



Full wwPDB X-ray Structure Validation Report ⓘ

May 19, 2020 – 12:50 pm BST

PDB ID : 1EBE
Title : Laue diffraction study on the structure of cytochrome c peroxidase compound I
Authors : Fulop, V.; Phizackerley, R.P.; Soltis, S.M.; Clifton, I.J.; Wakatsuki, S.; Erman, J.E.; Hajdu, J.; Edwards, S.L.
Deposited on : 2001-07-25
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

<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 : 1.8.5 (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) : 2.11

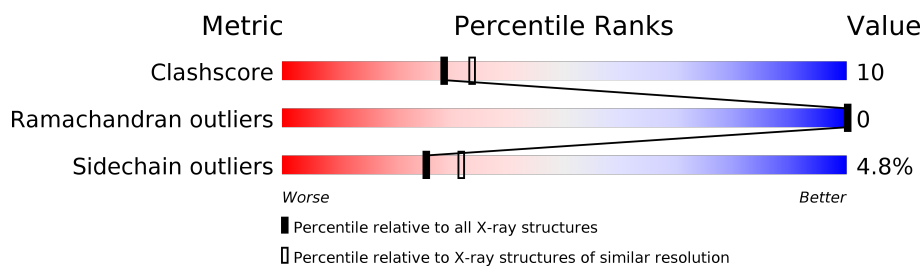
1 Overall quality at a glance

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	141614	5594 (2.20-2.20)
Ramachandran outliers	138981	5503 (2.20-2.20)
Sidechain outliers	138945	5504 (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 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 $\leq 5\%$.

Note EDS was not executed.

Mol	Chain	Length	Quality of chain
1	A	294	 71% 25% . .

2 Entry composition [i](#)

There are 4 unique types of molecules in this entry. The entry contains 2603 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	293	Total	C	N	O	S	0	0	0
			2298	1473	377	442	6			

There is a discrepancy between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	272	ASP	ASN	conflict	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 OXYGEN ATOM (three-letter code: O) (formula: O).

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

- Molecule 4 is water.

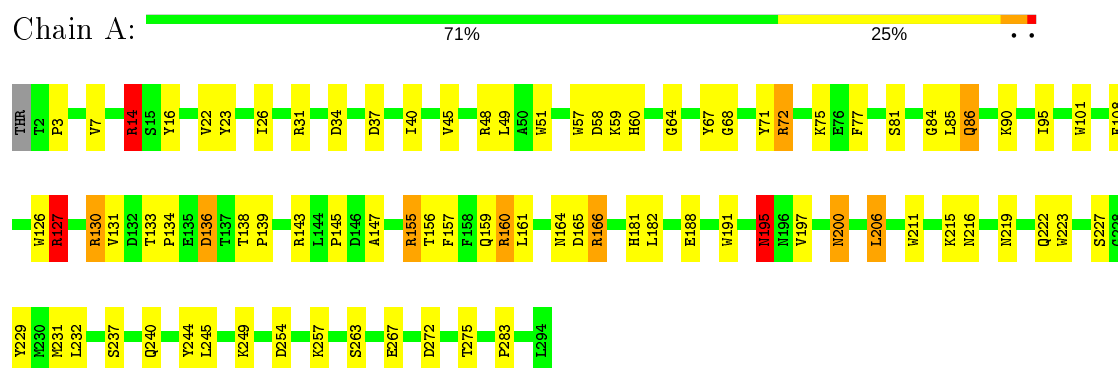
Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
4	A	261	Total 261	O 261	0	0

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. 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 C PEROXIDASE



4 Data and refinement statistics

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	107.40 Å 76.80 Å 51.40 Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	8.00 – 2.20	Depositor
% Data completeness (in resolution range)	42.0 (8.00-2.20)	Depositor
R_{merge}	0.09	Depositor
R_{sym}	(Not available)	Depositor
Refinement program	X-PLOR 3.1	Depositor
R, R_{free}	0.144 , (Not available)	Depositor
Estimated twinning fraction	No twinning to report.	Xtriage
Total number of atoms	2603	wwPDB-VP
Average B, all atoms (Å ²)	32.0	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, O

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	0.96	0/2365	1.83	54/3215 (1.7%)

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

There are no bond length outliers.

All (54) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	155	ARG	NE-CZ-NH1	-20.21	110.19	120.30
1	A	155	ARG	NE-CZ-NH2	18.09	129.35	120.30
1	A	14	ARG	NE-CZ-NH2	17.61	129.10	120.30
1	A	31	ARG	NE-CZ-NH1	-15.42	112.59	120.30
1	A	14	ARG	NE-CZ-NH1	-14.06	113.27	120.30
1	A	130	ARG	NE-CZ-NH2	12.27	126.44	120.30
1	A	160	ARG	NE-CZ-NH2	11.34	125.97	120.30
1	A	166	ARG	NE-CZ-NH1	-11.09	114.76	120.30
1	A	127	ARG	NE-CZ-NH2	10.97	125.79	120.30
1	A	72	ARG	NE-CZ-NH2	9.62	125.11	120.30
1	A	130	ARG	NE-CZ-NH1	-9.04	115.78	120.30
1	A	143	ARG	NE-CZ-NH1	-8.80	115.90	120.30
1	A	51	TRP	CD1-CG-CD2	8.79	113.33	106.30
1	A	143	ARG	NE-CZ-NH2	8.56	124.58	120.30
1	A	101	TRP	CE2-CD2-CG	-8.50	100.50	107.30
1	A	229	TYR	CB-CG-CD1	-8.35	115.99	121.00

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Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	57	TRP	CD1-CG-CD2	8.33	112.96	106.30
1	A	191	TRP	CD1-CG-CD2	8.24	112.89	106.30
1	A	223	TRP	CD1-CG-CD2	7.95	112.66	106.30
1	A	211	TRP	CD1-CG-CD2	7.87	112.60	106.30
1	A	51	TRP	CB-CG-CD1	-7.87	116.77	127.00
1	A	191	TRP	CE2-CD2-CG	-7.68	101.16	107.30
1	A	51	TRP	CE2-CD2-CG	-7.49	101.31	107.30
1	A	223	TRP	CE2-CD2-CG	-7.47	101.32	107.30
1	A	101	TRP	CD1-CG-CD2	7.46	112.27	106.30
1	A	160	ARG	NE-CZ-NH1	-7.40	116.60	120.30
1	A	126	TRP	CD1-CG-CD2	7.29	112.13	106.30
1	A	127	ARG	NE-CZ-NH1	-7.25	116.67	120.30
1	A	126	TRP	CE2-CD2-CG	-7.13	101.60	107.30
1	A	166	ARG	NE-CZ-NH2	6.94	123.77	120.30
1	A	16	TYR	CB-CG-CD1	-6.84	116.90	121.00
1	A	57	TRP	CG-CD1-NE1	-6.64	103.46	110.10
1	A	22	VAL	CG1-CB-CG2	-6.61	100.33	110.90
1	A	127	ARG	CB-CG-CD	-6.51	94.68	111.60
1	A	57	TRP	CE2-CD2-CG	-6.25	102.30	107.30
1	A	206	LEU	CA-CB-CG	6.21	129.57	115.30
1	A	31	ARG	NE-CZ-NH2	6.00	123.30	120.30
1	A	101	TRP	CG-CD2-CE3	5.99	139.29	133.90
1	A	166	ARG	CG-CD-NE	-5.89	99.43	111.80
1	A	161	LEU	CA-CB-CG	5.77	128.57	115.30
1	A	211	TRP	CE2-CD2-CG	-5.74	102.71	107.30
1	A	263	SER	N-CA-CB	-5.55	102.18	110.50
1	A	51	TRP	CG-CD1-NE1	-5.53	104.57	110.10
1	A	223	TRP	CG-CD2-CE3	5.50	138.85	133.90
1	A	191	TRP	CG-CD2-CE3	5.39	138.75	133.90
1	A	72	ARG	NE-CZ-NH1	-5.35	117.62	120.30
1	A	254	ASP	CB-CG-OD1	5.30	123.07	118.30
1	A	191	TRP	CB-CG-CD1	-5.29	120.12	127.00
1	A	267	GLU	CA-CB-CG	-5.27	101.81	113.40
1	A	136	ASP	CB-CG-OD1	5.24	123.02	118.30
1	A	272	ASP	CB-CG-OD1	5.20	122.98	118.30
1	A	195	ASN	CB-CA-C	-5.17	100.06	110.40
1	A	23	TYR	CB-CG-CD1	-5.10	117.94	121.00
1	A	3	PRO	N-CA-CB	5.07	109.39	103.30

There are no chirality outliers.

All (1) planarity outliers are listed below:

Mol	Chain	Res	Type	Group
1	A	244	TYR	Sidechain

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	2298	0	2086	43	0
2	A	43	0	30	0	0
3	A	1	0	0	0	0
4	A	261	0	0	5	0
All	All	2603	0	2116	43	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 (43) 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:216:ASN:HD22	1:A:222:GLN:HE21	1.34	0.73
1:A:127:ARG:HD2	1:A:283:PRO:HG3	1.69	0.72
1:A:188:GLU:H	1:A:222:GLN:HE22	1.39	0.70
1:A:182:LEU:HD13	1:A:188:GLU:HB2	1.74	0.70
1:A:84:GLY:H	1:A:86:GLN:HE22	1.42	0.68
1:A:26:ILE:HG13	1:A:95:ILE:HD13	1.75	0.68
1:A:67:TYR:HA	1:A:130:ARG:HG2	1.77	0.66
1:A:49:LEU:HD13	1:A:85:LEU:HB3	1.78	0.65
1:A:206:LEU:HD13	1:A:231:MET:SD	2.38	0.63
1:A:155:ARG:HD3	1:A:165:ASP:OD1	2.04	0.58
1:A:49:LEU:HD12	1:A:85:LEU:HD13	1.89	0.55
1:A:68:GLY:HA2	1:A:131:VAL:O	2.08	0.54
1:A:215:LYS:HE3	1:A:219:ASN:CG	2.27	0.53
1:A:245:LEU:O	1:A:249:LYS:HG3	2.10	0.52
1:A:86:GLN:H	1:A:86:GLN:NE2	2.10	0.50
1:A:86:GLN:HG2	4:A:2097:HOH:O	2.11	0.50
1:A:34:ASP:HB2	4:A:2038:HOH:O	2.11	0.50
1:A:68:GLY:O	1:A:72:ARG:NH1	2.46	0.49
1:A:237:SER:HA	1:A:240:GLN:OE1	2.12	0.49

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:14:ARG:HD3	4:A:2009:HOH:O	2.12	0.49
1:A:164:ASN:HB2	4:A:2162:HOH:O	2.13	0.48
1:A:127:ARG:O	1:A:130:ARG:NH1	2.46	0.48
1:A:26:ILE:CG1	1:A:95:ILE:HD13	2.41	0.48
1:A:275:THR:HA	4:A:2245:HOH:O	2.13	0.47
1:A:75:LYS:HB3	1:A:138:THR:HG21	1.96	0.47
1:A:58:ASP:HA	1:A:160:ARG:HD3	1.96	0.47
1:A:147:ALA:HB1	1:A:232:LEU:HD22	1.97	0.47
1:A:64:GLY:HA2	1:A:139:PRO:HG3	1.97	0.47
1:A:14:ARG:HD2	1:A:14:ARG:N	2.30	0.46
1:A:145:PRO:HD3	1:A:157:PHE:CZ	2.51	0.46
1:A:200:ASN:N	1:A:200:ASN:HD22	2.14	0.45
1:A:134:PRO:HB2	1:A:136:ASP:OD1	2.17	0.45
1:A:59:LYS:HE3	1:A:60:HIS:CE1	2.52	0.45
1:A:48:ARG:HB3	1:A:85:LEU:HD21	1.99	0.44
1:A:195:ASN:H	1:A:195:ASN:HD22	1.67	0.43
1:A:84:GLY:N	1:A:86:GLN:HE22	2.12	0.43
1:A:71:TYR:HB3	1:A:108:PHE:CE1	2.53	0.43
1:A:86:GLN:O	1:A:90:LYS:HB2	2.21	0.41
1:A:166:ARG:HH11	1:A:257:LYS:HE3	1.84	0.41
1:A:77:PHE:CZ	1:A:86:GLN:HB3	2.56	0.41
1:A:131:VAL:O	1:A:133:THR:HG23	2.21	0.41
1:A:37:ASP:O	1:A:40:ILE:HD12	2.20	0.40
1:A:156:THR:HA	1:A:159:GLN:NE2	2.36	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	291/294 (99%)	281 (97%)	10 (3%)	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	228/253 (90%)	217 (95%)	11 (5%)	25	32

All (11) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	7	VAL
1	A	14	ARG
1	A	45	VAL
1	A	81	SER
1	A	86	GLN
1	A	127	ARG
1	A	181	HIS
1	A	195	ASN
1	A	197	VAL
1	A	200	ASN
1	A	227	SER

Some sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (9) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	20	GLN
1	A	24	ASN
1	A	60	HIS
1	A	86	GLN
1	A	159	GLN
1	A	195	ASN
1	A	200	ASN
1	A	222	GLN
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 ⓘ

Of 2 ligands modelled in this entry, 1 is monoatomic - leaving 1 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	$\# Z > 2$
2	HEM	A	1295	1,3	27,50,50	1.66	6 (22%)	17,82,82	1.57	5 (29%)

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	1295	1,3	-	0/6/54/54	-

All (6) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
2	A	1295	HEM	C3B-C2B	-4.09	1.34	1.40
2	A	1295	HEM	C3B-CAB	-3.98	1.39	1.47
2	A	1295	HEM	C3C-CAC	-3.26	1.41	1.47
2	A	1295	HEM	CBB-CAB	2.71	1.47	1.29

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Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
2	A	1295	HEM	CBC-CAC	2.45	1.45	1.29
2	A	1295	HEM	C1A-NA	2.10	1.40	1.36

All (5) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
2	A	1295	HEM	CAD-CBD-CGD	2.78	117.33	112.67
2	A	1295	HEM	CBD-CAD-C3D	2.78	117.59	112.48
2	A	1295	HEM	C4C-C3C-C2C	-2.53	105.13	106.90
2	A	1295	HEM	CMC-C2C-C3C	2.40	129.16	124.68
2	A	1295	HEM	C3B-C4B-NB	2.17	112.01	109.21

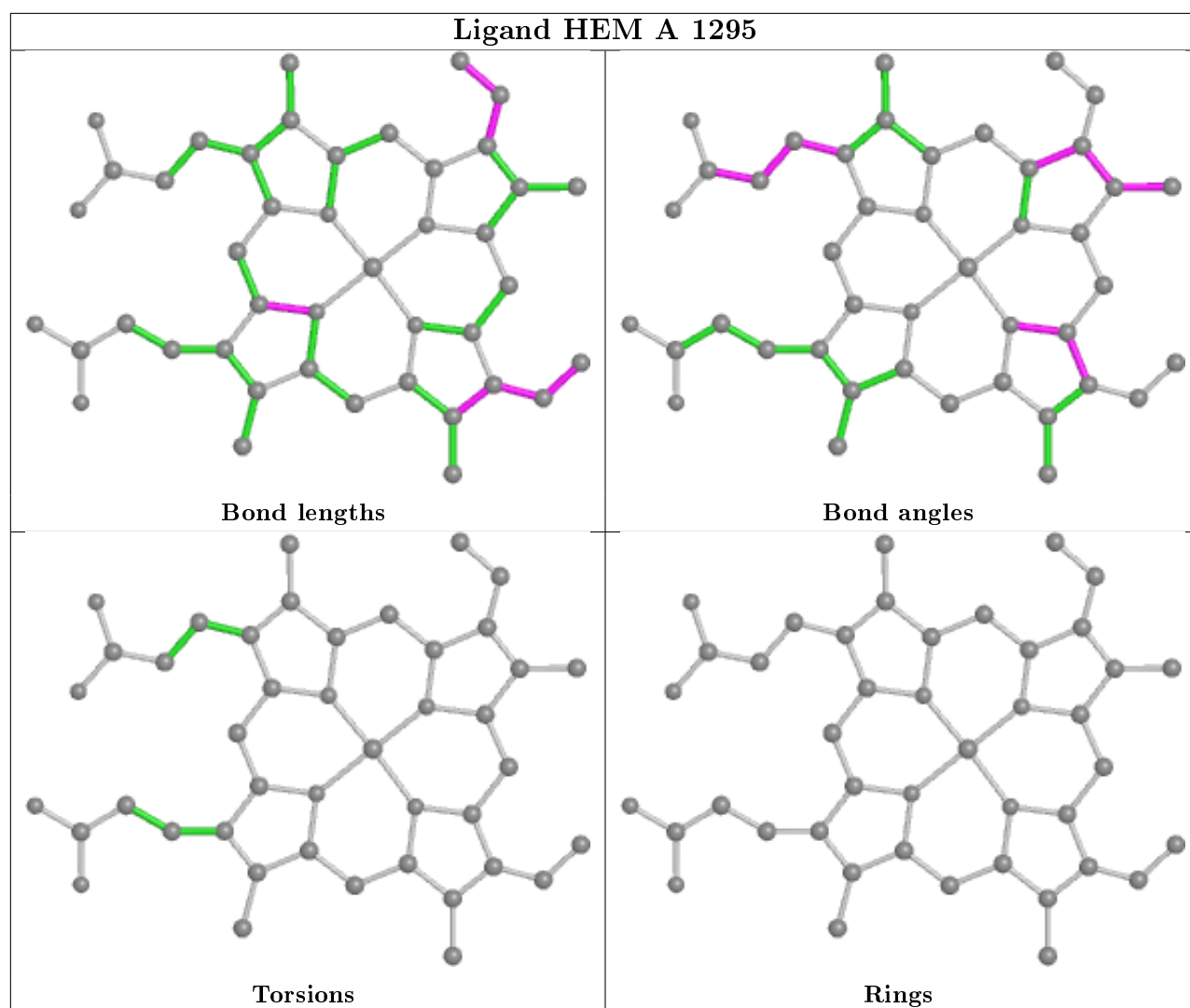
There are no chirality outliers.

There are no torsion outliers.

There are no ring outliers.

No monomer is involved in short contacts.

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 than 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.



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 ⓘ

6.1 Protein, DNA and RNA chains ⓘ

EDS was not executed - this section is therefore empty.

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

EDS was not executed - this section is therefore empty.

6.3 Carbohydrates ⓘ

EDS was not executed - this section is therefore empty.

6.4 Ligands ⓘ

EDS was not executed - this section is therefore empty.

6.5 Other polymers ⓘ

EDS was not executed - this section is therefore empty.