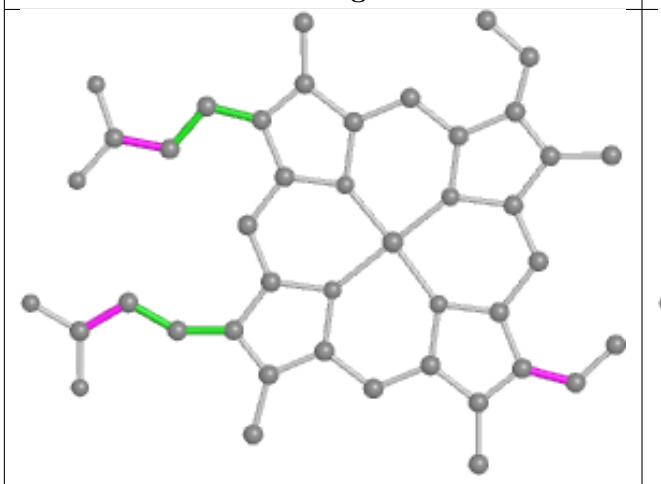
Ligand HEM A 1001



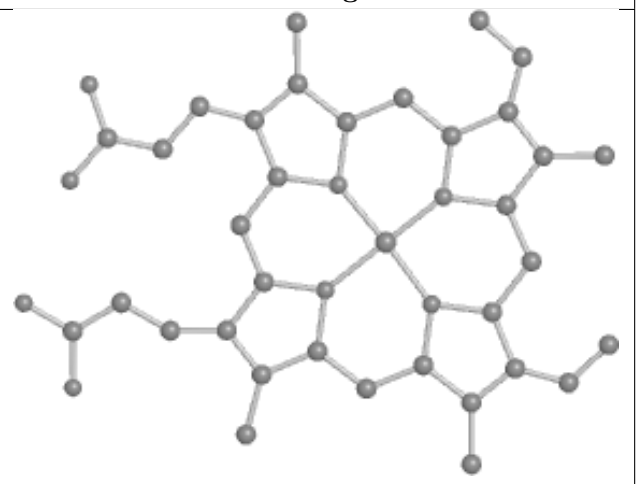
Bond lengths



Bond angles

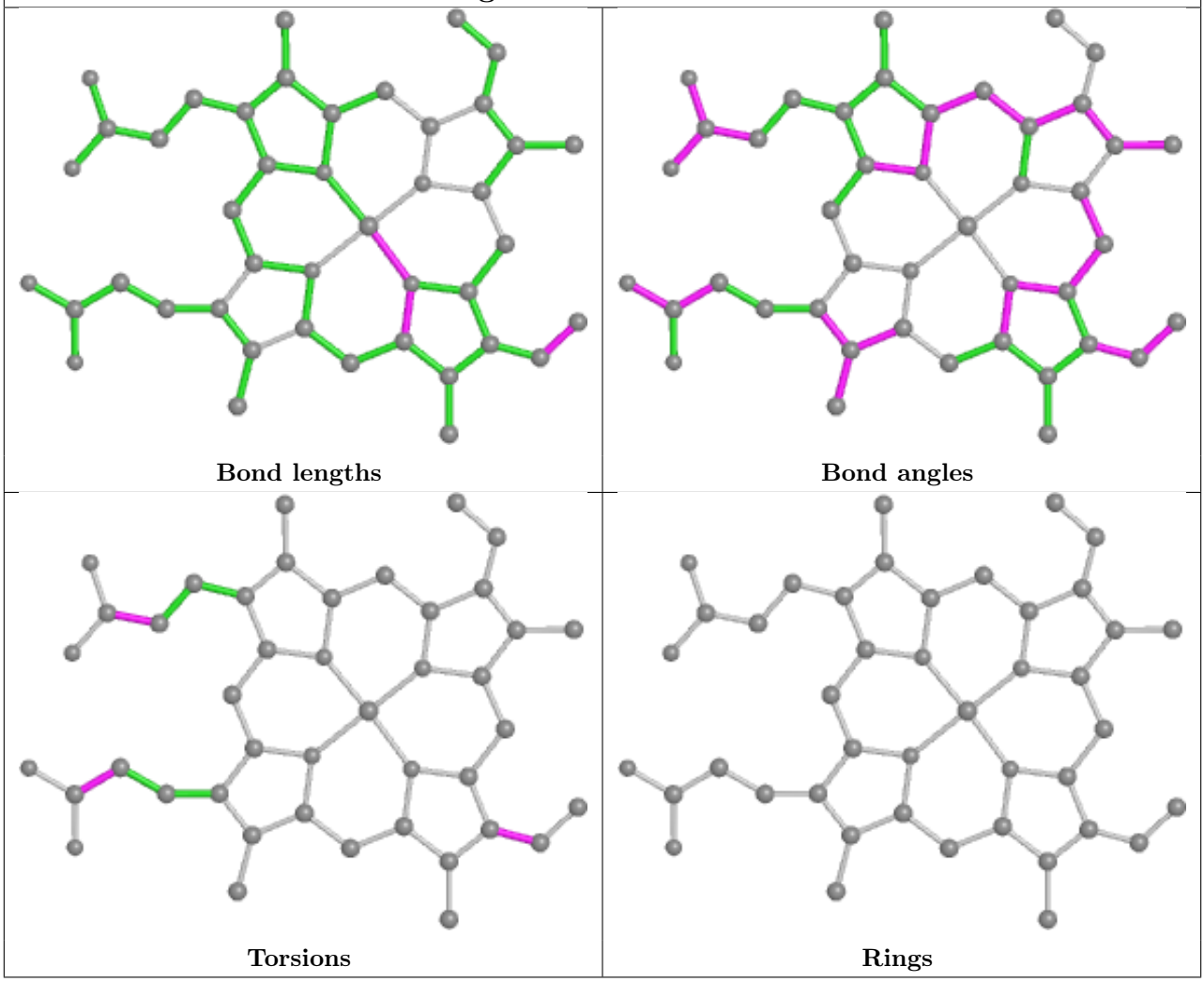


Torsions



Rings

Ligand HEM A 1003



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 is therefore empty.

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

EDS was not executed - this section is therefore empty.

6.3 Carbohydrates (i)

EDS was not executed - this section is therefore empty.

6.4 Ligands (i)

EDS was not executed - this section is therefore empty.

6.5 Other polymers (i)

EDS was not executed - this section is therefore empty.