



Full wwPDB X-ray Structure Validation Report ⓘ

Mar 12, 2026 – 07:49 PM UTC

PDB ID : 1P0X / pdb_00001p0x
Title : F393Y mutant heme domain of flavocytochrome P450 BM3
Authors : Ost, T.W.B.; Clark, J.; Miles, C.S.; Walkinshaw, M.D.; Reid, G.A.; Chapman, S.K.; Daff, S.; Mowat, C.G.
Deposited on : 2003-04-11
Resolution : 2.00 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

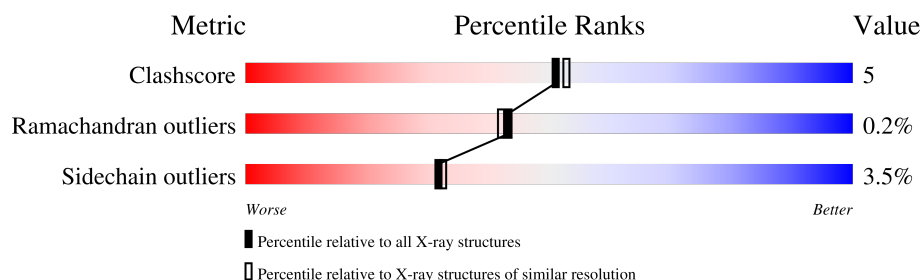
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 2.00 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	11152 (2.00-2.00)
Ramachandran outliers	187476	11031 (2.00-2.00)
Sidechain outliers	187428	11029 (2.00-2.00)

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	455	 79% 14% . . .
1	B	455	 78% 18% . .

2 Entry composition [i](#)

There are 3 unique types of molecules in this entry. The entry contains 8407 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 Bifunctional P-450:NADPH-P450 reductase.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	441	Total	C	N	O	S	0	0	0
			3506	2250	592	647	17			
1	B	448	Total	C	N	O	S	0	0	0
			3577	2292	603	665	17			

There are 2 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	393	TYR	PHE	engineered mutation	UNP P14779
B	393	TYR	PHE	engineered mutation	UNP P14779

- 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		

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

- Molecule 3 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
3	A	585	Total	O	0	0
			585	585		
3	B	653	Total	O	0	0
			653	653		

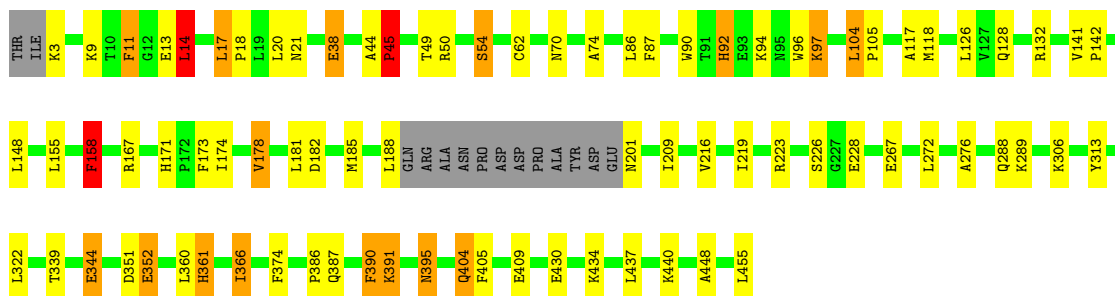
3 Residue-property plots [i](#)

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.

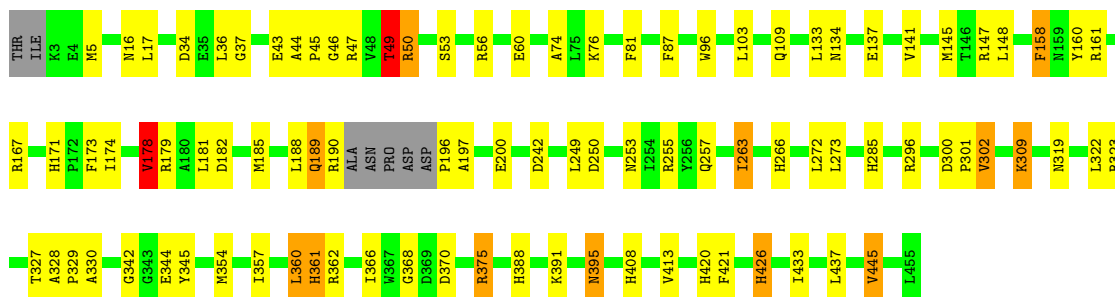
- Molecule 1: Bifunctional P-450:NADPH-P450 reductase

Chain A:  79% 14% . . .



- Molecule 1: Bifunctional P-450:NADPH-P450 reductase

Chain B:  78% 18% . .



4 Data and refinement statistics

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

Property	Value	Source
Space group	P 1 21 1	Depositor
Cell constants a, b, c, α , β , γ	59.61Å 152.98Å 61.77Å 90.00° 94.54° 90.00°	Depositor
Resolution (Å)	17.00 – 2.00	Depositor
% Data completeness (in resolution range)	(Not available) (17.00-2.00)	Depositor
R_{merge}	0.09	Depositor
R_{sym}	(Not available)	Depositor
Refinement program	REFMAC	Depositor
R, R_{free}	0.172 , 0.237	Depositor
Estimated twinning fraction	No twinning to report.	Xtriage
Total number of atoms	8407	wwPDB-VP
Average B, all atoms (Å ²)	28.0	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

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	0.81	0/3587	1.65	43/4857 (0.9%)
1	B	0.84	1/3660 (0.0%)	1.73	61/4952 (1.2%)
All	All	0.83	1/7247 (0.0%)	1.69	104/9809 (1.1%)

All (1) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	B	361	HIS	CE1-NE2	6.82	1.39	1.32

All (104) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	87	PHE	CA-CB-CG	12.03	125.83	113.80
1	B	47	ARG	N-CA-C	10.35	125.80	109.65
1	B	302	VAL	N-CA-CB	-8.41	99.44	111.21
1	B	445	VAL	N-CA-CB	-8.38	97.72	111.45
1	A	158	PHE	CA-CB-CG	8.04	121.84	113.80
1	A	391	LYS	CG-CD-CE	7.61	128.79	111.30
1	B	178	VAL	N-CA-CB	7.51	120.75	110.54
1	B	87	PHE	CA-CB-CG	7.40	121.20	113.80
1	B	158	PHE	CA-CB-CG	7.39	121.19	113.80
1	B	368	GLY	CA-C-O	-7.39	116.69	122.52
1	B	413	VAL	N-CA-C	7.00	117.79	110.72
1	B	266	HIS	N-CA-C	7.00	118.56	111.07
1	A	288	GLN	OE1-CD-NE2	-6.92	115.68	122.60
1	B	319	ASN	OD1-CG-ND2	-6.90	115.70	122.60
1	B	37	GLY	O-C-N	-6.83	117.03	122.90
1	B	357	ILE	O-C-N	-6.83	116.05	120.42
1	B	161	ARG	NE-CZ-NH2	-6.80	113.08	119.20
1	A	50	ARG	NE-CZ-NH2	6.71	125.24	119.20

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Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	395	ASN	N-CA-C	6.71	120.10	109.50
1	B	437	LEU	N-CA-C	-6.65	104.11	111.82
1	B	330	ALA	CA-C-O	-6.62	113.39	121.06
1	A	132	ARG	NE-CZ-NH1	-6.61	114.89	121.50
1	B	255	ARG	NE-CZ-NH2	6.55	125.09	119.20
1	B	395	ASN	N-CA-C	6.55	120.19	109.06
1	A	366	ILE	CB-CA-C	-6.53	105.24	111.44
1	A	132	ARG	NE-CZ-NH2	6.49	125.04	119.20
1	B	147	ARG	CD-NE-CZ	6.49	133.49	124.40
1	A	448	ALA	CA-C-O	-6.40	113.40	120.38
1	A	209	ILE	CA-C-O	6.33	128.07	121.05
1	B	263	ILE	CA-CB-CG2	6.32	121.24	110.50
1	A	405	PHE	CA-CB-CG	6.25	120.05	113.80
1	B	34	ASP	CA-CB-CG	6.20	118.80	112.60
1	B	36	LEU	CA-C-O	-6.18	112.11	119.15
1	B	263	ILE	CB-CG1-CD1	-6.16	100.87	113.80
1	A	38	GLU	N-CA-C	6.15	120.39	113.01
1	A	437	LEU	N-CA-C	-6.14	104.69	111.82
1	B	250	ASP	CA-CB-CG	6.13	118.73	112.60
1	A	96	TRP	N-CA-C	-6.11	104.55	111.14
1	B	56	ARG	CA-C-O	-6.10	114.08	120.55
1	A	86	LEU	N-CA-C	6.07	117.90	111.28
1	B	81	PHE	CA-CB-CG	6.07	119.87	113.80
1	B	327	THR	N-CA-C	5.96	120.16	113.01
1	A	391	LYS	CB-CA-C	-5.93	103.52	111.11
1	B	360	LEU	CA-C-O	5.91	127.02	120.63
1	A	11	PHE	CA-CB-CG	5.83	119.63	113.80
1	B	362	ARG	CD-NE-CZ	5.82	132.54	124.40
1	A	94	LYS	CA-C-O	-5.82	114.68	120.90
1	B	148	LEU	N-CA-C	5.82	117.29	111.07
1	A	276	ALA	O-C-N	-5.80	116.10	122.07
1	A	360	LEU	CA-C-O	5.76	126.66	120.55
1	B	329	PRO	N-CA-C	5.76	121.06	113.86
1	A	117	ALA	O-C-N	-5.75	116.02	122.12
1	B	375	ARG	NE-CZ-NH2	5.75	124.37	119.20
1	B	366	ILE	CB-CA-C	-5.73	105.04	111.80
1	A	361	HIS	CA-CB-CG	5.72	119.52	113.80
1	A	21	ASN	CA-CB-CG	-5.70	106.90	112.60
1	B	189	GLN	CB-CG-CD	5.69	122.27	112.60
1	B	103	LEU	N-CA-C	5.67	119.92	112.89
1	A	390	PHE	CA-C-O	5.67	126.45	120.33
1	B	50	ARG	NE-CZ-NH1	5.67	127.17	121.50

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Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	B	182	ASP	CA-CB-CG	5.64	118.24	112.60
1	B	47	ARG	CA-C-O	5.52	128.36	121.46
1	B	433	ILE	N-CA-C	5.52	115.59	107.15
1	A	216	VAL	CA-C-O	-5.47	115.06	120.85
1	A	50	ARG	NE-CZ-NH1	-5.44	116.06	121.50
1	A	70	ASN	OD1-CG-ND2	5.42	128.02	122.60
1	B	296	ARG	CD-NE-CZ	5.38	131.94	124.40
1	A	181	LEU	CA-C-O	5.35	126.09	120.42
1	A	182	ASP	N-CA-CB	-5.34	102.27	110.01
1	B	242	ASP	CA-CB-CG	5.34	117.94	112.60
1	B	179	ARG	CA-C-N	5.33	127.86	120.29
1	B	179	ARG	C-N-CA	5.33	127.86	120.29
1	A	339	THR	O-C-N	-5.32	117.72	123.42
1	B	96	TRP	CA-C-O	5.32	126.18	120.70
1	A	14	LEU	N-CA-C	-5.32	106.79	113.28
1	A	54	SER	CA-C-O	-5.29	115.04	121.28
1	A	13	GLU	CA-C-O	5.23	125.97	119.12
1	B	426	HIS	CA-CB-CG	-5.21	108.59	113.80
1	A	404	GLN	CB-CG-CD	5.21	121.46	112.60
1	B	87	PHE	N-CA-C	5.21	118.79	112.23
1	B	345	TYR	CA-C-N	5.20	125.36	119.90
1	B	345	TYR	C-N-CA	5.20	125.36	119.90
1	A	351	ASP	N-CA-CB	5.19	117.67	109.83
1	B	421	PHE	N-CA-C	5.18	117.06	109.24
1	B	285	HIS	CA-C-N	5.18	127.08	120.56
1	B	285	HIS	C-N-CA	5.18	127.08	120.56
1	B	249	LEU	CA-C-O	-5.17	115.52	121.47
1	B	420	HIS	CA-CB-CG	-5.17	108.63	113.80
1	B	328	ALA	N-CA-C	-5.17	97.54	108.39
1	B	178	VAL	CA-C-O	-5.16	115.58	120.95
1	B	147	ARG	N-CA-C	-5.16	105.55	111.07
1	B	273	LEU	O-C-N	-5.14	116.67	122.12
1	A	352	GLU	N-CA-C	5.14	118.59	109.96
1	B	17	LEU	CA-C-N	5.11	124.78	119.56
1	B	17	LEU	C-N-CA	5.11	124.78	119.56
1	A	167	ARG	N-CA-C	5.09	116.99	108.99
1	B	49	THR	OG1-CB-CG2	5.09	119.47	109.30
1	B	167	ARG	N-CA-C	5.09	117.11	109.23
1	B	96	TRP	CA-CB-CG	-5.04	104.02	113.60
1	A	374	PHE	CA-C-N	-5.04	116.22	122.42
1	A	374	PHE	C-N-CA	-5.04	116.22	122.42
1	A	17	LEU	CA-C-N	5.01	125.28	119.47

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Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	17	LEU	C-N-CA	5.01	125.28	119.47
1	A	387	GLN	O-C-N	-5.01	116.86	122.97

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	3506	0	3439	38	0
1	B	3577	0	3516	34	0
2	A	43	0	30	1	0
2	B	43	0	30	1	0
3	A	585	0	0	8	0
3	B	653	0	0	3	0
All	All	8407	0	7015	74	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 5.

All (74) 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:404:GLN:HG3	3:A:1004:HOH:O	1.72	0.90
1:A:361:HIS:HE1	1:A:391:LYS:H	1.29	0.79
1:B:171:HIS:HD2	1:B:173:PHE:H	1.32	0.77
1:B:361:HIS:HE1	1:B:391:LYS:H	1.33	0.76
1:A:74:ALA:HB1	1:A:185:MET:HE1	1.74	0.70
1:A:97:LYS:HB2	3:A:883:HOH:O	1.92	0.69
1:B:16:ASN:HD22	1:B:43:GLU:H	1.41	0.68
1:A:17:LEU:HB3	1:A:18:PRO:HD3	1.76	0.68
1:A:171:HIS:HD2	1:A:173:PHE:H	1.41	0.66
1:B:49:THR:HG21	1:B:354:MET:HG2	1.78	0.65
1:A:118:MET:HG3	3:A:988:HOH:O	1.98	0.62
1:B:171:HIS:CD2	1:B:173:PHE:H	2.15	0.61

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:391:LYS:NZ	1:A:395:ASN:HD22	2.00	0.59
1:A:49:THR:OG1	1:A:352:GLU:HG2	2.02	0.59
1:B:309:LYS:NZ	1:B:408:HIS:ND1	2.50	0.59
1:A:306:LYS:HG3	3:A:581:HOH:O	2.04	0.57
1:B:174:ILE:O	1:B:178:VAL:HG13	2.06	0.56
1:B:300:ASP:HB3	1:B:301:PRO:HD2	1.89	0.55
1:A:434:LYS:HD3	1:A:440:LYS:HE2	1.89	0.55
2:A:460:HEM:HMC1	2:A:460:HEM:HBC2	1.89	0.55
1:B:5:MET:HE1	1:B:50:ARG:HD3	1.89	0.54
1:B:370:ASP:OD2	1:B:375:ARG:NH1	2.37	0.54
1:A:118:MET:SD	1:A:155:LEU:HD13	2.48	0.54
1:B:76:LYS:HE2	3:B:832:HOH:O	2.08	0.54
1:B:391:LYS:NZ	1:B:395:ASN:HD22	2.06	0.53
1:A:289:LYS:HE2	1:A:313:TYR:CE1	2.43	0.53
1:A:201:ASN:N	3:A:562:HOH:O	2.40	0.53
1:B:189:GLN:HG2	3:B:1058:HOH:O	2.08	0.53
1:A:226:SER:OG	1:A:228:GLU:HG2	2.09	0.53
1:A:409:GLU:HG2	3:A:1025:HOH:O	2.09	0.52
1:A:141:VAL:HB	1:A:142:PRO:HD3	1.92	0.51
1:A:352:GLU:HB2	3:A:670:HOH:O	2.10	0.51
1:A:223:ARG:HD3	1:A:228:GLU:HG3	1.93	0.51
1:B:370:ASP:OD2	1:B:375:ARG:NH2	2.42	0.51
1:B:388:HIS:HD2	1:B:391:LYS:HZ3	1.59	0.50
1:A:174:ILE:O	1:A:178:VAL:HG13	2.12	0.50
1:B:200:GLU:OE2	1:B:200:GLU:HA	2.12	0.49
1:B:74:ALA:HB1	1:B:185:MET:HE1	1.95	0.48
1:A:38:GLU:HB2	1:A:54:SER:HB3	1.95	0.48
1:A:272:LEU:HD13	1:A:322:LEU:HG	1.94	0.48
1:A:62:CYS:HB3	1:A:395:ASN:ND2	2.29	0.48
1:B:109:GLN:HE22	1:B:309:LYS:NZ	2.12	0.48
1:B:190:ARG:HA	3:B:1027:HOH:O	2.14	0.48
1:A:44:ALA:HB1	1:A:45:PRO:HD2	1.96	0.48
1:B:323:ARG:HG2	1:B:361:HIS:HB3	1.94	0.48
1:A:391:LYS:HZ3	1:A:395:ASN:HD22	1.61	0.47
1:A:361:HIS:CE1	1:A:390:PHE:HA	2.50	0.47
1:A:158:PHE:CE2	1:A:219:ILE:HD13	2.50	0.47
1:B:60:GLU:OE2	1:B:342:GLY:HA2	2.15	0.46
1:A:9:LYS:HA	3:A:871:HOH:O	2.15	0.46
1:A:171:HIS:CD2	1:A:173:PHE:H	2.29	0.45
1:A:366:ILE:HD12	1:A:386:PRO:HG2	1.97	0.45
1:A:104:LEU:N	1:A:105:PRO:HD2	2.32	0.44

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:B:171:HIS:HD2	1:B:173:PHE:N	2.08	0.44
1:B:253:ASN:O	1:B:257:GLN:HG2	2.18	0.44
1:B:391:LYS:HZ3	1:B:395:ASN:HD22	1.66	0.44
1:B:160:TYR:OH	1:B:171:HIS:HE1	2.01	0.44
1:B:426:HIS:H	1:B:426:HIS:CD2	2.35	0.44
1:B:134:ASN:N	1:B:137:GLU:OE1	2.43	0.43
1:A:3:LYS:CD	1:A:344:GLU:HB3	2.49	0.43
1:B:141:VAL:O	1:B:145:MET:HG2	2.18	0.43
1:B:109:GLN:HE22	1:B:309:LYS:HZ2	1.65	0.43
1:A:11:PHE:O	1:A:14:LEU:HB2	2.19	0.43
1:A:17:LEU:HD22	1:A:45:PRO:HD2	2.01	0.42
1:B:272:LEU:HD13	1:B:322:LEU:HG	2.01	0.42
1:B:196:PRO:HG2	1:B:197:ALA:H	1.84	0.42
1:A:90:TRP:HB3	1:A:92:HIS:CE1	2.55	0.41
1:B:44:ALA:O	1:B:45:PRO:C	2.63	0.41
2:B:460:HEM:HMC1	2:B:460:HEM:HBC2	2.01	0.41
1:A:126:LEU:C	1:A:126:LEU:HD13	2.45	0.41
1:A:9:LYS:HE2	1:A:11:PHE:CE2	2.56	0.41
1:A:44:ALA:O	1:A:45:PRO:C	2.64	0.40
1:B:323:ARG:HA	1:B:361:HIS:CD2	2.56	0.40
1:B:53:SER:O	1:B:360:LEU:HA	2.21	0.40

There are no symmetry-related clashes.

5.3 Torsion angles ⓘ

5.3.1 Protein backbone ⓘ

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	437/455 (96%)	427 (98%)	9 (2%)	1 (0%)	43	42
1	B	444/455 (98%)	430 (97%)	13 (3%)	1 (0%)	43	42
All	All	881/910 (97%)	857 (97%)	22 (2%)	2 (0%)	43	42

All (2) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	45	PRO
1	B	46	GLY

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	371/399 (93%)	356 (96%)	15 (4%)	28	27
1	B	382/399 (96%)	371 (97%)	11 (3%)	37	40
All	All	753/798 (94%)	727 (96%)	26 (4%)	32	32

All (26) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	14	LEU
1	A	20	LEU
1	A	45	PRO
1	A	92	HIS
1	A	97	LYS
1	A	104	LEU
1	A	128	GLN
1	A	148	LEU
1	A	158	PHE
1	A	178	VAL
1	A	188	LEU
1	A	267	GLU
1	A	344	GLU
1	A	430	GLU
1	A	455	LEU
1	B	49	THR
1	B	133	LEU
1	B	158	PHE
1	B	178	VAL
1	B	181	LEU
1	B	188	LEU

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Mol	Chain	Res	Type
1	B	263	ILE
1	B	302	VAL
1	B	309	LYS
1	B	344	GLU
1	B	445	VAL

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (29) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	21	ASN
1	A	70	ASN
1	A	95	ASN
1	A	109	GLN
1	A	110	GLN
1	A	128	GLN
1	A	171	HIS
1	A	201	ASN
1	A	266	HIS
1	A	319	ASN
1	A	361	HIS
1	A	395	ASN
1	B	7	GLN
1	B	16	ASN
1	B	21	ASN
1	B	70	ASN
1	B	109	GLN
1	B	171	HIS
1	B	189	GLN
1	B	201	ASN
1	B	229	GLN
1	B	236	HIS
1	B	239	ASN
1	B	319	ASN
1	B	361	HIS
1	B	387	GLN
1	B	388	HIS
1	B	395	ASN
1	B	426	HIS

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 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	460	1,3	50,50,50	1.50	10 (20%)	67,82,82	1.00	3 (4%)
2	HEM	B	460	1,3	50,50,50	1.39	8 (16%)	67,82,82	0.82	1 (1%)

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	460	1,3	-	2/14/54/54	-
2	HEM	B	460	1,3	-	2/14/54/54	-

All (18) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
2	A	460	HEM	FE-ND	3.62	2.06	1.94

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Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
2	B	460	HEM	FE-NB	3.08	2.04	1.94
2	A	460	HEM	CMC-C2C	2.98	1.56	1.50
2	B	460	HEM	FE-ND	2.85	2.03	1.94
2	A	460	HEM	CMB-C2B	2.85	1.56	1.50
2	A	460	HEM	CMD-C2D	2.71	1.56	1.50
2	A	460	HEM	FE-NB	2.65	2.03	1.94
2	B	460	HEM	CMD-C2D	2.62	1.56	1.50
2	A	460	HEM	CAC-C3C	2.56	1.54	1.47
2	A	460	HEM	CMA-C3A	2.50	1.55	1.50
2	B	460	HEM	CAB-C3B	2.43	1.53	1.47
2	B	460	HEM	CAC-C3C	2.34	1.53	1.47
2	A	460	HEM	CAA-C2A	2.21	1.57	1.51
2	B	460	HEM	CMC-C2C	2.15	1.55	1.50
2	B	460	HEM	FE-NC	2.07	2.02	1.95
2	A	460	HEM	C3B-C2B	-2.07	1.33	1.37
2	A	460	HEM	CAB-C3B	2.04	1.52	1.47
2	B	460	HEM	C3B-C4B	2.03	1.48	1.44

All (4) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
2	A	460	HEM	C3B-C2B-C1B	3.49	109.03	106.41
2	A	460	HEM	O2A-CGA-CBA	2.57	122.11	114.00
2	B	460	HEM	C3B-C2B-C1B	2.53	108.31	106.41
2	A	460	HEM	CHB-C4A-NA	2.05	127.58	123.86

There are no chirality outliers.

All (4) torsion outliers are listed below:

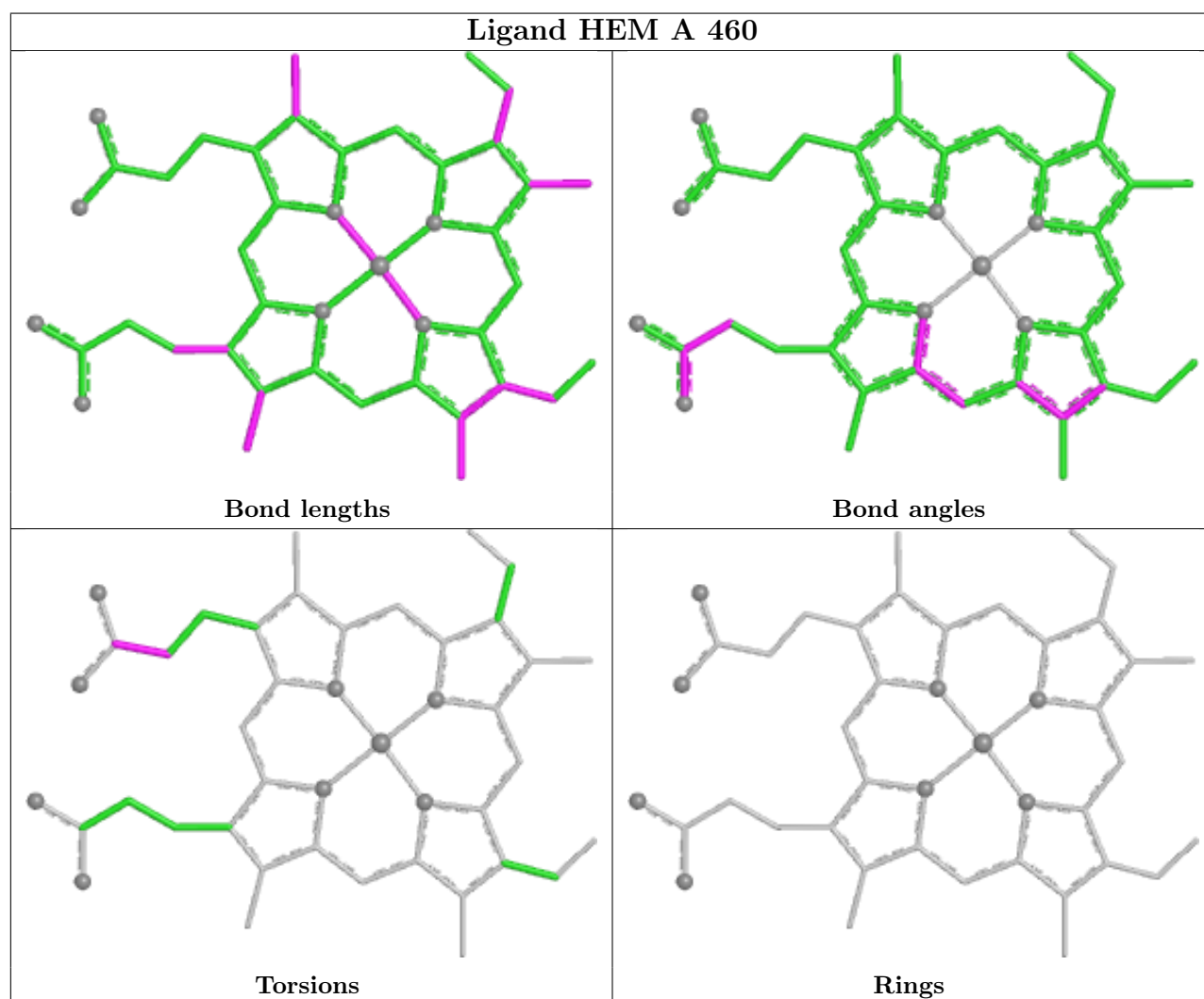
Mol	Chain	Res	Type	Atoms
2	B	460	HEM	CAD-CBD-CGD-O1D
2	B	460	HEM	CAD-CBD-CGD-O2D
2	A	460	HEM	CAD-CBD-CGD-O1D
2	A	460	HEM	CAD-CBD-CGD-O2D

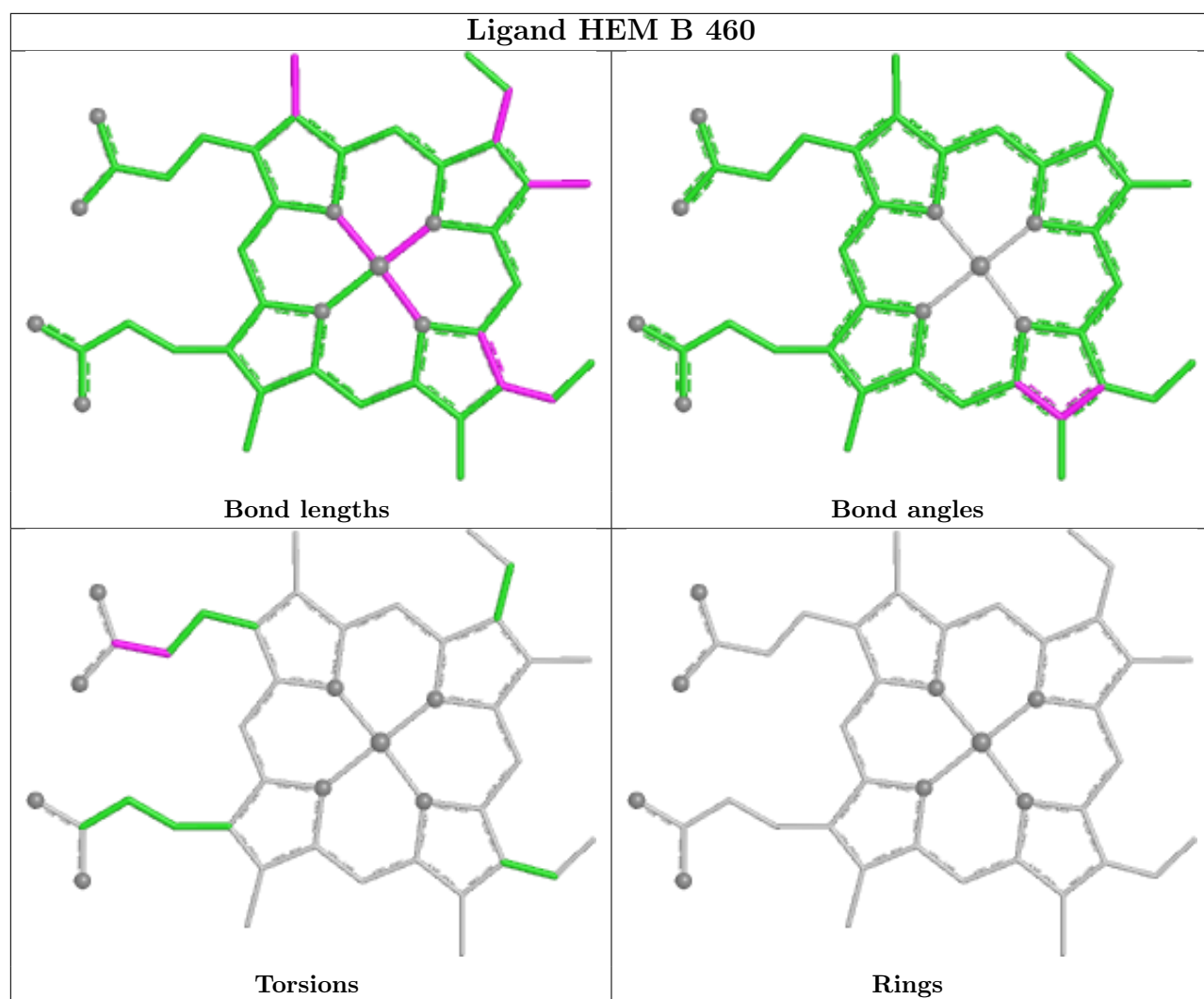
There are no ring outliers.

2 monomers are involved in 2 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
2	A	460	HEM	1	0
2	B	460	HEM	1	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.