



wwPDB X-ray Structure Validation Summary Report ⓘ

Sep 18, 2023 – 02:20 PM EDT

PDB ID : 8CAT
Title : The NADPH binding site on beef liver catalase
Authors : Murthy, M.R.N.; Reid III, T.J.; Sicignano, A.; Tanaka, N.; Fita, I.; Rossmann, M.G.
Deposited on : 1984-11-15
Resolution : 2.50 Å (reported)

This is a wwPDB X-ray Structure Validation Summary 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 : 4.02b-467
Mogul : 1.8.5 (274361), CSD as541be (2020)
Xtrriage (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) : 2.35.1

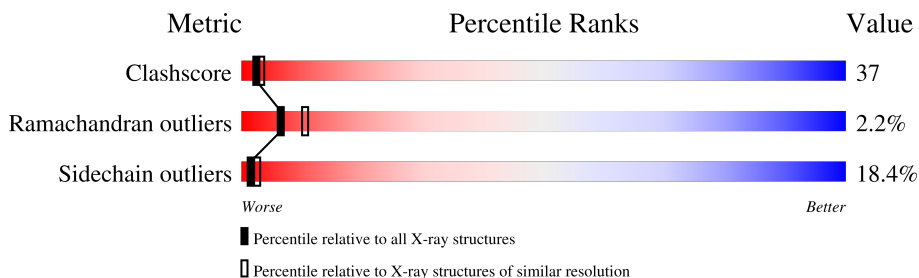
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 2.50 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	5346 (2.50-2.50)
Ramachandran outliers	138981	5231 (2.50-2.50)
Sidechain outliers	138945	5233 (2.50-2.50)

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	506	
1	B	506	

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	NDP	A	508	X	-	-	-
3	NDP	B	508	X	-	-	-

2 Entry composition [i](#)

There are 4 unique types of molecules in this entry. The entry contains 8296 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 CATALASE.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
1	A	498	4008	2543	714	737	14	0	0	0
1	B	498	4008	2543	714	737	14	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
2	B	1	43	34	1	4	4	0	0

- Molecule 3 is NADPH DIHYDRO-NICOTINAMIDE-ADENINE-DINUCLEOTIDE PHOSPHATE (three-letter code: NDP) (formula: $C_{21}H_{30}N_7O_{17}P_3$).



Mol	Chain	Residues	Atoms				ZeroOcc	AltConf	
			Total	C	N	O			P
3	A	1	48	21	7	17	3	0	0
3	B	1	48	21	7	17	3	0	0

- Molecule 4 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
4	A	48	Total	O	0	0
			48	48		
4	B	50	Total	O	0	0
			50	50		

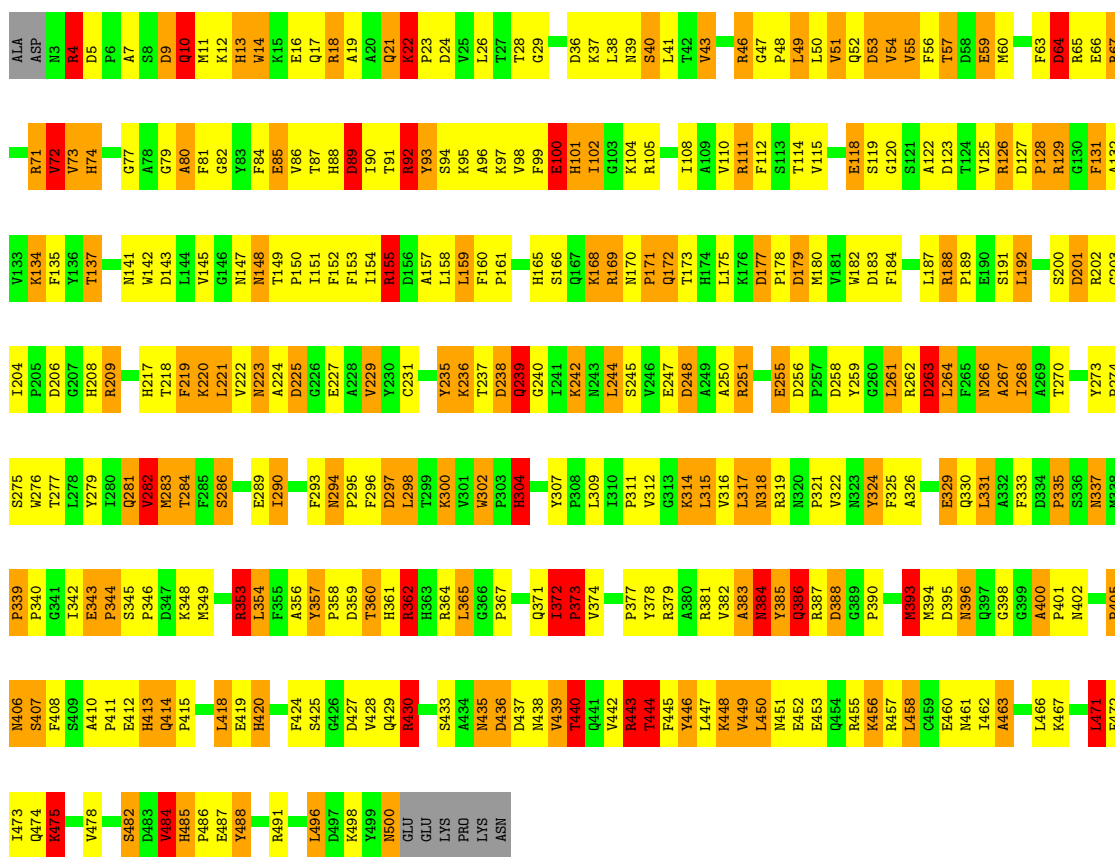
3 Residue-property plots

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.

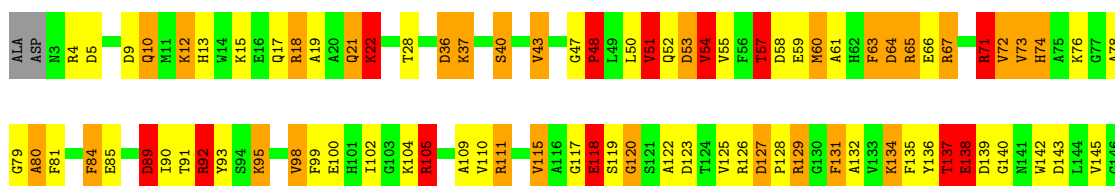
- Molecule 1: CATALASE

Chain A: 



- Molecule 1: CATALASE

Chain B: 



GLU	D436	M147	L221	F283	L365	D436	L365	D436	L365
GLU	D437	M148	V222	R294	Y369	D437	Y369	D437	L492
LYS	N438	T149	R223	P295	L370	N438	L370	N438	I492
PRO	N439	A224	A224	F296	L371	N439	L371	N439	Q493
LYS	T440	I151	D225	P297	Q371	T440	Q371	T440	A494
ASN	Q441	F152	L288	D297	Q441	Q441	Q441	Q441	L495
	Y442	F153	L288	L288	P373	Y442	P373	Y442	L496
	R443	I154	A228	T299	V374	R443	V374	R443	D497
	T444	R155	V229	K300	N375	T444	N375	T444	K498
	F445	D156	Y230	V301	Y378	F445	Y378	F445	
	Y446	A157	C231	W302	R379	Y446	R379	Y446	
	K447	L158	Y235	H304	A380	K447	A380	K447	
	K448	L159	K236	G305	R381	K448	R381	K448	
	V449	F160	T237	D306	V382	V449	V382	V449	
	N451	S162	Q239	P308	A383	N451	A383	N451	
	E452	F163	K242	L309	Y384	E452	Y384	E452	
	E453	K168	W243	I310	Y385	E453	Y385	E453	
	Q454	R169	L244	P311	R386	Q454	R386	Q454	
	R455	M170	S245	V312	R387	R455	R387	R455	
	R456	Q171	V246	G313	D388	R456	D388	R456	
	R457	Q172	E247	K314	C392	R457	C392	R457	
	L458	T173	D248	L315	M393	L458	M393	L458	
	E459	H174	R251	V316	M394	E459	M394	E459	
	E460	L175	L252	M318	D395	E460	D395	E460	
	H461	K176	L252	R319	N396	H461	N396	H461	
	I462	D177	L261	M320	A400	I462	A400	I462	
	L466	P178	R262	P321	P401	L466	P401	L466	
	K467	D179	D263	V322	N402	K467	N402	K467	
	D468	M180	L264	L331	Y403	D468	Y403	D468	
	A469	W181	F265	A332	Y404	A469	Y404	A469	
	Q470	E182	W266	F333	P405	Q470	P405	Q470	
	F471	D183	A267	D334	N406	F471	N406	F471	
	F472	S186	L266	P335	S407	F472	S407	F472	
	K475	L187	F265	S336	F408	K475	F408	K475	
	K476	R188	W266	M337	S409	K476	S409	K476	
	A477	P189	A267	M338	A410	A477	A410	A477	
	V478	E190	N272	R339	P411	V478	P411	V478	
	K479	S191	Y273	E343	H413	K479	H413	K479	
	S482	L192	P274	H413	Q414	S482	Q414	S482	
	D483	H193	S275	Q414	P415	D483	P415	D483	
	V484	Q194	W276	S416	A417	V484	A417	V484	
	H485	V195	Y279	A417	H420	H485	H420	H485	
	P486	L198	I280	H420	R421	P486	R421	P486	
	E487	D201	V281	R421	H421	E487	H421	E487	
	Y488	R202	W282	L350	G352	Y488	G352	Y488	
	R491	D206	M283	R353	L354	R491	L354	R491	
	I492	T284	F285	L354	F355	I492	F355	I492	
	Q493	F285	A356	A356	D427	Q493	D427	Q493	
	A494	R209	S286	A356	V428	A494	V428	A494	
	L495	E287	E287	A356	I495	L495	I495	L495	
	L496	A288	A288	A356	Q429	L496	Q429	L496	
	D497	E289	E289	A356	R430	D497	R430	D497	
	K498	L290	L290	A356	F431	K498	F431	K498	
	Y499	F291	P292	A356	M432	Y499	M432	Y499	
	N500	K220		A356	N435	N500	N435	N500	

4 Data and refinement statistics

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

Property	Value	Source
Space group	P 32 2 1	Depositor
Cell constants a, b, c, α , β , γ	142.00Å 142.00Å 103.70Å 90.00° 90.00° 120.00°	Depositor
Resolution (Å)	8.50 – 2.50	Depositor
% Data completeness (in resolution range)	(Not available) (8.50-2.50)	Depositor
R_{merge}	(Not available)	Depositor
R_{sym}	(Not available)	Depositor
Refinement program	unknown	Depositor
R, R_{free}	0.191 , (Not available)	Depositor
Estimated twinning fraction	No twinning to report.	Xtrriage
Total number of atoms	8296	wwPDB-VP
Average B, all atoms (Å ²)	21.0	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: NDP, 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	1.53	22/4128 (0.5%)	2.37	193/5607 (3.4%)
1	B	1.57	21/4128 (0.5%)	2.42	233/5607 (4.2%)
All	All	1.55	43/8256 (0.5%)	2.39	426/11214 (3.8%)

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	4
1	B	0	2
All	All	0	6

The worst 5 of 43 bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	A	67	ARG	CD-NE	-6.84	1.34	1.46
1	A	343	GLU	N-CA	6.50	1.59	1.46
1	A	166	SER	CB-OG	6.44	1.50	1.42
1	B	100	GLU	CD-OE2	-6.35	1.18	1.25
1	B	119	SER	CB-OG	-6.28	1.34	1.42

The worst 5 of 426 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	67	ARG	CD-NE-CZ	25.87	159.81	123.60
1	B	92	ARG	NE-CZ-NH1	23.31	131.96	120.30
1	B	126	ARG	NE-CZ-NH2	21.07	130.84	120.30
1	B	261	LEU	CA-CB-CG	20.41	162.25	115.30

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Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	362	ARG	NE-CZ-NH2	-20.39	110.11	120.30

There are no chirality outliers.

5 of 6 planarity outliers are listed below:

Mol	Chain	Res	Type	Group
1	A	353	ARG	Sidechain
1	A	362	ARG	Sidechain
1	A	430	ARG	Sidechain
1	A	71	ARG	Sidechain
1	B	105	ARG	Sidechain

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	4008	0	3830	327	3
1	B	4008	0	3825	292	2
2	A	43	0	30	15	0
2	B	43	0	30	11	0
3	A	48	0	24	0	0
3	B	48	0	24	3	0
4	A	48	0	0	4	1
4	B	50	0	0	5	0
All	All	8296	0	7763	597	3

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 37.

The worst 5 of 597 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:155:ARG:NH2	1:A:438:ASN:HD21	1.19	1.38
1:A:155:ARG:HH22	1:A:438:ASN:ND2	1.28	1.31
1:B:155:ARG:HH22	1:B:438:ASN:ND2	1.27	1.29

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:B:155:ARG:NH2	1:B:438:ASN:HD21	1.34	1.26
1:A:367:PRO:HG2	1:A:390:PRO:HG2	1.19	1.14

All (3) symmetry-related close contacts are listed below. The label for Atom-2 includes the symmetry operator and encoded unit-cell translations to be applied.

Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:419:GLU:OE2	1:B:430:ARG:NH1[6_556]	1.78	0.42
1:A:10:GLN:NE2	4:A:541:HOH:O[6_556]	1.86	0.34
1:A:183:ASP:OD1	1:B:407:SER:OG[6_556]	2.12	0.08

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	496/506 (98%)	418 (84%)	64 (13%)	14 (3%)	5 7
1	B	496/506 (98%)	425 (86%)	63 (13%)	8 (2%)	9 17
All	All	992/1012 (98%)	843 (85%)	127 (13%)	22 (2%)	6 10

5 of 22 Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	242	LYS
1	A	267	ALA
1	A	373	PRO
1	A	440	THR
1	A	451	ASN

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	430/437 (98%)	351 (82%)	79 (18%)	1	2
1	B	430/437 (98%)	351 (82%)	79 (18%)	1	2
All	All	860/874 (98%)	702 (82%)	158 (18%)	1	2

5 of 158 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	B	236	LYS
1	B	406	ASN
1	B	247	GLU
1	B	337	ASN
1	B	450	LEU

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. 5 of 53 such sidechains are listed below:

Mol	Chain	Res	Type
1	B	21	GLN
1	B	281	GLN
1	B	429	GLN
1	B	148	ASN
1	B	223	ASN

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](#)

4 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	NDP	A	508	-	45,52,52	2.52	11 (24%)	53,80,80	2.20	12 (22%)
2	HEM	B	507	1	41,50,50	1.46	7 (17%)	45,82,82	2.14	12 (26%)
3	NDP	B	508	-	45,52,52	2.54	11 (24%)	53,80,80	2.20	12 (22%)
2	HEM	A	507	1	41,50,50	1.55	9 (21%)	45,82,82	2.45	18 (40%)

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	NDP	A	508	-	1/1/14/17	3/30/77/77	0/5/5/5
2	HEM	B	507	1	-	1/12/54/54	-
3	NDP	B	508	-	1/1/14/17	3/30/77/77	0/5/5/5
2	HEM	A	507	1	-	0/12/54/54	-

The worst 5 of 38 bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
3	B	508	NDP	O4B-C1B	9.67	1.54	1.41
3	A	508	NDP	O4B-C1B	9.62	1.54	1.41
3	B	508	NDP	P2B-O2B	8.71	1.75	1.59
3	A	508	NDP	P2B-O2B	8.60	1.75	1.59
3	B	508	NDP	O3B-C3B	-5.10	1.31	1.43

The worst 5 of 54 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
3	A	508	NDP	O3B-C3B-C4B	9.48	138.46	111.05
3	B	508	NDP	O3B-C3B-C4B	9.46	138.40	111.05
2	A	507	HEM	C4B-CHC-C1C	6.55	131.21	122.56
2	B	507	HEM	CMC-C2C-C3C	6.41	136.67	124.68
3	A	508	NDP	O4B-C1B-C2B	-6.36	95.55	106.59

All (2) chirality outliers are listed below:

Mol	Chain	Res	Type	Atom
3	A	508	NDP	C3B
3	B	508	NDP	C3B

5 of 7 torsion outliers are listed below:

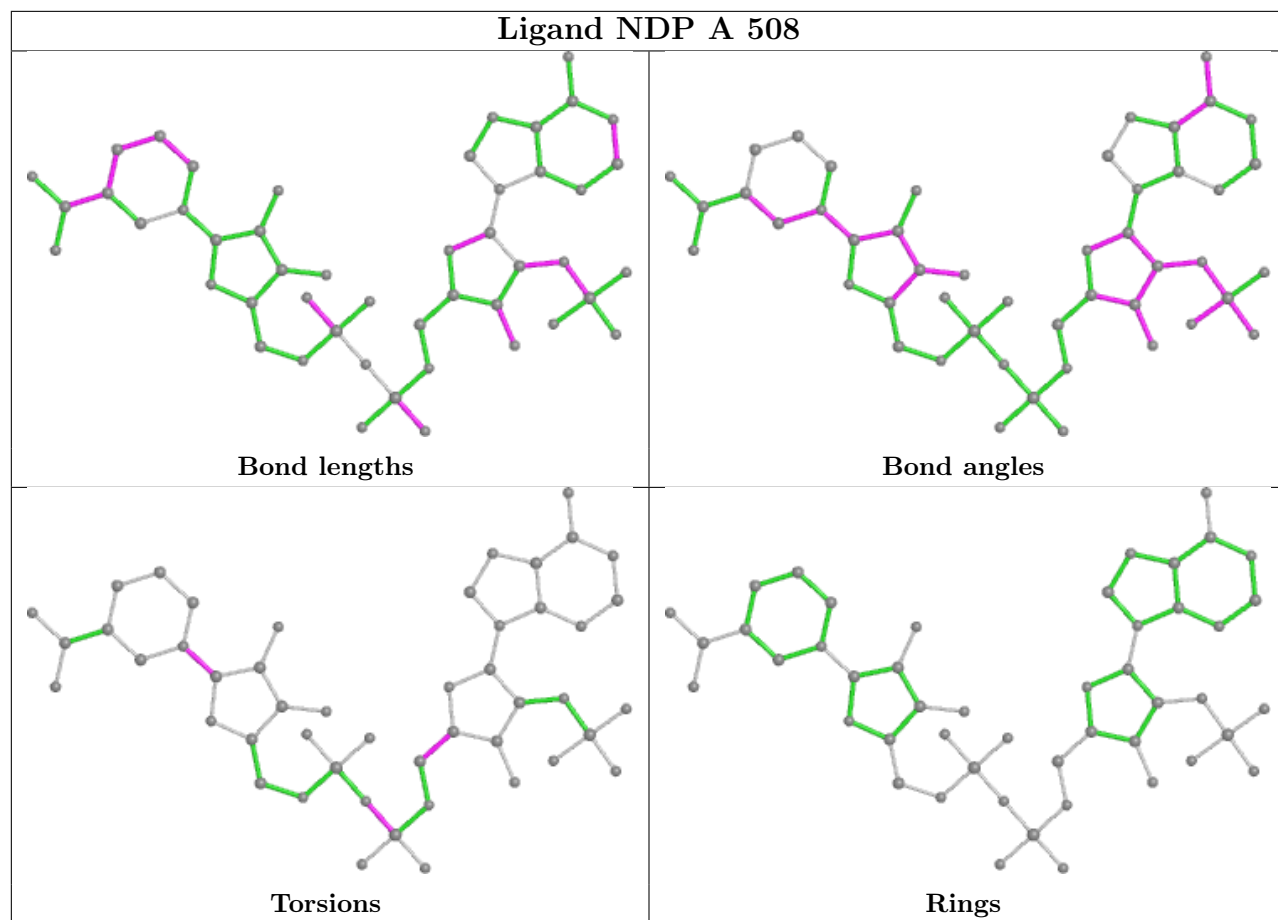
Mol	Chain	Res	Type	Atoms
3	A	508	NDP	O4B-C4B-C5B-O5B
3	B	508	NDP	O4B-C4B-C5B-O5B
3	A	508	NDP	PN-O3-PA-O2A
3	B	508	NDP	PN-O3-PA-O2A
3	A	508	NDP	O4D-C1D-N1N-C6N

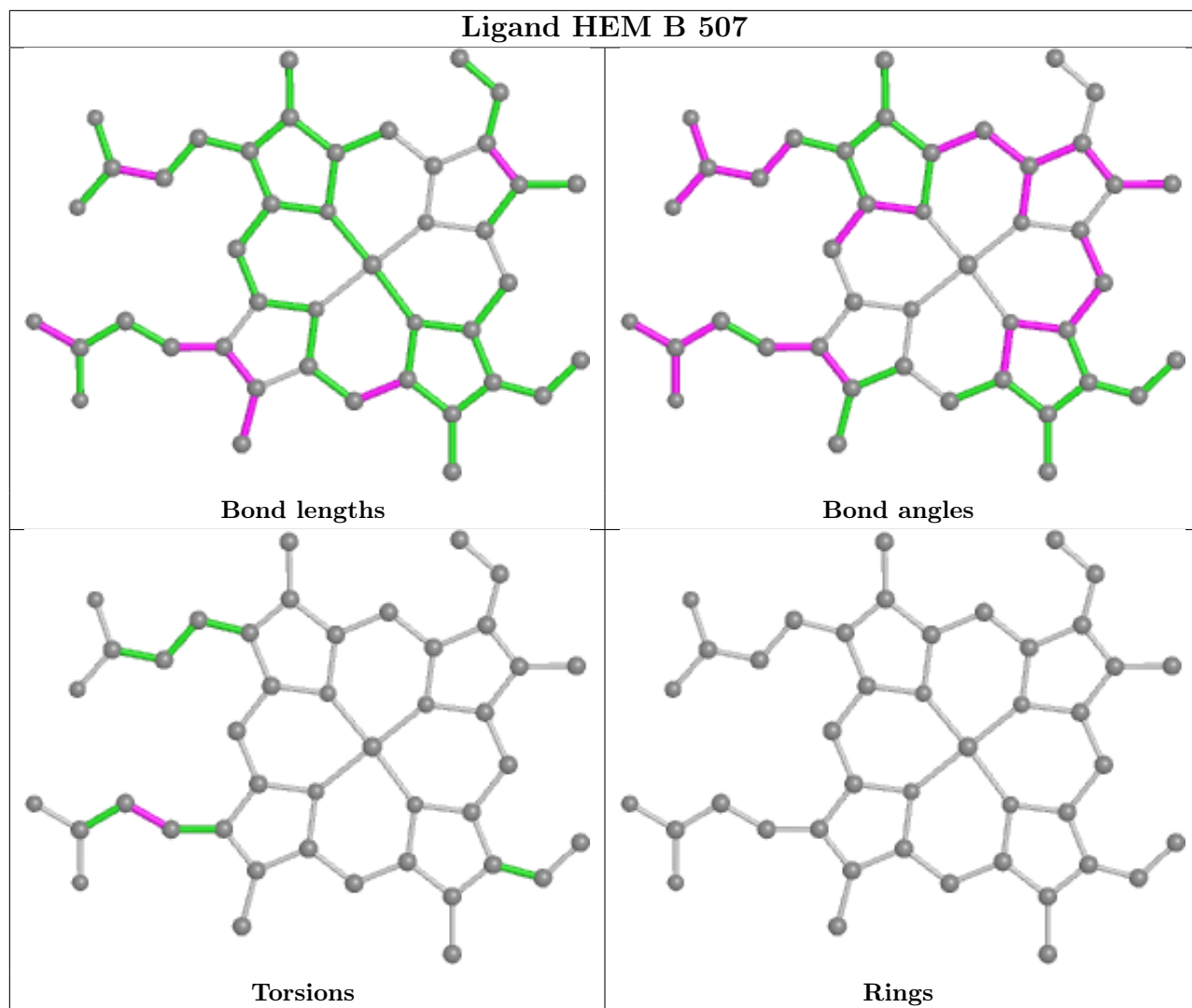
There are no ring outliers.

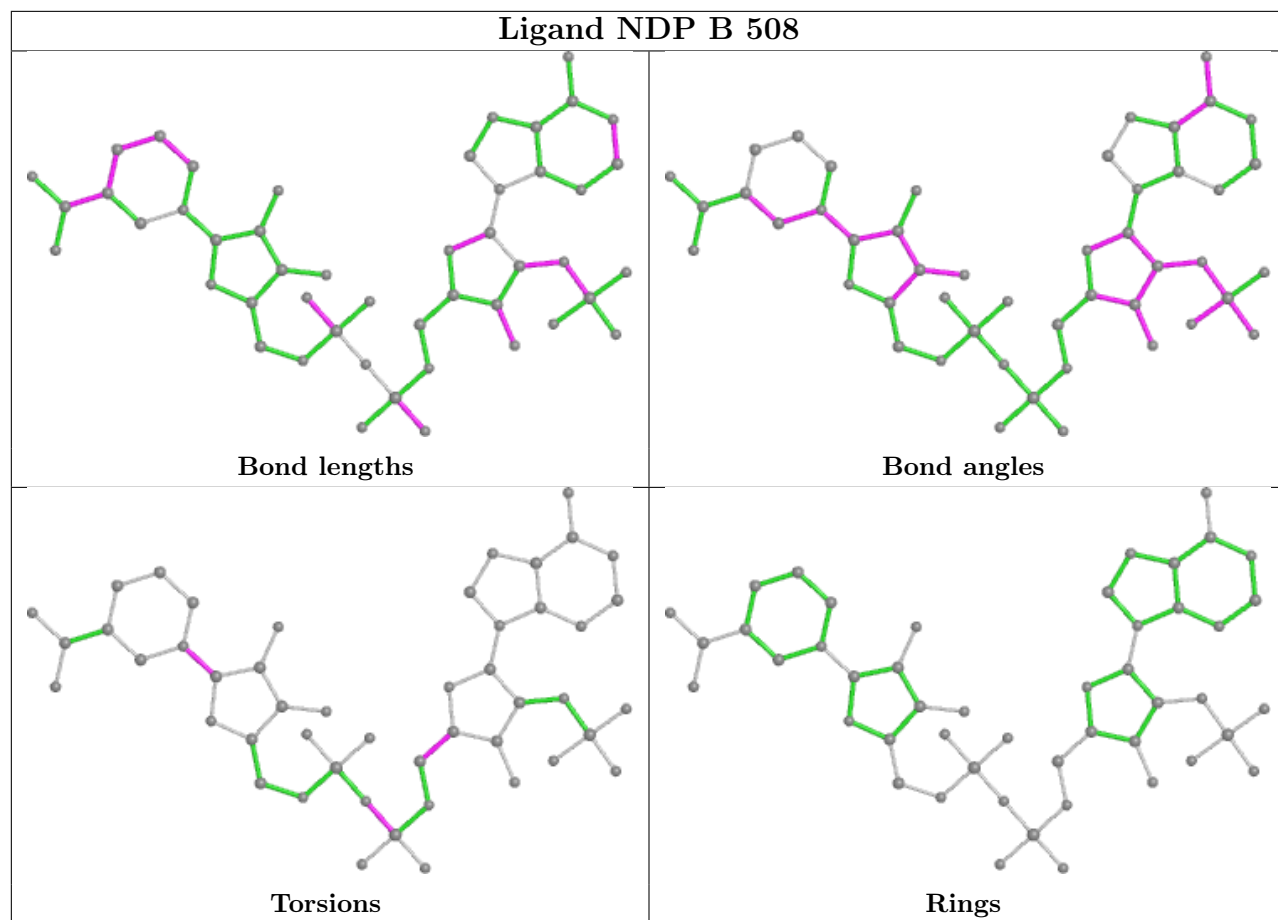
3 monomers are involved in 29 short contacts:

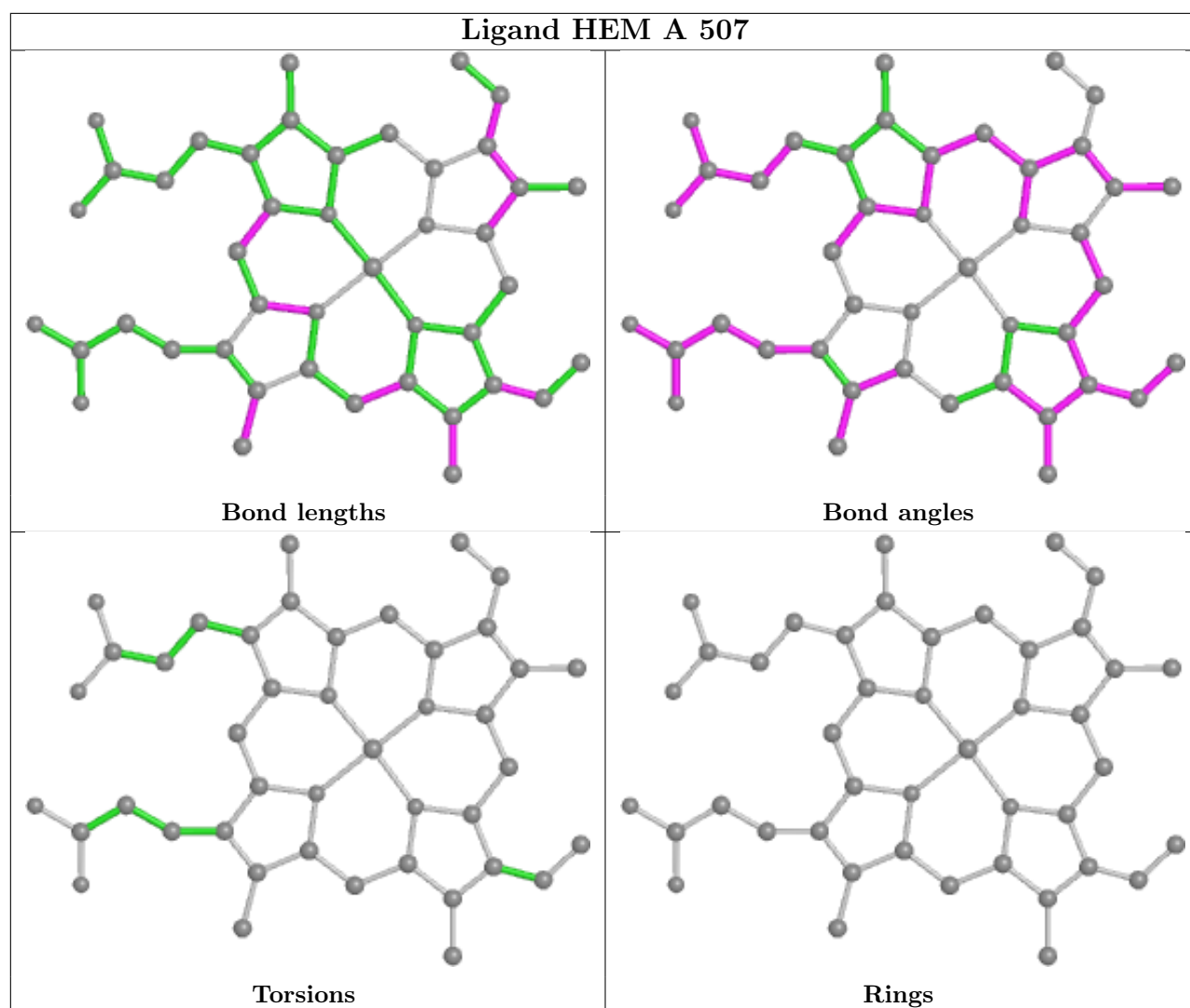
Mol	Chain	Res	Type	Clashes	Symm-Clashes
2	B	507	HEM	11	0
3	B	508	NDP	3	0
2	A	507	HEM	15	0

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 [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.