



# wwPDB X-ray Structure Validation Summary Report ⓘ

Feb 15, 2017 – 02:39 am GMT

PDB ID : 4NKZ  
Title : Human steroidogenic cytochrome P450 17A1 mutant A105L with substrate 17alpha-hydroxypregnenolone  
Authors : Scott, E.E.; Petrunak, E.M.  
Deposited on : 2013-11-13  
Resolution : 3.00 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](mailto:validation@mail.wwpdb.org)

A user guide is available at

<http://wwpdb.org/validation/2016/XrayValidationReportHelp>

with specific help available everywhere you see the ⓘ symbol.

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

MolProbity : 4.02b-467  
Mogul : 1.7.2 (RC1), CSD as538be (2017)  
Xtriage (Phenix) : 1.9-1692  
EDS : trunk28620  
Percentile statistics : 20161228.v01 (using entries in the PDB archive December 28th 2016)  
Refmac : 5.8.0135  
CCP4 : 6.5.0  
Ideal geometry (proteins) : Engh & Huber (2001)  
Ideal geometry (DNA, RNA) : Parkinson et al. (1996)  
Validation Pipeline (wwPDB-VP) : recalc28949

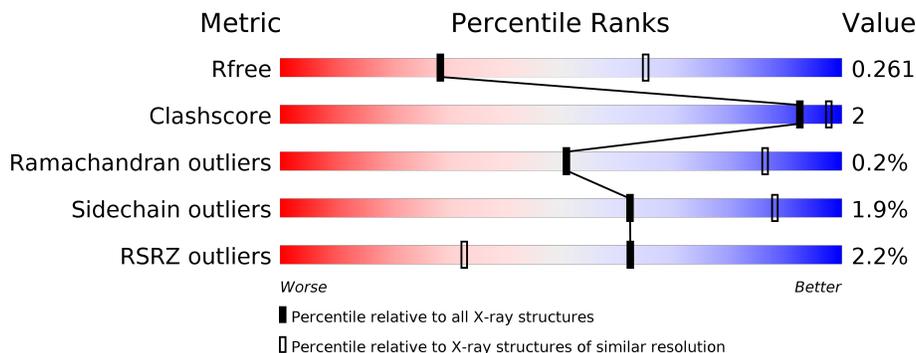
# 1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

*X-RAY DIFFRACTION*

The reported resolution of this entry is 3.00 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))
$R_{free}$	100719	1692 (3.00-3.00)
Clashscore	112137	2037 (3.00-3.00)
Ramachandran outliers	110173	1973 (3.00-3.00)
Sidechain outliers	110143	1976 (3.00-3.00)
RSRZ outliers	101464	1716 (3.00-3.00)

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 on the lower bar indicate the fraction of residues that contain outliers for  $\geq 3$ , 2, 1 and 0 types of geometric quality criteria. 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  $\leq 5\%$ . The upper red bar (where present) indicates the fraction of residues that have poor fit to the electron density. The numeric value is given above the bar.

Mol	Chain	Length	Quality of chain
1	A	494	 2% 87% 6% 6%
1	B	494	 2% 88% 5% 7%
1	C	494	 2% 88% 5% 6%
1	D	494	 2% 90% 6% 6%

## 2 Entry composition [i](#)

There are 4 unique types of molecules in this entry. The entry contains 30483 atoms, of which 15410 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 Steroid 17-alpha-hydroxylase/17,20 lyase.

Mol	Chain	Residues	Atoms						ZeroOcc	AltConf	Trace
			Total	C	H	N	O	S			
1	A	463	7488	2376	3792	639	666	15	0	0	0
1	B	461	7462	2368	3780	636	663	15	0	0	0
1	C	464	7502	2382	3794	642	669	15	0	0	0
1	D	465	7507	2383	3796	641	672	15	0	0	0

There are 40 discrepancies between the modelled and reference sequences:

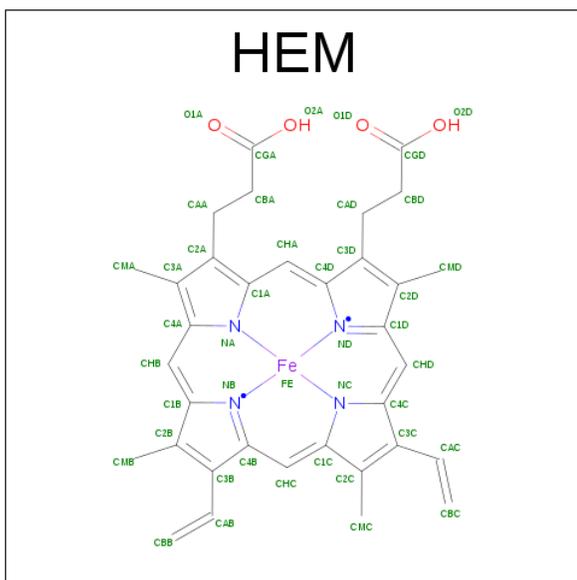
Chain	Residue	Modelled	Actual	Comment	Reference
A	19	MET	-	EXPRESSION TAG	UNP P05093
A	20	ALA	-	EXPRESSION TAG	UNP P05093
A	21	LYS	-	EXPRESSION TAG	UNP P05093
A	22	LYS	-	EXPRESSION TAG	UNP P05093
A	23	THR	-	EXPRESSION TAG	UNP P05093
A	105	LEU	ALA	ENGINEERED MUTATION	UNP P05093
A	509	HIS	-	EXPRESSION TAG	UNP P05093
A	510	HIS	-	EXPRESSION TAG	UNP P05093
A	511	HIS	-	EXPRESSION TAG	UNP P05093
A	512	HIS	-	EXPRESSION TAG	UNP P05093
B	19	MET	-	EXPRESSION TAG	UNP P05093
B	20	ALA	-	EXPRESSION TAG	UNP P05093
B	21	LYS	-	EXPRESSION TAG	UNP P05093
B	22	LYS	-	EXPRESSION TAG	UNP P05093
B	23	THR	-	EXPRESSION TAG	UNP P05093
B	105	LEU	ALA	ENGINEERED MUTATION	UNP P05093
B	509	HIS	-	EXPRESSION TAG	UNP P05093
B	510	HIS	-	EXPRESSION TAG	UNP P05093
B	511	HIS	-	EXPRESSION TAG	UNP P05093
B	512	HIS	-	EXPRESSION TAG	UNP P05093
C	19	MET	-	EXPRESSION TAG	UNP P05093

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Chain	Residue	Modelled	Actual	Comment	Reference
C	20	ALA	-	EXPRESSION TAG	UNP P05093
C	21	LYS	-	EXPRESSION TAG	UNP P05093
C	22	LYS	-	EXPRESSION TAG	UNP P05093
C	23	THR	-	EXPRESSION TAG	UNP P05093
C	105	LEU	ALA	ENGINEERED MUTATION	UNP P05093
C	509	HIS	-	EXPRESSION TAG	UNP P05093
C	510	HIS	-	EXPRESSION TAG	UNP P05093
C	511	HIS	-	EXPRESSION TAG	UNP P05093
C	512	HIS	-	EXPRESSION TAG	UNP P05093
D	19	MET	-	EXPRESSION TAG	UNP P05093
D	20	ALA	-	EXPRESSION TAG	UNP P05093
D	21	LYS	-	EXPRESSION TAG	UNP P05093
D	22	LYS	-	EXPRESSION TAG	UNP P05093
D	23	THR	-	EXPRESSION TAG	UNP P05093
D	105	LEU	ALA	ENGINEERED MUTATION	UNP P05093
D	509	HIS	-	EXPRESSION TAG	UNP P05093
D	510	HIS	-	EXPRESSION TAG	UNP P05093
D	511	HIS	-	EXPRESSION TAG	UNP P05093
D	512	HIS	-	EXPRESSION TAG	UNP P05093

- Molecule 2 is PROTOPORPHYRIN IX CONTAINING FE (three-letter code: HEM) (formula: C<sub>34</sub>H<sub>32</sub>FeN<sub>4</sub>O<sub>4</sub>).



Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	
			Total	C	Fe	H	N			O
2	A	1	73	34	1	30	4	4	0	0

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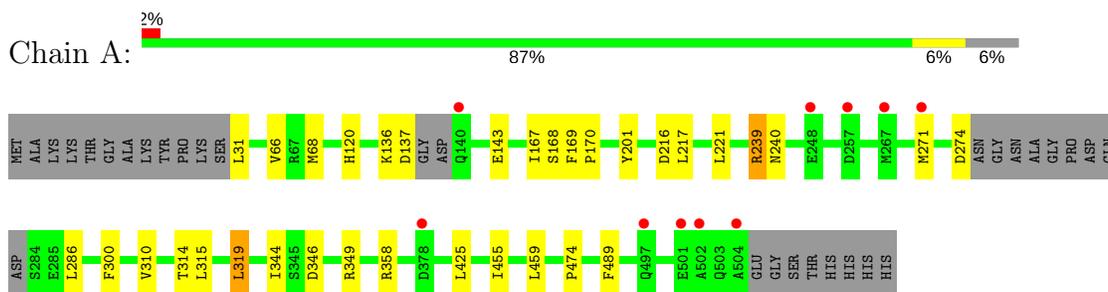
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<b>Mol</b>	<b>Chain</b>	<b>Residues</b>	<b>Atoms</b>		<b>ZeroOcc</b>	<b>AltConf</b>
4	D	1	Total	O	0	0
			1	1		

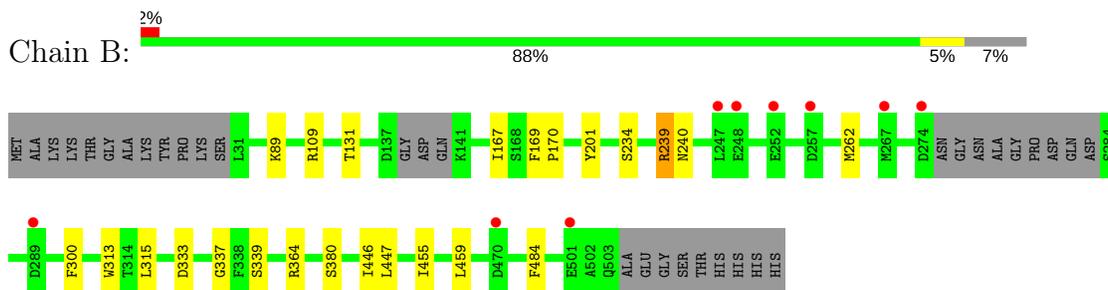
### 3 Residue-property plots [i](#)

These plots are drawn for all protein, RNA and DNA 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 and electron density. 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. A red dot above a residue indicates a poor fit to the electron density ( $RSRZ > 2$ ). 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.

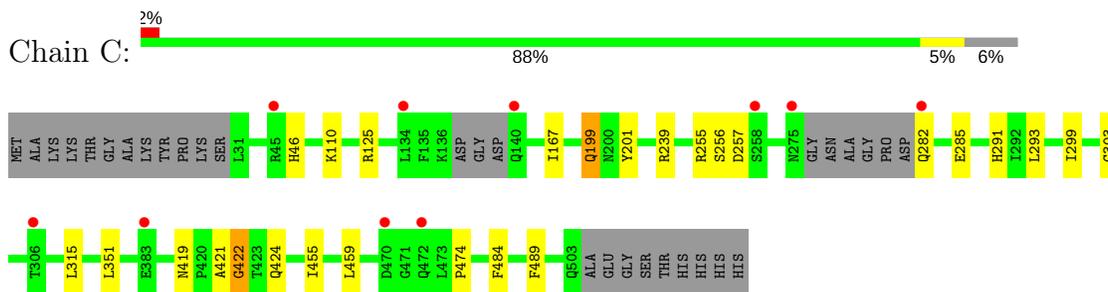
- Molecule 1: Steroid 17-alpha-hydroxylase/17,20 lyase



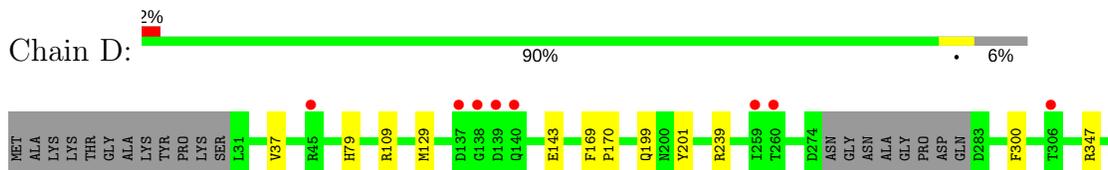
- Molecule 1: Steroid 17-alpha-hydroxylase/17,20 lyase



- Molecule 1: Steroid 17-alpha-hydroxylase/17,20 lyase



- Molecule 1: Steroid 17-alpha-hydroxylase/17,20 lyase





## 4 Data and refinement statistics

Property	Value	Source
Space group	P 21 21 21	Depositor
Cell constants a, b, c, $\alpha$ , $\beta$ , $\gamma$	85.82Å 151.09Å 170.34Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	38.70 – 3.00 38.70 – 3.00	Depositor EDS
% Data completeness (in resolution range)	97.5 (38.70-3.00) 97.8 (38.70-3.00)	Depositor EDS
$R_{merge}$	(Not available)	Depositor
$R_{sym}$	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ <sup>1</sup>	1.41 (at 3.01Å)	Xtrriage
Refinement program	PHENIX (phenix.refine: 1.8.2_1309)	Depositor
R, $R_{free}$	0.191 , 0.261 0.194 , 0.261	Depositor DCC
$R_{free}$ test set	2201 reflections (5.02%)	DCC
Wilson B-factor (Å <sup>2</sup> )	69.9	Xtrriage
Anisotropy	0.732	Xtrriage
Bulk solvent $k_{sol}$ (e/Å <sup>3</sup> ), $B_{sol}$ (Å <sup>2</sup> )	0.41 , 46.6	EDS
L-test for twinning <sup>2</sup>	$\langle  L  \rangle = 0.47$ , $\langle L^2 \rangle = 0.30$	Xtrriage
Estimated twinning fraction	No twinning to report.	Xtrriage
$F_o, F_c$ correlation	0.95	EDS
Total number of atoms	30483	wwPDB-VP
Average B, all atoms (Å <sup>2</sup> )	80.0	wwPDB-VP

Xtrriage's analysis on translational NCS is as follows: *The analyses of the Patterson function reveals a significant off-origin peak that is 40.96 % of the origin peak, indicating pseudo translational symmetry. The chance of finding a peak of this or larger height randomly in a structure without pseudo translational symmetry is equal to 2.5331e-04. The detected translational NCS is most likely also responsible for the elevated intensity ratio.*

<sup>1</sup>Intensities estimated from amplitudes.

<sup>2</sup>Theoretical values of  $\langle |L| \rangle$ ,  $\langle L^2 \rangle$  for acentric reflections are 0.5, 0.333 respectively for untwinned datasets, and 0.375, 0.2 for perfectly twinned datasets.

## 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, LZZ

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	0.44	0/3775	0.62	0/5109
1	B	0.44	0/3761	0.64	0/5090
1	C	0.47	0/3787	0.63	0/5125
1	D	0.46	0/3791	0.66	1/5132 (0.0%)
All	All	0.45	0/15114	0.64	1/20456 (0.0%)

There are no bond length outliers.

All (1) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	D	129	MET	CG-SD-CE	-6.14	90.37	100.20

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	3696	3792	3778	14	0
1	B	3682	3780	3765	10	0
1	C	3708	3794	3787	14	0
1	D	3711	3796	3785	11	0
2	A	43	30	30	2	0
2	B	43	30	30	1	0

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Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
2	C	43	30	30	5	0
2	D	43	30	30	2	0
3	A	24	32	32	0	0
3	B	24	32	32	0	0
3	C	24	32	32	0	0
3	D	24	32	32	0	0
4	A	2	0	0	0	0
4	B	5	0	0	0	0
4	D	1	0	0	0	0
All	All	15073	15410	15363	55	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 2.

The worst 5 of 55 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:D:445:GLU:OE2	1:D:449:ARG:NH2	2.30	0.65
1:C:282:GLN:HG3	1:C:282:GLN:O	1.97	0.64
1:C:199:GLN:O	1:C:199:GLN:NE2	2.32	0.63
1:A:167:ILE:HD11	1:A:315:LEU:CD1	2.31	0.60
2:A:600:HEM:HHD	2:A:600:HEM:HBC2	1.84	0.59

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	457/494 (92%)	443 (97%)	14 (3%)	0	100 100
1	B	455/494 (92%)	439 (96%)	16 (4%)	0	100 100

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Mol	Chain	Analysed	Favoured	Allowed	Outliers	Percentiles	
1	C	458/494 (93%)	446 (97%)	9 (2%)	3 (1%)	25	67
1	D	461/494 (93%)	444 (96%)	17 (4%)	0	100	100
All	All	1831/1976 (93%)	1772 (97%)	56 (3%)	3 (0%)	51	86

All (3) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	C	421	ALA
1	C	46	HIS
1	C	422	GLY

### 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	414/437 (95%)	404 (98%)	10 (2%)	54	85
1	B	413/437 (94%)	406 (98%)	7 (2%)	66	89
1	C	416/437 (95%)	409 (98%)	7 (2%)	66	89
1	D	416/437 (95%)	409 (98%)	7 (2%)	66	89
All	All	1659/1748 (95%)	1628 (98%)	31 (2%)	62	88

5 of 31 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	B	300	PHE
1	C	199	GLN
1	D	300	PHE
1	B	333	ASP
1	C	201	TYR

Some sidechains can be flipped to improve hydrogen bonding and reduce clashes. 5 of 8 such sidechains are listed below:

Mol	Chain	Res	Type
1	C	50	HIS
1	D	50	HIS
1	C	291	HIS
1	B	120	HIS
1	C	199	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 carbohydrates in this entry.

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

8 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	600	1	28,50,50	2.22	8 (28%)	17,82,82	1.60	3 (17%)
3	LZZ	A	601	-	26,27,27	3.19	8 (30%)	41,45,45	2.08	12 (29%)
2	HEM	B	600	1	28,50,50	2.17	7 (25%)	17,82,82	1.99	6 (35%)
3	LZZ	B	601	-	26,27,27	3.33	8 (30%)	41,45,45	2.07	10 (24%)
2	HEM	C	600	1	28,50,50	2.25	9 (32%)	17,82,82	1.66	5 (29%)
3	LZZ	C	601	-	26,27,27	3.27	9 (34%)	41,45,45	2.24	13 (31%)
2	HEM	D	600	1	28,50,50	2.22	9 (32%)	17,82,82	1.37	3 (17%)
3	LZZ	D	601	-	26,27,27	3.36	8 (30%)	41,45,45	1.97	10 (24%)

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	600	1	-	0/6/54/54	0/0/8/8
3	LZZ	A	601	-	-	0/6/68/68	0/4/4/4
2	HEM	B	600	1	-	0/6/54/54	0/0/8/8
3	LZZ	B	601	-	-	0/6/68/68	0/4/4/4
2	HEM	C	600	1	-	0/6/54/54	0/0/8/8
3	LZZ	C	601	-	-	0/6/68/68	0/4/4/4
2	HEM	D	600	1	-	0/6/54/54	0/0/8/8
3	LZZ	D	601	-	-	0/6/68/68	0/4/4/4

The worst 5 of 66 bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
3	B	601	LZZ	CAM-CAQ	-12.09	1.37	1.57
3	D	601	LZZ	CAM-CAQ	-12.05	1.37	1.57
3	C	601	LZZ	CAM-CAQ	-11.68	1.38	1.57
3	A	601	LZZ	CAM-CAQ	-11.33	1.38	1.57
2	C	600	HEM	C3C-C2C	-5.25	1.33	1.40

The worst 5 of 62 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
3	D	601	LZZ	CAC-CAE-CAF	-5.65	101.97	111.98
3	C	601	LZZ	CAC-CAE-CAF	-5.56	102.13	111.98
3	A	601	LZZ	CAC-CAE-CAF	-5.47	102.28	111.98
3	B	601	LZZ	CAC-CAE-CAF	-5.28	102.62	111.98
3	B	601	LZZ	CAK-CAJ-CAI	-4.67	111.64	119.07

There are no chirality outliers.

There are no torsion outliers.

There are no ring outliers.

4 monomers are involved in 10 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
2	A	600	HEM	2	0
2	B	600	HEM	1	0
2	C	600	HEM	5	0
2	D	600	HEM	2	0

## 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](#)

In the following table, the column labelled ‘#RSRZ > 2’ contains the number (and percentage) of RSRZ outliers, followed by percent RSRZ outliers for the chain as percentile scores relative to all X-ray entries and entries of similar resolution. The OWAB column contains the minimum, median, 95<sup>th</sup> percentile and maximum values of the occupancy-weighted average B-factor per residue. The column labelled ‘Q < 0.9’ lists the number of (and percentage) of residues with an average occupancy less than 0.9.

Mol	Chain	Analysed	<RSRZ>	#RSRZ>2	OWAB(Å <sup>2</sup> )	Q<0.9
1	A	463/494 (93%)	0.02	10 (2%) 62 33	52, 72, 105, 136	0
1	B	461/494 (93%)	0.03	9 (1%) 65 36	49, 70, 97, 118	0
1	C	464/494 (93%)	0.07	10 (2%) 62 33	53, 71, 98, 119	0
1	D	465/494 (94%)	0.17	11 (2%) 59 30	51, 71, 96, 128	0
All	All	1853/1976 (93%)	0.07	40 (2%) 62 33	49, 71, 99, 136	0

The worst 5 of 40 RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	D	139	ASP	4.9
1	B	274	ASP	4.2
1	A	140	GLN	4.0
1	A	504	ALA	3.5
1	C	282	GLN	3.4

### 6.2 Non-standard residues in protein, DNA, RNA chains [i](#)

There are no non-standard protein/DNA/RNA residues in this entry.

### 6.3 Carbohydrates [i](#)

There are no carbohydrates in this entry.

### 6.4 Ligands [i](#)

In the following table, the Atoms column lists the number of modelled atoms in the group and the number defined in the chemical component dictionary. LLDF column lists the quality of electron density of the group with respect to its neighbouring residues in protein, DNA or RNA chains. The B-factors column lists the minimum, median, 95<sup>th</sup> percentile and maximum values of B factors

of atoms in the group. The column labelled 'Q < 0.9' lists the number of atoms with occupancy less than 0.9.

Mol	Type	Chain	Res	Atoms	RSCC	RSR	LLDF	B-factors(Å <sup>2</sup> )	Q<0.9
2	HEM	C	600	43/43	0.97	0.36	1.46	48,64,80,85	0
2	HEM	D	600	43/43	0.96	0.38	1.41	53,68,82,85	0
2	HEM	A	600	43/43	0.97	0.29	1.17	49,63,81,87	0
2	HEM	B	600	43/43	0.97	0.28	0.95	48,63,81,85	0
3	LZZ	C	601	24/24	0.96	0.29	0.38	53,69,81,85	0
3	LZZ	D	601	24/24	0.96	0.30	0.31	52,68,82,88	0
3	LZZ	B	601	24/24	0.98	0.25	-0.14	59,75,88,98	0
3	LZZ	A	601	24/24	0.97	0.20	-0.79	55,74,86,90	0

## 6.5 Other polymers [i](#)

There are no such residues in this entry.