



Full wwPDB X-ray Structure Validation Report ⓘ

Mar 5, 2026 – 07:42 PM UTC

PDB ID : 6CPP / pdb_00006cpp
Title : CRYSTAL STRUCTURES OF CYTOCHROME P450-CAM COMPLEXED WITH CAMPHANE, THIOCAMPHOR, AND ADAMANTANE: FACTORS CONTROLLING P450 SUBSTRATE HYDROXYLATION
Authors : Raag, R.; Poulos, T.L.
Deposited on : 1990-05-18
Resolution : 1.90 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 types of validation reports are described at

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

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)
Xtriage (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

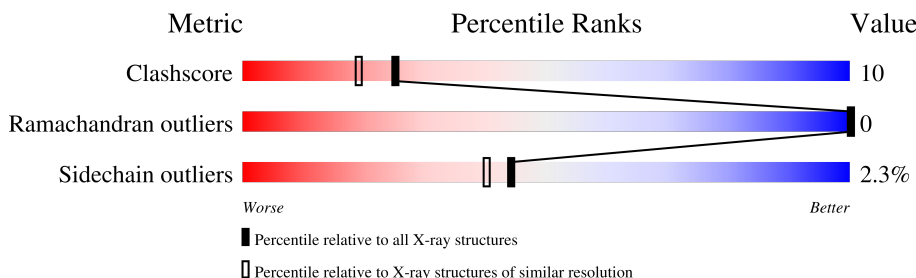
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 1.90 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	8410 (1.90-1.90)
Ramachandran outliers	187476	8333 (1.90-1.90)
Sidechain outliers	187428	8333 (1.90-1.90)

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 $\leq 5\%$.

Note EDS was not executed.

Mol	Chain	Length	Quality of chain
1	A	414	 58% 32% 7% ..

2 Entry composition [i](#)

There are 4 unique types of molecules in this entry. The entry contains 3465 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 P450-CAM.

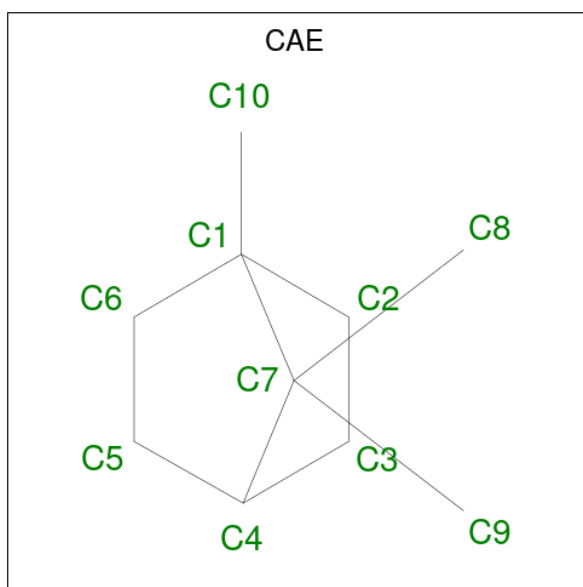
Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	405	Total	C	N	O	S	0	0	0
			3208	2033	560	597	18			

- Molecule 2 is PROTOPORPHYRIN IX CONTAINING FE (CCD ID: 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 CAMPHANE (CCD ID: CAE) (formula: $C_{10}H_{18}$).



Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
3	A	1	Total C 10 10	0	1

- Molecule 4 is water.

Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
4	A	204	Total O 204 204	0	0

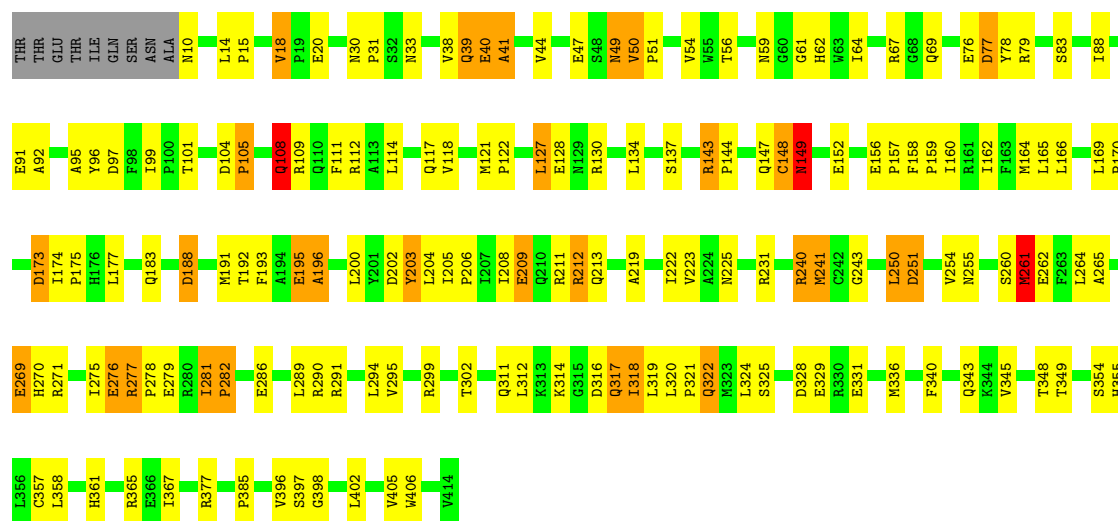
3 Residue-property plots

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 P450-CAM

Chain A: 



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	108.67Å 103.90Å 36.38Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	(Not available) – 1.90	Depositor
% Data completeness (in resolution range)	(Not available) ((Not available)-1.90)	Depositor
R_{merge}	(Not available)	Depositor
R_{sym}	(Not available)	Depositor
Refinement program	PROFFT	Depositor
R, R_{free}	0.190 , (Not available)	Depositor
Estimated twinning fraction	No twinning to report.	Xtriage
Total number of atoms	3465	wwPDB-VP
Average B, all atoms (Å ²)	21.0	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, CAE

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	1.45	15/3287 (0.5%)	2.21	120/4465 (2.7%)

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	8

All (15) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	A	317	GLN	N-CA	7.52	1.54	1.45
1	A	211	ARG	NE-CZ	-6.87	1.25	1.33
1	A	99	ILE	CA-CB	6.50	1.62	1.54
1	A	397	SER	N-CA	5.86	1.52	1.45
1	A	265	ALA	N-CA	-5.64	1.39	1.46
1	A	18	VAL	N-CA	5.45	1.50	1.46
1	A	211	ARG	CD-NE	-5.40	1.38	1.46
1	A	127	LEU	C-N	-5.30	1.27	1.33
1	A	112	ARG	NE-CZ	5.26	1.38	1.33
1	A	251	ASP	C-O	5.18	1.30	1.24
1	A	318	ILE	CA-C	5.10	1.58	1.52
1	A	312	LEU	N-CA	5.09	1.52	1.46
1	A	367	ILE	CA-CB	5.08	1.60	1.54
1	A	398	GLY	N-CA	5.02	1.50	1.45
1	A	405	VAL	N-CA	5.00	1.51	1.46

All (120) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	211	ARG	CD-NE-CZ	36.54	175.56	124.40
1	A	271	ARG	CD-NE-CZ	11.65	140.71	124.40
1	A	64	ILE	CA-C-O	-10.19	109.32	120.43
1	A	108	GLN	CB-CG-CD	9.88	129.39	112.60
1	A	148	CYS	CA-C-N	9.64	135.71	122.79
1	A	148	CYS	C-N-CA	9.64	135.71	122.79
1	A	251	ASP	O-C-N	-8.94	111.35	122.35
1	A	15	PRO	O-C-N	8.77	125.27	121.15
1	A	149	ASN	CA-C-O	-8.25	110.40	121.86
1	A	195	GLU	CA-CB-CG	7.94	129.99	114.10
1	A	358	LEU	O-C-N	7.92	132.94	122.33
1	A	209	GLU	CA-C-N	7.88	130.83	120.28
1	A	209	GLU	C-N-CA	7.88	130.83	120.28
1	A	40	GLU	CB-CG-CD	7.84	125.93	112.60
1	A	340	PHE	CA-CB-CG	7.71	121.51	113.80
1	A	250	LEU	N-CA-C	7.55	122.94	112.45
1	A	202	ASP	CA-CB-CG	7.51	120.11	112.60
1	A	188	ASP	CA-CB-CG	7.39	119.99	112.60
1	A	260	SER	O-C-N	7.32	129.61	122.07
1	A	324	LEU	N-CA-C	7.29	119.30	111.36
1	A	406	TRP	O-C-N	7.18	130.80	123.26
1	A	203	TYR	CA-C-N	6.87	129.37	120.44
1	A	203	TYR	C-N-CA	6.87	129.37	120.44
1	A	108	GLN	OE1-CD-NE2	-6.84	115.76	122.60
1	A	173	ASP	CA-CB-CG	6.75	119.36	112.60
1	A	343	GLN	N-CA-CB	6.69	119.95	110.12
1	A	33	ASN	CB-CA-C	6.66	120.86	111.74
1	A	212	ARG	CD-NE-CZ	6.66	133.72	124.40
1	A	118	VAL	N-CA-C	6.60	118.19	111.00
1	A	69	GLN	CA-C-N	6.57	129.62	120.29
1	A	69	GLN	C-N-CA	6.57	129.62	120.29
1	A	282	PRO	CA-C-N	6.33	128.67	120.44
1	A	282	PRO	C-N-CA	6.33	128.67	120.44
1	A	118	VAL	CA-C-N	6.29	130.08	122.16
1	A	118	VAL	C-N-CA	6.29	130.08	122.16
1	A	328	ASP	CA-CB-CG	6.25	118.85	112.60
1	A	108	GLN	CA-CB-CG	6.25	126.59	114.10
1	A	255	ASN	OD1-CG-ND2	6.20	128.80	122.60
1	A	149	ASN	N-CA-CB	6.18	119.82	110.11
1	A	276	GLU	N-CA-C	6.13	119.96	112.23
1	A	329	GLU	CB-CG-CD	6.12	123.00	112.60
1	A	291	ARG	N-CA-C	6.08	118.87	111.82
1	A	289	LEU	CA-C-O	-6.04	114.10	120.63

Continued on next page...

Continued from previous page...

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	195	GLU	CB-CG-CD	6.03	122.85	112.60
1	A	128	GLU	N-CA-CB	6.03	118.98	109.82
1	A	241	MET	N-CA-CB	6.00	118.77	110.07
1	A	165	LEU	CA-C-N	5.94	128.73	120.29
1	A	165	LEU	C-N-CA	5.94	128.73	120.29
1	A	361	HIS	CA-CB-CG	-5.93	107.86	113.80
1	A	196	ALA	O-C-N	5.93	128.41	122.12
1	A	18	VAL	O-C-N	5.93	125.10	121.37
1	A	250	LEU	CA-C-N	5.90	131.64	122.26
1	A	250	LEU	C-N-CA	5.90	131.64	122.26
1	A	104	ASP	CA-C-N	5.89	123.90	119.66
1	A	104	ASP	C-N-CA	5.89	123.90	119.66
1	A	343	GLN	O-C-N	5.84	128.31	122.12
1	A	109	ARG	N-CA-C	5.80	119.18	111.75
1	A	299	ARG	NE-CZ-NH2	-5.80	113.98	119.20
1	A	294	LEU	N-CA-CB	-5.78	99.57	111.07
1	A	130	ARG	N-CA-CB	5.75	118.67	110.16
1	A	318	ILE	O-C-N	5.73	129.39	123.20
1	A	311	GLN	CA-C-N	-5.68	114.69	122.93
1	A	311	GLN	C-N-CA	-5.68	114.69	122.93
1	A	264	LEU	CA-C-N	5.67	128.44	120.28
1	A	264	LEU	C-N-CA	5.67	128.44	120.28
1	A	322	GLN	OE1-CD-NE2	-5.64	116.96	122.60
1	A	262	GLU	CA-C-O	-5.56	114.98	120.82
1	A	18	VAL	N-CA-C	5.55	113.05	107.55
1	A	286	GLU	N-CA-CB	5.54	118.35	110.16
1	A	262	GLU	N-CA-CB	5.51	117.99	110.01
1	A	365	ARG	CD-NE-CZ	5.50	132.10	124.40
1	A	243	GLY	N-CA-C	-5.50	106.14	112.73
1	A	149	ASN	O-C-N	-5.49	115.84	122.65
1	A	20	GLU	CA-CB-CG	5.46	125.02	114.10
1	A	76	GLU	CA-C-N	5.43	131.92	121.54
1	A	76	GLU	C-N-CA	5.43	131.92	121.54
1	A	76	GLU	CB-CG-CD	5.39	121.76	112.60
1	A	281	ILE	CA-C-N	5.38	124.57	118.97
1	A	281	ILE	C-N-CA	5.38	124.57	118.97
1	A	62	HIS	CA-CB-CG	5.38	119.18	113.80
1	A	316	ASP	CA-C-N	-5.37	113.50	122.64
1	A	316	ASP	C-N-CA	-5.37	113.50	122.64
1	A	357	CYS	CB-CA-C	-5.37	102.60	110.06
1	A	261	MET	CG-SD-CE	5.36	112.70	100.90
1	A	324	LEU	CA-C-O	-5.36	114.74	120.42

Continued on next page...

Continued from previous page...

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	137	SER	N-CA-C	5.34	117.18	111.36
1	A	358	LEU	CA-C-O	-5.33	113.50	119.79
1	A	279	GLU	CB-CG-CD	5.30	121.61	112.60
1	A	277	ARG	CA-C-N	5.29	124.95	119.56
1	A	277	ARG	C-N-CA	5.29	124.95	119.56
1	A	260	SER	CA-C-O	-5.28	115.28	120.82
1	A	271	ARG	NE-CZ-NH1	5.28	126.78	121.50
1	A	265	ALA	N-CA-CB	5.27	118.33	110.22
1	A	50	VAL	CB-CA-C	5.25	115.99	110.37
1	A	88	ILE	CB-CG1-CD1	5.25	124.83	113.80
1	A	225	ASN	OD1-CG-ND2	-5.25	117.35	122.60
1	A	67	ARG	O-C-N	5.22	130.02	123.23
1	A	251	ASP	N-CA-C	5.22	120.51	113.72
1	A	316	ASP	CA-CB-CG	5.21	117.81	112.60
1	A	77	ASP	N-CA-C	5.18	121.84	110.80
1	A	67	ARG	NE-CZ-NH2	-5.15	114.56	119.20
1	A	254	VAL	N-CA-CB	-5.15	104.79	110.51
1	A	231	ARG	CA-C-N	5.15	125.05	119.85
1	A	231	ARG	C-N-CA	5.15	125.05	119.85
1	A	349	THR	CA-CB-OG1	-5.15	101.88	109.60
1	A	38	VAL	CA-C-N	5.14	127.16	120.28
1	A	38	VAL	C-N-CA	5.14	127.16	120.28
1	A	105	PRO	N-CA-CB	5.12	105.88	103.22
1	A	270	HIS	CA-CB-CG	-5.09	108.71	113.80
1	A	204	LEU	N-CA-C	5.09	116.52	111.07
1	A	143	ARG	CA-C-N	5.08	124.69	119.56
1	A	143	ARG	C-N-CA	5.08	124.69	119.56
1	A	41	ALA	N-CA-CB	5.04	117.33	110.01
1	A	59	ASN	OD1-CG-ND2	5.03	127.63	122.60
1	A	152	GLU	CA-CB-CG	5.03	124.17	114.10
1	A	10	ASN	CA-CB-CG	5.03	117.63	112.60
1	A	322	GLN	CB-CG-CD	5.02	121.13	112.60
1	A	169	LEU	O-C-N	5.01	125.71	121.20
1	A	147	GLN	CG-CD-NE2	5.01	123.91	116.40
1	A	47	GLU	CB-CG-CD	5.00	121.11	112.60

There are no chirality outliers.

All (8) planarity outliers are listed below:

Mol	Chain	Res	Type	Group
1	A	148	CYS	Mainchain
1	A	149	ASN	Mainchain

Continued on next page...

Continued from previous page...

Mol	Chain	Res	Type	Group
1	A	240	ARG	Sidechain
1	A	250	LEU	Mainchain
1	A	251	ASP	Mainchain
1	A	277	ARG	Sidechain
1	A	377	ARG	Sidechain
1	A	77	ASP	Mainchain

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	3208	0	3156	61	0
2	A	43	0	30	1	0
3	A	10	0	18	3	0
4	A	204	0	0	7	0
All	All	3465	0	3204	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 10.

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:191:MET:HE2	1:A:196:ALA:HA	1.70	0.73
1:A:121:MET:HB2	1:A:122:PRO:HD3	1.70	0.71
1:A:40:GLU:HG3	1:A:336:MET:HE2	1.76	0.67
1:A:101:THR:HG21	3:A:422[B]:CAE:H31	1.82	0.62
1:A:205:ILE:HB	1:A:206:PRO:HD3	1.82	0.61
2:A:417:HEM:C1A	3:A:422[B]:CAE:H4	2.38	0.58
1:A:158:PHE:HB3	1:A:159:PRO:HD3	1.84	0.57
1:A:49:ASN:HD22	1:A:49:ASN:H	1.52	0.57
1:A:56:THR:O	1:A:61:GLY:HA2	2.04	0.56
1:A:160:ILE:O	1:A:164:MET:HG2	2.05	0.56
1:A:39:GLN:NE2	1:A:39:GLN:H	2.04	0.56
1:A:325:SER:O	1:A:331:GLU:HG3	2.07	0.55
1:A:149:ASN:ND2	1:A:402:LEU:H	2.04	0.55

Continued on next page...

Continued from previous page...

Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
3:A:422[B]:CAE:H52	4:A:697:HOH:O	2.07	0.55
1:A:134:LEU:HB2	4:A:589:HOH:O	2.06	0.54
1:A:95:ALA:HB3	1:A:193:PHE:HD2	1.74	0.52
1:A:183:GLN:OE1	1:A:188:ASP:HB3	2.09	0.51
1:A:322:GLN:HB3	1:A:348:THR:O	2.10	0.51
1:A:276:GLU:C	1:A:278:PRO:HD3	2.36	0.51
1:A:30:ASN:ND2	4:A:555:HOH:O	2.40	0.51
1:A:269:GLU:CD	1:A:269:GLU:H	2.19	0.50
1:A:302:THR:O	1:A:314:LYS:HG3	2.12	0.50
1:A:192:THR:OG1	1:A:195:GLU:HG2	2.12	0.50
1:A:208:ILE:O	1:A:212:ARG:HG3	2.12	0.50
1:A:78:TYR:CD1	1:A:105:PRO:HD2	2.46	0.50
1:A:261:MET:HA	1:A:261:MET:HE2	1.94	0.49
1:A:174:ILE:N	1:A:175:PRO:HD2	2.28	0.49
1:A:114:LEU:HB3	1:A:241:MET:HE1	1.95	0.48
1:A:108:GLN:HE22	1:A:354:SER:HB2	1.79	0.48
1:A:143:ARG:HB3	1:A:144:PRO:HD3	1.96	0.47
1:A:319:LEU:C	1:A:321:PRO:HD3	2.40	0.47
1:A:209:GLU:O	1:A:213:GLN:HG3	2.15	0.47
1:A:127:LEU:HD11	1:A:166:LEU:HD13	1.95	0.46
1:A:191:MET:HE2	1:A:196:ALA:CA	2.42	0.46
1:A:114:LEU:O	1:A:117:GLN:HB2	2.16	0.46
1:A:14:LEU:HD11	1:A:18:VAL:CG1	2.46	0.46
1:A:91:GLU:H	1:A:91:GLU:CD	2.23	0.46
1:A:275:ILE:HG21	4:A:691:HOH:O	2.15	0.46
1:A:319:LEU:O	1:A:321:PRO:HD3	2.16	0.46
1:A:83:SER:HB3	1:A:101:THR:O	2.17	0.45
1:A:149:ASN:HD21	1:A:402:LEU:H	1.65	0.45
1:A:51:PRO:HD2	1:A:54:VAL:CG1	2.47	0.45
1:A:97:ASP:O	1:A:240:ARG:HD2	2.17	0.45
1:A:164:MET:HE1	1:A:177:LEU:HD12	2.00	0.44
1:A:295:VAL:HG22	1:A:396:VAL:HG22	1.99	0.44
1:A:31:PRO:HA	4:A:502:HOH:O	2.17	0.44
1:A:41:ALA:O	1:A:44:VAL:HG22	2.17	0.44
1:A:158:PHE:CE1	1:A:162:ILE:HD11	2.52	0.44
1:A:318:ILE:HD13	1:A:320:LEU:HD21	1.99	0.44
1:A:156:GLU:HB2	1:A:157:PRO:HD3	1.99	0.43
1:A:317:GLN:NE2	4:A:646:HOH:O	2.51	0.43
1:A:319:LEU:HG	1:A:321:PRO:HG3	2.01	0.43
1:A:281:ILE:N	1:A:282:PRO:CD	2.82	0.43
1:A:30:ASN:ND2	4:A:554:HOH:O	2.51	0.43

Continued on next page...

Continued from previous page...

Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:219:ALA:O	1:A:223:VAL:HG23	2.18	0.43
1:A:170:PRO:HG2	1:A:173:ASP:OD1	2.18	0.42
1:A:200:LEU:O	1:A:203:TYR:HB3	2.20	0.42
1:A:160:ILE:HG21	1:A:174:ILE:HG23	2.02	0.41
1:A:92:ALA:O	1:A:96:TYR:HB2	2.21	0.41
1:A:108:GLN:HG3	1:A:355:HIS:CE1	2.56	0.41
1:A:290:ARG:HD3	1:A:345:VAL:HG13	2.01	0.41
1:A:50:VAL:HA	1:A:51:PRO:HD3	1.82	0.40
1:A:111:PHE:HB3	1:A:241:MET:HE2	2.03	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	403/414 (97%)	384 (95%)	19 (5%)	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	350/358 (98%)	342 (98%)	8 (2%)	44	40

All (8) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	39	GLN
1	A	49	ASN
1	A	79	ARG
1	A	108	GLN
1	A	222	ILE
1	A	261	MET
1	A	269	GLU
1	A	385	PRO

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (12) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	21	HIS
1	A	30	ASN
1	A	39	GLN
1	A	46	GLN
1	A	49	ASN
1	A	108	GLN
1	A	129	ASN
1	A	149	ASN
1	A	225	ASN
1	A	317	GLN
1	A	361	HIS
1	A	388	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

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	417	1,4	50,50,50	1.52	8 (16%)	67,82,82	1.39	9 (13%)
3	CAE	A	422[B]	-	11,11,11	1.82	4 (36%)	16,19,19	2.60	6 (37%)

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	417	1,4	-	2/14/54/54	-
3	CAE	A	422[B]	-	-	-	0/3/2/2

All (12) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
2	A	417	HEM	FE-NB	4.23	2.07	1.94
2	A	417	HEM	FE-NC	3.26	2.05	1.95
3	A	422[B]	CAE	C2-C1	3.01	1.61	1.55
3	A	422[B]	CAE	C10-C1	-2.99	1.47	1.53
2	A	417	HEM	CBD-CGD	2.68	1.56	1.50
2	A	417	HEM	FE-NA	2.50	2.03	1.95
2	A	417	HEM	FE-ND	2.46	2.02	1.94
3	A	422[B]	CAE	C5-C4	2.41	1.60	1.53
2	A	417	HEM	CAC-C3C	2.33	1.53	1.47
2	A	417	HEM	CMC-C2C	2.26	1.55	1.50
3	A	422[B]	CAE	C7-C4	2.05	1.60	1.54
2	A	417	HEM	C3C-C2C	-2.01	1.33	1.37

All (15) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
3	A	422[B]	CAE	C1-C7-C4	5.31	100.81	93.28
3	A	422[B]	CAE	C10-C1-C6	5.09	122.11	110.93
2	A	417	HEM	O1D-CGD-CBD	-3.96	110.54	123.09
2	A	417	HEM	O2A-CGA-O1A	3.84	133.21	123.33
3	A	422[B]	CAE	C9-C7-C8	-3.78	98.10	107.67
2	A	417	HEM	O2D-CGD-O1D	3.17	131.49	123.33
3	A	422[B]	CAE	C5-C4-C7	-3.07	97.01	102.83
2	A	417	HEM	CMA-C3A-C2A	3.05	132.10	125.62
3	A	422[B]	CAE	C3-C4-C7	-2.78	97.56	102.83
2	A	417	HEM	CBD-CAD-C3D	2.76	120.15	112.53
2	A	417	HEM	CMA-C3A-C4A	-2.72	121.28	125.42
2	A	417	HEM	CHB-C4A-NA	2.23	127.91	123.86
2	A	417	HEM	C3D-C4D-ND	-2.20	107.76	110.17
2	A	417	HEM	CAD-C3D-C4D	-2.12	121.01	124.70
3	A	422[B]	CAE	C2-C3-C4	2.09	106.42	103.16

There are no chirality outliers.

All (2) torsion outliers are listed below:

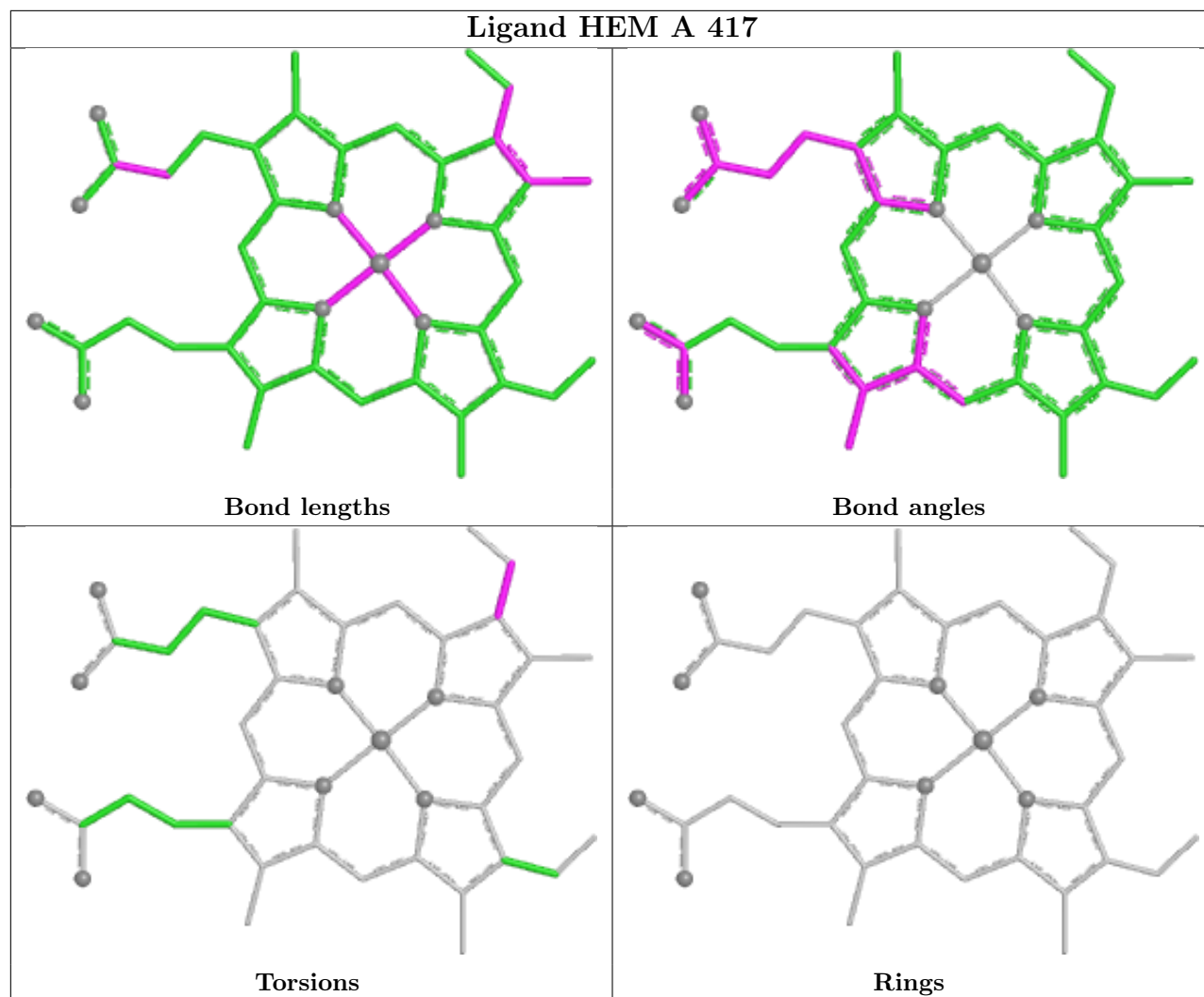
Mol	Chain	Res	Type	Atoms
2	A	417	HEM	C2C-C3C-CAC-CBC
2	A	417	HEM	C4C-C3C-CAC-CBC

There are no ring outliers.

2 monomers are involved in 3 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
2	A	417	HEM	1	0
3	A	422[B]	CAE	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.