



# Full wwPDB X-ray Structure Validation Report ⓘ

Mar 5, 2026 – 03:32 PM UTC

PDB ID : 1DCC / pdb\_00001dcc  
Title : 2.2 ANGSTROM STRUCTURE OF OXYPEROXIDASE: A MODEL FOR  
THE ENZYME:PEROXIDE COMPLEX  
Authors : Miller, M.A.; Shaw, A.; Kraut, J.  
Deposited on : 1994-06-01  
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](mailto: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 types of validation reports are described at

<http://www.wwpdb.org/validation/2017/FAQs#types>.

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

MolProbity : 4-5-2 with Phenix2.0  
Mogul : 2022.3.0, CSD as543be (2022)  
Xtrriage (Phenix) : **NOT EXECUTED**  
EDS : **NOT EXECUTED**  
Buster-report : wwPDB partial adaption of 1.1.7 (2018)  
Percentile statistics : 20250101.v01 (using entries in the PDB archive January 1st 2025)  
Ideal geometry (proteins) : Engh & Huber (2001)  
Ideal geometry (DNA, RNA) : Parkinson et al. (1996)  
Validation Pipeline (wwPDB-VP) : 2.49

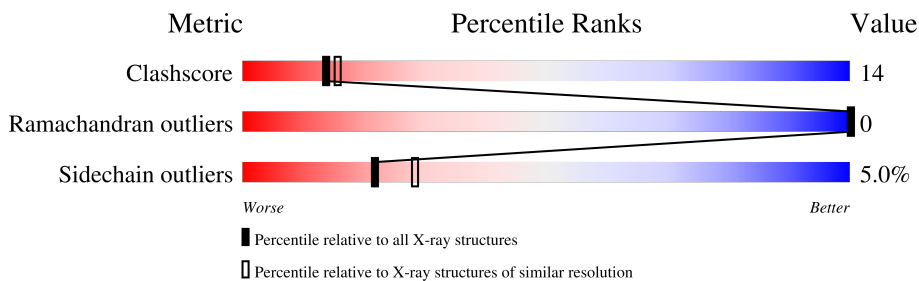
# 1 Overall quality at a glance i

The following experimental techniques were used to determine the structure:

*X-RAY DIFFRACTION*

The reported resolution of this entry is 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	190562	6851 (2.20-2.20)
Ramachandran outliers	187476	6768 (2.20-2.20)
Sidechain outliers	187428	6769 (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 of the lower bar indicate the fraction of residues that contain outliers for  $\geq 3$ , 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	296	

## 2 Entry composition [i](#)

There are 4 unique types of molecules in this entry. The entry contains 2552 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.

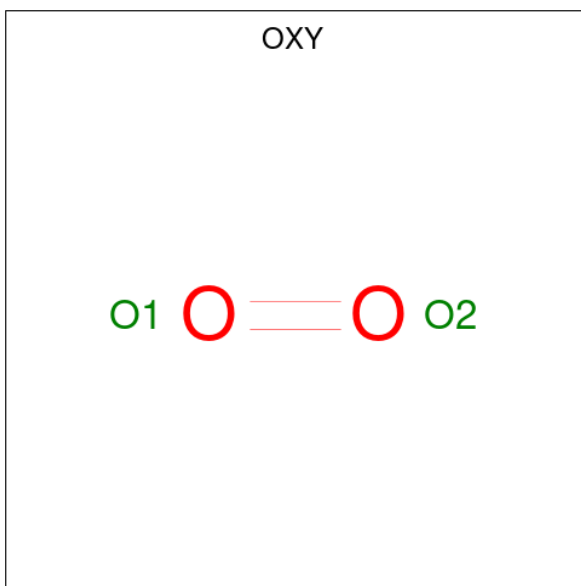
- Molecule 1 is a protein called CYTOCHROME C PEROXIDASE.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
1	A	291	2325	1487	383	449	6	0	0	0

There are 3 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	53	ILE	THR	conflict	UNP P00431
A	152	GLY	ASP	conflict	UNP P00431
A	191	PHE	TRP	conflict	UNP P00431

- Molecule 2 is OXYGEN MOLECULE (CCD ID: OXY) (formula: O<sub>2</sub>).



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

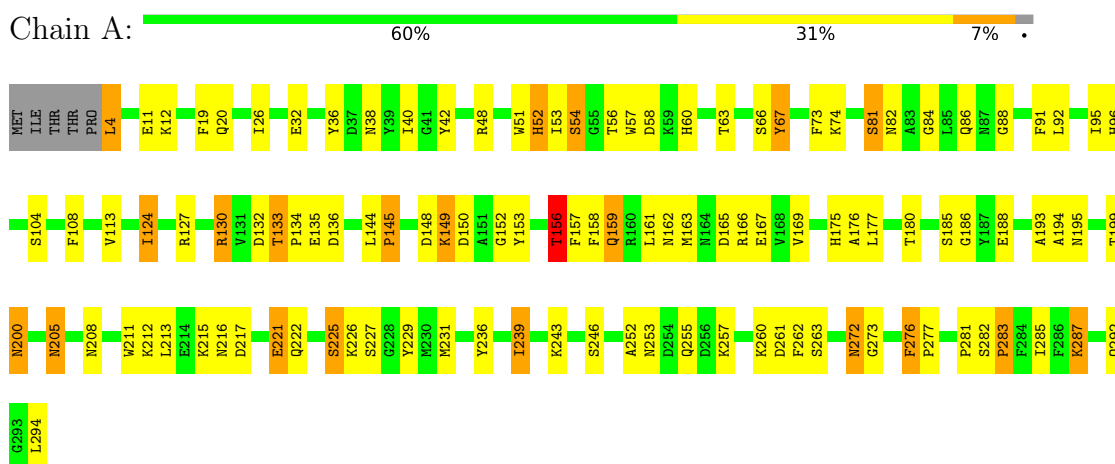


### 3 Residue-property plots [i](#)

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 C PEROXIDASE



## 4 Data and refinement statistics

Xtrriage (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, $\alpha$ , $\beta$ , $\gamma$	104.72Å 74.45Å 45.17Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	(Not available) – 2.20	Depositor
% Data completeness (in resolution range)	(Not available) ((Not available)-2.20)	Depositor
$R_{merge}$	(Not available)	Depositor
$R_{sym}$	(Not available)	Depositor
Refinement program	TNT	Depositor
R, $R_{free}$	0.155 , (Not available)	Depositor
Estimated twinning fraction	No twinning to report.	Xtrriage
Total number of atoms	2552	wwPDB-VP
Average B, all atoms (Å <sup>2</sup> )	28.0	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: OXY, HEM

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	0.94	0/2390	1.96	63/3240 (1.9%)

There are no bond length outliers.

All (63) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	176	ALA	N-CA-C	-11.52	99.34	113.50
1	A	38	ASN	CA-CB-CG	-11.37	101.23	112.60
1	A	208	ASN	N-CA-C	10.11	125.61	113.28
1	A	169	VAL	N-CA-CB	7.60	120.88	110.54
1	A	177	LEU	N-CA-C	7.43	121.95	109.76
1	A	66	SER	N-CA-C	7.06	121.16	112.54
1	A	145	PRO	CB-CA-C	-7.04	101.76	110.98
1	A	67	TYR	N-CA-C	6.99	122.84	111.37
1	A	262	PHE	CA-C-O	6.97	127.94	120.55
1	A	145	PRO	N-CA-C	6.84	122.25	111.38
1	A	162	ASN	CA-CB-CG	-6.83	105.77	112.60
1	A	252	ALA	N-CA-C	-6.75	103.99	111.82
1	A	133	THR	CA-C-N	6.71	126.63	119.85
1	A	133	THR	C-N-CA	6.71	126.63	119.85
1	A	32	GLU	N-CA-C	6.54	118.49	111.36
1	A	130	ARG	CA-C-O	-6.46	114.70	121.55
1	A	260	LYS	CB-CA-C	-6.44	100.78	110.88
1	A	19	PHE	CA-CB-CG	-6.35	107.45	113.80
1	A	272	ASN	N-CA-CB	6.32	119.28	109.48
1	A	149	LYS	CB-CA-C	-6.25	97.99	110.42
1	A	185	SER	N-CA-C	6.16	121.73	113.72
1	A	54	SER	CB-CA-C	-6.10	99.03	109.65
1	A	56	THR	CA-CB-OG1	-6.00	100.61	109.60
1	A	150	ASP	N-CA-C	5.99	118.58	109.95

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Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	96	HIS	CA-CB-CG	-5.83	107.97	113.80
1	A	175	HIS	CA-CB-CG	-5.83	107.97	113.80
1	A	186	GLY	N-CA-C	-5.80	107.18	115.64
1	A	263	SER	CB-CA-C	5.79	119.98	110.88
1	A	156	THR	OG1-CB-CG2	-5.75	97.80	109.30
1	A	26	ILE	N-CA-C	-5.61	105.26	110.53
1	A	158	PHE	CA-CB-CG	-5.59	108.21	113.80
1	A	227	SER	N-CA-C	-5.56	106.58	113.19
1	A	11	GLU	CB-CA-C	5.54	118.14	110.16
1	A	205	ASN	N-CA-CB	5.47	118.17	110.12
1	A	91	PHE	CA-CB-CG	5.44	119.24	113.80
1	A	161	LEU	CA-C-N	-5.42	115.18	123.47
1	A	161	LEU	C-N-CA	-5.42	115.18	123.47
1	A	282	SER	CB-CA-C	-5.34	99.31	110.31
1	A	285	ILE	CA-CB-CG1	-5.34	101.33	110.40
1	A	273	GLY	CA-C-N	-5.33	116.23	123.10
1	A	273	GLY	C-N-CA	-5.33	116.23	123.10
1	A	11	GLU	N-CA-C	-5.32	102.03	109.96
1	A	150	ASP	N-CA-CB	-5.32	102.51	110.60
1	A	12	LYS	N-CA-C	5.31	118.27	110.30
1	A	253	ASN	CA-C-N	-5.31	114.51	122.47
1	A	253	ASN	C-N-CA	-5.31	114.51	122.47
1	A	88	GLY	CA-C-O	5.30	126.13	120.30
1	A	283	PRO	CB-CA-C	-5.29	104.05	110.98
1	A	221	GLU	CA-CB-CG	-5.27	103.56	114.10
1	A	276	PHE	CA-C-N	5.27	125.20	119.78
1	A	276	PHE	C-N-CA	5.27	125.20	119.78
1	A	152	GLY	O-C-N	5.22	127.20	122.19
1	A	40	ILE	N-CA-C	-5.22	104.99	112.35
1	A	136	ASP	N-CA-C	5.19	119.09	112.87
1	A	161	LEU	O-C-N	5.16	128.39	122.25
1	A	52	HIS	N-CA-C	5.14	116.89	111.28
1	A	108	PHE	CA-CB-CG	-5.12	108.68	113.80
1	A	281	PRO	CB-CA-C	-5.10	104.26	110.95
1	A	144	LEU	CB-CA-C	5.10	116.21	108.86
1	A	165	ASP	N-CA-C	5.07	117.19	111.11
1	A	180	THR	CA-CB-CG2	-5.05	101.91	110.50
1	A	226	LYS	N-CA-CB	5.05	118.00	110.22
1	A	239	ILE	N-CA-CB	5.03	119.71	112.07

There are no chirality outliers.

There are no planarity outliers.

## 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	2325	0	2163	63	0
2	A	2	0	0	0	0
3	A	43	0	30	3	0
4	A	182	0	0	8	0
All	All	2552	0	2193	66	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 (66) 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:20:GLN:HE22	1:A:287:LYS:H	1.10	0.97
3:A:296:HEM:HMB2	3:A:296:HEM:HBB2	1.52	0.91
1:A:216:ASN:HD22	1:A:222:GLN:HE21	1.18	0.90
1:A:84:GLY:H	1:A:86:GLN:NE2	1.77	0.82
1:A:216:ASN:HD22	1:A:222:GLN:NE2	1.78	0.79
1:A:84:GLY:N	1:A:86:GLN:NE2	2.30	0.79
1:A:255:GLN:HG2	4:A:556:HOH:O	1.88	0.73
1:A:84:GLY:C	1:A:86:GLN:HE21	2.04	0.66
1:A:86:GLN:NE2	1:A:86:GLN:H	1.95	0.64
3:A:296:HEM:HBB2	3:A:296:HEM:CMB	2.25	0.64
1:A:148:ASP:OD1	1:A:149:LYS:HD3	1.97	0.63
1:A:236:TYR:CE1	1:A:239:ILE:HD11	2.32	0.63
1:A:257:LYS:HE3	1:A:261:ASP:OD2	1.98	0.62
1:A:149:LYS:HG3	1:A:153:TYR:CG	2.35	0.61
1:A:145:PRO:HD3	1:A:157:PHE:CZ	2.36	0.61
1:A:133:THR:HB	1:A:134:PRO:HD2	1.82	0.60
1:A:20:GLN:HE22	1:A:287:LYS:N	1.90	0.58
1:A:84:GLY:CA	1:A:86:GLN:HE21	2.17	0.58
1:A:53:ILE:C	1:A:53:ILE:HD12	2.29	0.56
1:A:213:LEU:HD11	1:A:221:GLU:HB3	1.88	0.56
1:A:57:TRP:CE3	1:A:272:ASN:HB3	2.43	0.54
1:A:4:LEU:HD22	1:A:4:LEU:N	2.23	0.54
1:A:163:MET:HA	1:A:167:GLU:OE1	2.07	0.54

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:20:GLN:NE2	1:A:287:LYS:H	1.93	0.54
1:A:63:THR:HA	4:A:363:HOH:O	2.07	0.53
1:A:73:PHE:CE2	1:A:135:GLU:HA	2.45	0.52
1:A:92:LEU:O	1:A:95:ILE:HB	2.09	0.52
1:A:216:ASN:ND2	1:A:222:GLN:HE21	1.99	0.51
1:A:57:TRP:CD2	1:A:272:ASN:HB3	2.45	0.51
3:A:296:HEM:HBC2	3:A:296:HEM:HMC2	1.93	0.50
1:A:73:PHE:CD2	1:A:135:GLU:HA	2.47	0.50
1:A:193:ALA:HB2	1:A:229:TYR:OH	2.12	0.50
1:A:53:ILE:HD12	1:A:54:SER:N	2.28	0.49
1:A:127:ARG:HG2	1:A:283:PRO:HA	1.93	0.49
1:A:113:VAL:HG13	1:A:124:ILE:HB	1.95	0.48
1:A:74:LYS:HG3	4:A:371:HOH:O	2.13	0.48
1:A:84:GLY:N	1:A:86:GLN:HE21	2.12	0.47
1:A:243:LYS:HD2	4:A:948:HOH:O	2.15	0.47
1:A:205:ASN:ND2	4:A:503:HOH:O	2.31	0.47
1:A:200:ASN:H	1:A:200:ASN:HD22	1.62	0.47
1:A:211:TRP:CZ3	1:A:225:SER:HB3	2.49	0.46
1:A:84:GLY:N	1:A:86:GLN:HE22	2.08	0.46
1:A:212:LYS:HD2	4:A:812:HOH:O	2.16	0.46
1:A:36:TYR:HB2	1:A:42:TYR:CE1	2.51	0.46
1:A:200:ASN:HD22	1:A:200:ASN:N	2.13	0.46
1:A:133:THR:HB	1:A:134:PRO:CD	2.44	0.45
1:A:4:LEU:N	1:A:4:LEU:CD2	2.80	0.45
1:A:67:TYR:O	1:A:130:ARG:HB3	2.17	0.45
1:A:211:TRP:CH2	1:A:231:MET:HG2	2.52	0.44
1:A:194:ALA:O	1:A:195:ASN:HB2	2.17	0.44
1:A:52:HIS:HE1	1:A:81:SER:O	2.02	0.43
1:A:276:PHE:HA	1:A:277:PRO:HD3	1.88	0.43
1:A:292:GLN:O	1:A:294:LEU:HD13	2.19	0.43
1:A:216:ASN:HB2	4:A:517:HOH:O	2.20	0.42
1:A:166:ARG:HD3	1:A:261:ASP:OD2	2.20	0.42
1:A:188:GLU:H	1:A:222:GLN:HE22	1.68	0.42
1:A:52:HIS:ND1	1:A:82:ASN:OD1	2.49	0.41
1:A:166:ARG:NH1	1:A:257:LYS:HE3	2.36	0.41
1:A:104:SER:N	1:A:132:ASP:OD1	2.51	0.41
1:A:199:THR:HA	1:A:255:GLN:OE1	2.20	0.41
1:A:157:PHE:CD1	1:A:157:PHE:C	2.98	0.41
1:A:48:ARG:NH2	4:A:784:HOH:O	2.46	0.41
1:A:84:GLY:CA	1:A:86:GLN:NE2	2.81	0.41
1:A:166:ARG:NH1	1:A:257:LYS:CE	2.84	0.41

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:58:ASP:OD1	1:A:60:HIS:HD2	2.02	0.40
1:A:156:THR:O	1:A:159:GLN:HB2	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	289/296 (98%)	279 (96%)	10 (4%)	0	<b>100</b> <b>100</b>

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	240/254 (94%)	228 (95%)	12 (5%)	<b>22</b> <b>28</b>

All (12) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	4	LEU
1	A	51	TRP
1	A	81	SER
1	A	124	ILE

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Mol	Chain	Res	Type
1	A	156	THR
1	A	159	GLN
1	A	200	ASN
1	A	215	LYS
1	A	217	ASP
1	A	225	SER
1	A	246	SER
1	A	287	LYS

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

Mol	Chain	Res	Type
1	A	6	HIS
1	A	20	GLN
1	A	24	ASN
1	A	60	HIS
1	A	86	GLN
1	A	87	ASN
1	A	200	ASN
1	A	222	GLN
1	A	292	GLN

### 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 oligosaccharides in this entry.

### 5.6 Ligand geometry [i](#)

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
3	HEM	A	296	1,2	50,50,50	1.24	4 (8%)	67,82,82	1.92	13 (19%)
2	OXY	A	999	3	1,1,1	0.23	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
3	HEM	A	296	1,2	-	3/14/54/54	-

All (4) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
3	A	296	HEM	FE-ND	3.33	2.05	1.94
3	A	296	HEM	CAC-C3C	2.83	1.54	1.47
3	A	296	HEM	FE-NB	2.77	2.03	1.94
3	A	296	HEM	CMC-C2C	2.67	1.56	1.50

All (13) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
3	A	296	HEM	C4A-CHB-C1B	-5.67	112.90	126.25
3	A	296	HEM	O1D-CGD-CBD	-4.66	108.30	123.09
3	A	296	HEM	CHB-C4A-NA	4.41	131.85	123.86
3	A	296	HEM	CHA-C1A-NA	4.38	131.81	123.86
3	A	296	HEM	O2D-CGD-O1D	4.31	134.42	123.33
3	A	296	HEM	CMA-C3A-C4A	-3.89	119.50	125.42
3	A	296	HEM	C1A-CHA-C4D	-3.49	118.03	126.25
3	A	296	HEM	CHA-C1A-C2A	-3.47	117.70	125.30
3	A	296	HEM	C3D-C4D-ND	-2.90	106.99	110.17
3	A	296	HEM	CHB-C4A-C3A	-2.84	119.19	127.43
3	A	296	HEM	CBB-CAB-C3B	-2.49	115.10	127.53
3	A	296	HEM	C2D-C1D-ND	-2.26	107.29	109.90

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Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
3	A	296	HEM	CHA-C4D-ND	2.25	127.15	124.37

There are no chirality outliers.

All (3) torsion outliers are listed below:

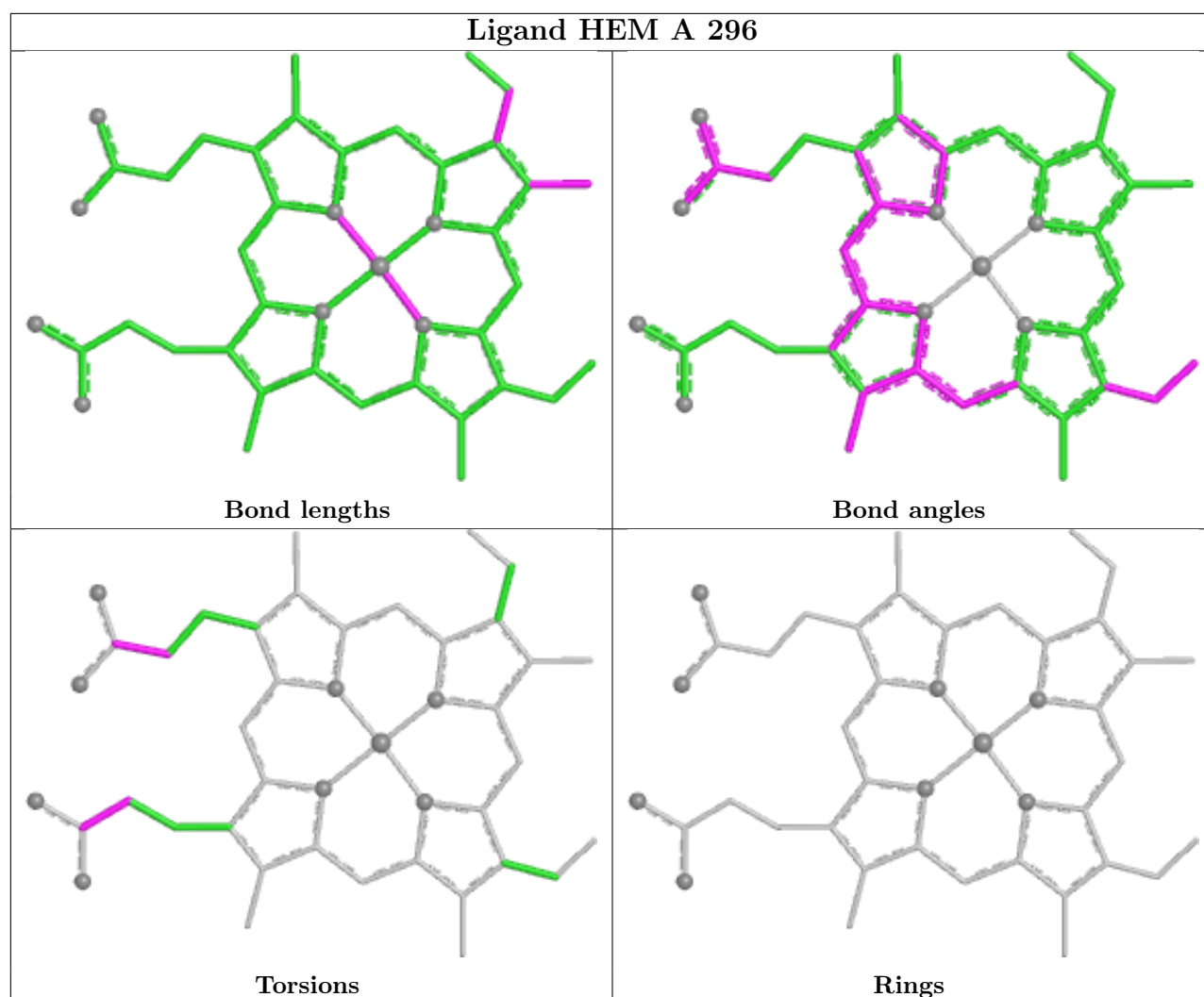
Mol	Chain	Res	Type	Atoms
3	A	296	HEM	CAA-CBA-CGA-O2A
3	A	296	HEM	CAA-CBA-CGA-O1A
3	A	296	HEM	CAD-CBD-CGD-O1D

There are no ring outliers.

1 monomer is involved in 3 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
3	A	296	HEM	3	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 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.