Full wwPDB X-ray Structure Validation Report ⓘ

Oct 17, 2021 – 12:41 AM EDT

PDB ID	:	1NZ4
Title	:	The horse heart myoglobin variant K45E/K63E complexed with Cadmium
Authors	:	Hunter, C.L.; Maurus, R.; Mauk, M.R.; Lee, H.; Raven, E.L.; Tong, H.; Nguyen, N.; Smith, S.; Brayer, G.D.; Mauk, A.G.
Deposited on	:	2003-02-15
Resolution	:	1.80 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:

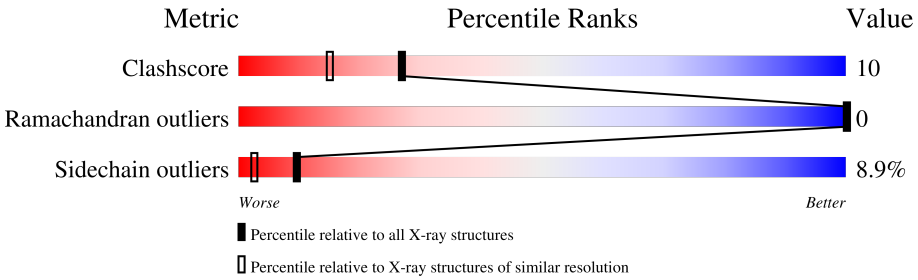
MolProbity	:	4.02b-467
Mogul	:	1.8.5 (274361), CSD as541be (2020)
Xtriage (Phenix)	:	NOT EXECUTED
EDS	:	NOT EXECUTED
buster-report	:	1.1.7 (2018)
Percentile statistics	:	20191225.v01 (using entries in the PDB archive December 25th 2019)
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, RNA)	:	Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP)	:	2.23.2

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 1.80 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	6793 (1.80-1.80)
Ramachandran outliers	138981	6697 (1.80-1.80)
Sidechain outliers	138945	6696 (1.80-1.80)

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 <=5%

Note EDS was not executed.

Mol	Chain	Length	Quality of chain
1	A	153	66% 26% 7%

2 Entry composition (i)

There are 4 unique types of molecules in this entry. The entry contains 1297 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 Myoglobin.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
1	A	153	1199	767	208	222	2	7	0	0

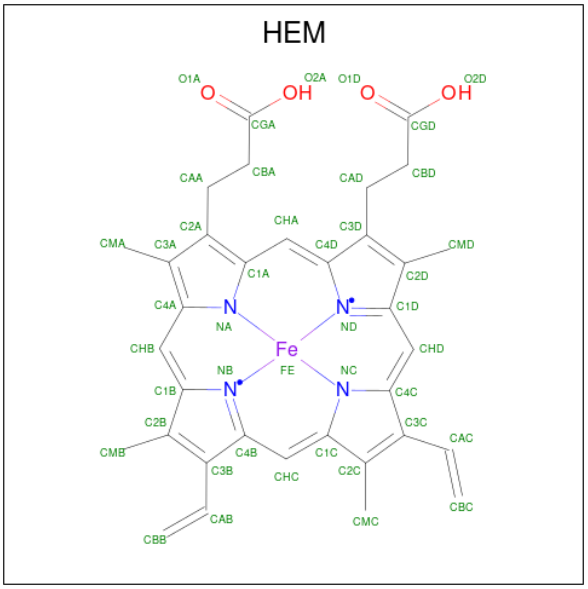
There are 2 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	45	GLU	LYS	engineered mutation	UNP P68082
A	63	GLU	LYS	engineered mutation	UNP P68082

- Molecule 2 is CADMIUM ION (three-letter code: CD) (formula: Cd).

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
			Total	Cd		
2	A	2	2	2	0	0

- Molecule 3 is PROTOPORPHYRIN IX CONTAINING FE (three-letter code: HEM) (formula: $C_{34}H_{32}FeN_4O_4$).



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

- Molecule 4 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
4	A	53	Total	O	0	0
			53	53		

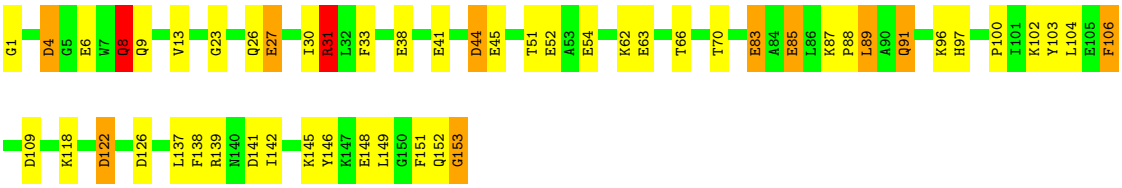
3 Residue-property plots (i)

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: Myoglobin

Chain A:



4 Data and refinement statistics (i)

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	29.30Å 35.80Å 125.10Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	10.00 – 1.80	Depositor
% Data completeness (in resolution range)	87.0 (10.00-1.80)	Depositor
R_{merge}	0.07	Depositor
R_{sym}	(Not available)	Depositor
Refinement program	PROLSQ	Depositor
R, R_{free}	0.199 , (Not available)	Depositor
Estimated twinning fraction	No twinning to report.	Xtriage
Total number of atoms	1297	wwPDB-VP
Average B, all atoms (Å^2)	19.0	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: HEM, CD

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	1.24	3/1226 (0.2%)	1.91	33/1647 (2.0%)

All (3) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	A	44	ASP	C-N	-10.79	1.09	1.34
1	A	54	GLU	CD-OE1	-5.18	1.20	1.25
1	A	6	GLU	CD-OE1	-5.03	1.20	1.25

All (33) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(^{o})	Ideal(^{o})
1	A	31	ARG	CD-NE-CZ	15.98	145.97	123.60
1	A	139	ARG	NE-CZ-NH1	15.34	127.97	120.30
1	A	8	GLN	CB-CG-CD	12.33	143.65	111.60
1	A	33	PHE	CB-CG-CD2	-10.23	113.64	120.80
1	A	141	ASP	CB-CG-OD1	9.93	127.23	118.30
1	A	146	TYR	CB-CG-CD2	9.66	126.80	121.00
1	A	33	PHE	CB-CG-CD1	9.06	127.14	120.80
1	A	106	PHE	CB-CG-CD1	-8.71	114.70	120.80
1	A	122	ASP	CB-CG-OD1	8.34	125.81	118.30
1	A	106	PHE	CB-CG-CD2	8.31	126.62	120.80
1	A	109	ASP	CB-CG-OD1	8.28	125.75	118.30
1	A	146	TYR	CB-CG-CD1	-7.91	116.25	121.00
1	A	83	GLU	CB-CG-CD	7.45	134.30	114.20
1	A	27	GLU	CA-CB-CG	7.28	129.41	113.40
1	A	38	GLU	OE1-CD-OE2	-7.19	114.67	123.30
1	A	1	GLY	CA-C-O	6.84	132.91	120.60
1	A	85	GLU	CA-CB-CG	6.63	127.98	113.40
1	A	153	GLY	CA-C-O	-6.55	108.80	120.60

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Mol	Chain	Res	Type	Atoms	Z	Observed(^{o})	Ideal(^{o})
1	A	139	ARG	NH1-CZ-NH2	-6.21	112.56	119.40
1	A	31	ARG	NE-CZ-NH2	6.08	123.34	120.30
1	A	139	ARG	CD-NE-CZ	6.04	132.05	123.60
1	A	148	GLU	CA-CB-CG	6.00	126.60	113.40
1	A	8	GLN	CB-CA-C	5.73	121.86	110.40
1	A	83	GLU	CA-CB-CG	5.68	125.90	113.40
1	A	126	ASP	CB-CG-OD1	5.68	123.41	118.30
1	A	44	ASP	CB-CG-OD1	5.60	123.34	118.30
1	A	83	GLU	OE1-CD-OE2	-5.55	116.64	123.30
1	A	151	PHE	O-C-N	5.50	131.51	122.70
1	A	8	GLN	OE1-CD-NE2	-5.30	109.70	121.90
1	A	103	TYR	CG-CD2-CE2	5.30	125.54	121.30
1	A	122	ASP	OD1-CG-OD2	-5.15	113.51	123.30
1	A	85	GLU	OE1-CD-OE2	5.11	129.44	123.30
1	A	45	GLU	CB-CA-C	-5.09	100.22	110.40

There are no chirality outliers.

There are no planarity outliers.

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	1199	0	1197	25	1
2	A	2	0	0	0	0
3	A	43	0	30	0	0
4	A	53	0	0	4	0
All	All	1297	0	1227	25	1

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 (25) 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:66:THR:O	1:A:70:THR:HG22	1.73	0.88

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:27:GLU:HG3	1:A:118:LYS:HD2	1.69	0.75
1:A:122:ASP:HB3	4:A:218:HOH:O	1.90	0.70
1:A:96:LYS:HD2	1:A:97:HIS:CE1	2.28	0.68
1:A:23:GLY:O	1:A:27:GLU:HG2	1.99	0.62
1:A:26:GLN:OE1	1:A:62:LYS:HE2	1.99	0.61
1:A:70:THR:HG23	4:A:185:HOH:O	2.02	0.59
1:A:87:LYS:CE	1:A:145:LYS:HD2	2.32	0.58
1:A:9:GLN:O	1:A:13:VAL:HG12	2.04	0.57
1:A:87:LYS:HG3	1:A:91:GLN:HE22	1.72	0.53
1:A:87:LYS:CD	1:A:145:LYS:HD2	2.38	0.53
1:A:102:LYS:HE3	1:A:106:PHE:CE2	2.45	0.52
1:A:31:ARG:HD2	4:A:193:HOH:O	2.10	0.52
1:A:31:ARG:O	1:A:31:ARG:HD3	2.11	0.49
1:A:4:ASP:OD2	1:A:8:GLN:NE2	2.47	0.48
1:A:104:LEU:CD1	1:A:142:ILE:HD13	2.45	0.47
1:A:87:LYS:N	1:A:88:PRO:HD2	2.30	0.47
1:A:138:PHE:CZ	1:A:142:ILE:HD11	2.50	0.47
1:A:87:LYS:HG3	1:A:91:GLN:NE2	2.30	0.46
1:A:30:ILE:HG21	1:A:52:GLU:HG3	1.98	0.44
1:A:91:GLN:HG3	1:A:149:LEU:HD11	2.00	0.43
1:A:87:LYS:NZ	1:A:145:LYS:HD2	2.34	0.42
1:A:104:LEU:HD11	1:A:142:ILE:HD13	2.03	0.41
1:A:100:PRO:HA	1:A:153:GLY:O	2.21	0.41
1:A:89:LEU:HD22	4:A:195:HOH:O	2.21	0.40

All (1) 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:51:THR:OG1	1:A:63:GLU:OE1[3_745]	2.05	0.15

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	151/153 (99%)	148 (98%)	3 (2%)	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	123/123 (100%)	112 (91%)	11 (9%)	9 2

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

Mol	Chain	Res	Type
1	A	4	ASP
1	A	8	GLN
1	A	31	ARG
1	A	41	GLU
1	A	44	ASP
1	A	83	GLU
1	A	85	GLU
1	A	89	LEU
1	A	91	GLN
1	A	137	LEU
1	A	152	GLN

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (1) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	128	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 monosaccharides in this entry.

5.6 Ligand geometry (i)

Of 3 ligands modelled in this entry, 2 are 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	$\#\|Z\| > 2$
3	HEM	A	154	2,4,1	27,50,50	2.09	11 (40%)	17,82,82	3.45	7 (41%)

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	154	2,4,1	-	0/6/54/54	-

All (11) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
3	A	154	HEM	C3C-C2C	-4.13	1.34	1.40
3	A	154	HEM	C3B-CAB	3.72	1.55	1.47
3	A	154	HEM	C3B-C2B	-3.51	1.35	1.40
3	A	154	HEM	CAD-C3D	3.45	1.58	1.52
3	A	154	HEM	CBB-CAB	3.43	1.52	1.29
3	A	154	HEM	C1C-C2C	2.72	1.48	1.42
3	A	154	HEM	C3C-CAC	2.55	1.53	1.47
3	A	154	HEM	CBC-CAC	2.54	1.46	1.29

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Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
3	A	154	HEM	CAA-C2A	2.38	1.55	1.52
3	A	154	HEM	C1D-CHD	-2.14	1.35	1.41
3	A	154	HEM	C4A-CHB	-2.03	1.35	1.41

All (7) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(^{o})	Ideal(^{o})
3	A	154	HEM	CAD-CBD-CGD	12.10	132.97	112.67
3	A	154	HEM	CMD-C2D-C1D	-3.40	123.23	128.46
3	A	154	HEM	CMA-C3A-C4A	-3.15	123.62	128.46
3	A	154	HEM	CMC-C2C-C3C	3.02	130.34	124.68
3	A	154	HEM	CMD-C2D-C3D	2.66	129.95	124.94
3	A	154	HEM	CMA-C3A-C2A	2.56	129.76	124.94
3	A	154	HEM	CBD-CAD-C3D	-2.41	108.04	112.48

There are no chirality outliers.

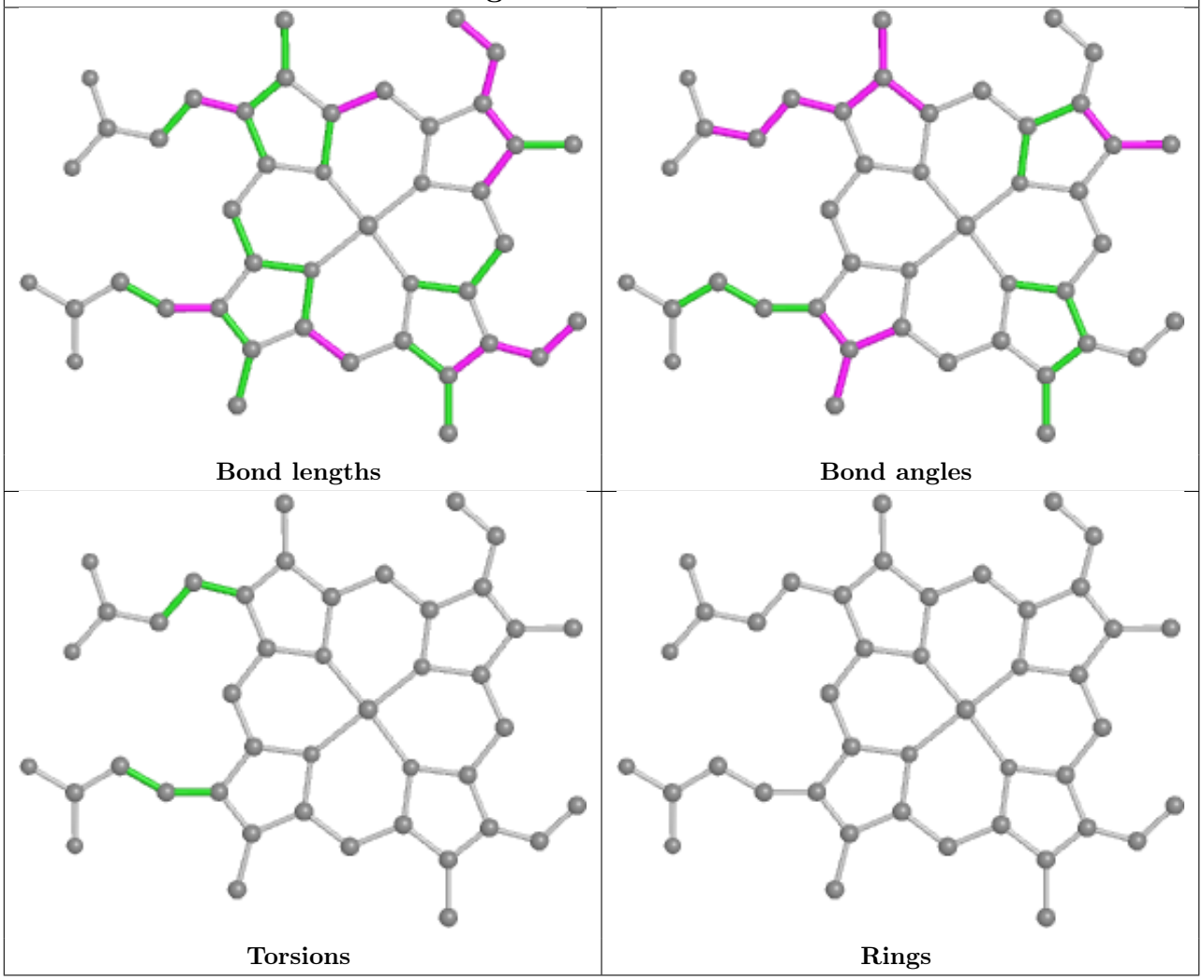
There are no torsion outliers.

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 then 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.

Ligand HEM A 154



5.7 Other polymers (i)

There are no such residues in this entry.

5.8 Polymer linkage issues (i)

The following chains have linkage breaks:

Mol	Chain	Number of breaks
1	A	1

All chain breaks are listed below:

Model	Chain	Residue-1	Atom-1	Residue-2	Atom-2	Distance (Å)
1	A	44:ASP	C	45:GLU	N	1.09

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.