



wwPDB X-ray Structure Validation Summary Report i

Feb 28, 2014 – 11:19 AM GMT

PDB ID : 3AE6
Title : Crystal structure of porcine heart mitochondrial complex II bound with N-(3-Isopropoxy-phenyl)-phthalamide
Authors : Harada, S.; Sasaki, T.; Shindo, M.; Kido, Y.; Inaoka, D.K.; Omori, J.; Osanai, A.; Sakamoto, K.; Mao, J.; Matsuoka, S.; Inoue, M.; Honma, T.; Tanaka, A.; Kita, K.
Deposited on : 2010-02-04
Resolution : 3.40 Å(reported)

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We welcome your comments at validation@mail.wwpdb.org
A user guide is available at <http://wwpdb.org/ValidationPDFNotes.html>

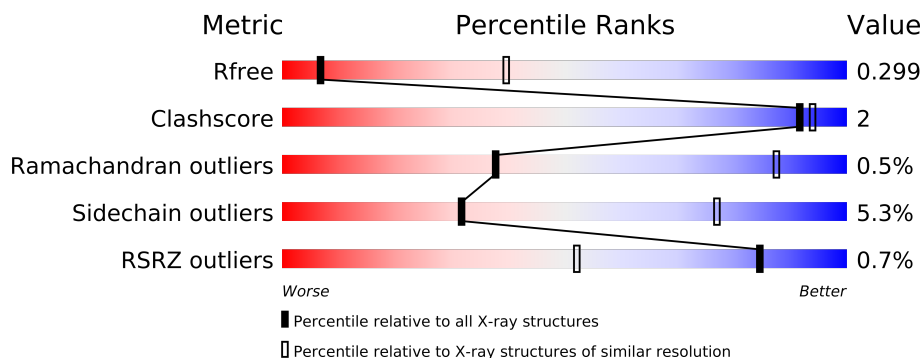
The following versions of software and data (see [references](#)) were used in the production of this report:

MolProbity : 4.02b-467
Mogul : 1.15 2013
Xtriage (Phenix) : dev-1323
EDS : stable22639
Percentile statistics : 21963
Refmac : 5.8.0049
CCP4 : 6.3.0 (Settle)
Ideal geometry (proteins) : Engh & Huber (2001)
Ideal geometry (DNA, RNA) : Parkinson et. al. (1996)
Validation Pipeline (wwPDB-VP) : stable22683

1 Overall quality at a glance

The reported resolution of this entry is 3.40 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}	66092	1017 (3.52-3.28)
Clashscore	79885	1214 (3.50-3.30)
Ramachandran outliers	78287	1177 (3.50-3.30)
Sidechain outliers	78261	1177 (3.50-3.30)
RSRZ outliers	66119	1017 (3.52-3.28)

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 ≥ 3 , 2, 1 and 0 types of geometric quality criteria. The upper red bar (where present) indicates the fraction of residues that have poor fit to the electron density.

Mol	Chain	Length	Quality of chain
1	A	622	
2	B	252	
3	C	140	
4	D	103	

The following table lists non-polymeric compounds that are outliers for geometric or electron-density-fit criteria:

Mol	Type	Chain	Res	Geometry	Electron density
10	EPH	D	1306	-	X
9	HEM	C	1305	-	X

2 Entry composition

There are 11 unique types of molecules in this entry. The entry contains 8661 atoms, of which 0 are hydrogen and 0 are deuterium.

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 Succinate dehydrogenase [ubiquinone] flavoprotein subunit, mitochondrial.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	613	Total	C	N	O	S	0	0	0
			4729	2954	848	895	32			

- Molecule 2 is a protein called Succinate dehydrogenase [ubiquinone] iron-sulfur subunit, mitochondrial.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
2	B	239	Total	C	N	O	S	0	0	0
			1922	1214	326	360	22			

- Molecule 3 is a protein called Succinate dehydrogenase cytochrome b560 subunit, mitochondrial.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
3	C	138	Total	C	N	O	S	0	0	0
			1064	695	179	183	7			

- Molecule 4 is a protein called Succinate dehydrogenase [ubiquinone] cytochrome b small subunit, mitochondrial.

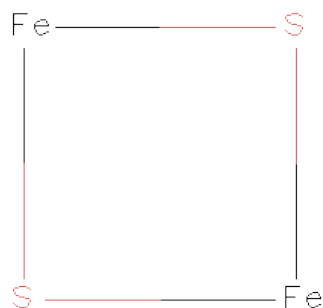
Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
4	D	102	Total	C	N	O	S	0	0	0
			765	499	128	133	5			

- Molecule 5 is FLAVIN-ADENINE DINUCLEOTIDE (three-letter code: FAD) (formula: C₂₇H₃₃N₉O₁₅P₂).



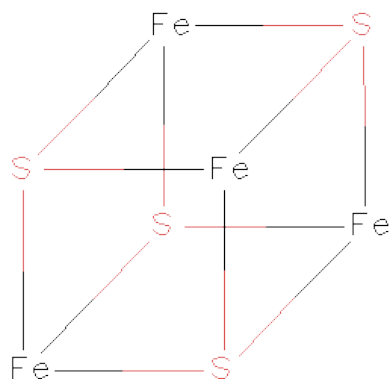
Mol	Chain	Residues	Atoms					ZeroOcc	AltConf
5	A	1	Total	C	N	O	P	0	0
			53	27	9	15	2		

- Molecule 6 is FE2/S2 (INORGANIC) CLUSTER (three-letter code: FES) (formula: Fe₂S₂).



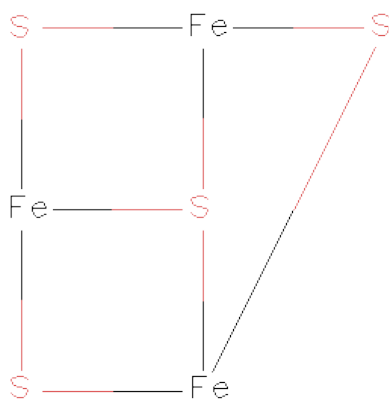
Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
6	B	1	Total	Fe	S	0	0
			4	2	2		

- Molecule 7 is IRON/SULFUR CLUSTER (three-letter code: SF4) (formula: Fe₄S₄).



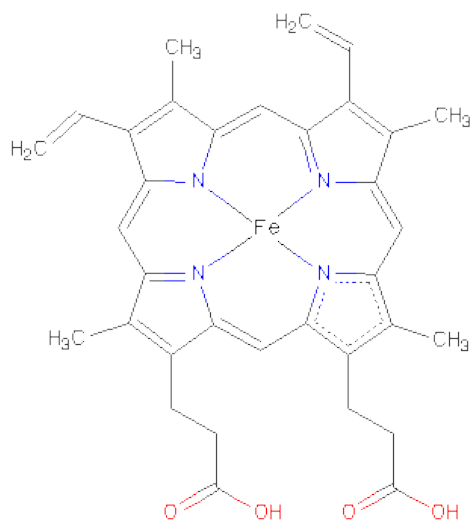
Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
7	B	1	Total	Fe	S	0	0
			8	4	4		

- Molecule 8 is FE3-S4 CLUSTER (three-letter code: F3S) (formula: Fe_3S_4).



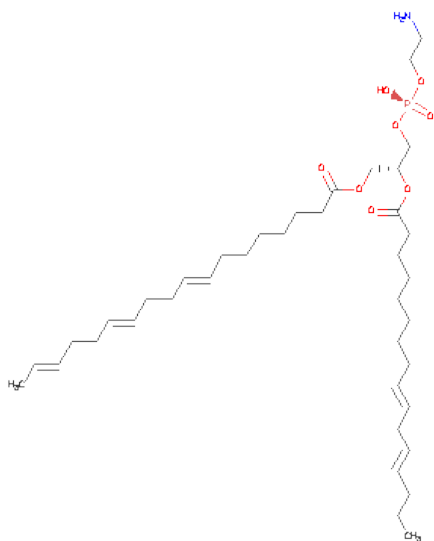
Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
8	B	1	Total	Fe	S	0	0
			7	3	4		

- Molecule 9 is PROTOPORPHYRIN IX CONTAINING FE (three-letter code: HEM) (formula: $\text{C}_{34}\text{H}_{32}\text{FeN}_4\text{O}_4$).



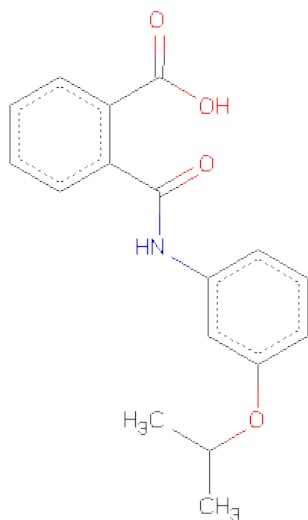
Mol	Chain	Residues	Atoms					ZeroOcc	AltConf
9	C	1	Total	C	Fe	N	O	0	0
			43	34	1	4	4		

- Molecule 10 is L-ALPHA-PHOSPHATIDYL-BETA-OLEOYL-GAMMA-PALMITOYL-PHOSPHATIDYLETHANOLAMINE (three-letter code: EPH) (formula: $C_{39}H_{68}NO_8P$).



Mol	Chain	Residues	Atoms					ZeroOcc	AltConf
10	D	1	Total	C	N	O	P	0	0
			44	34	1	8	1		

- Molecule 11 is 2-{[3-(1-METHYLETHOXY)PHENYL]CARBAMOYL}BENZOICACID (three-letter code: JMP) (formula: $C_{17}H_{17}NO_4$).



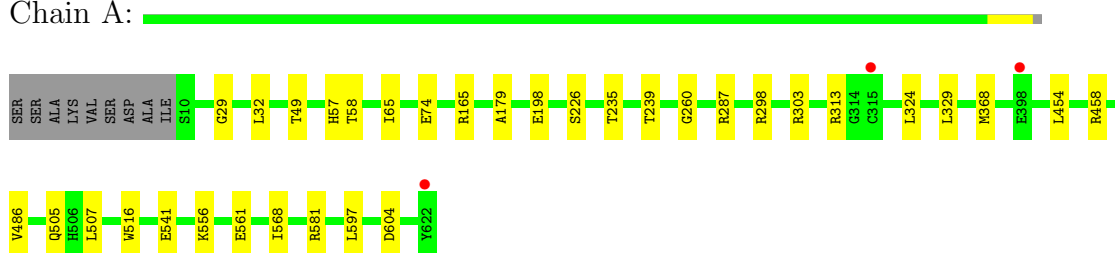
Mol	Chain	Residues	Atoms				ZeroOcc	AltConf
			Total	C	N	O		
11	C	1	22	17	1	4	0	0

3 Residue-property plots

These plots are drawn for all protein, RNA and DNA chains in the entry. The first graphic for a chain summarises the proportions of errors 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.

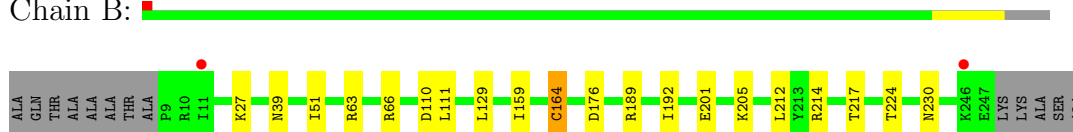
- Molecule 1: Succinate dehydrogenase [ubiquinone] flavoprotein subunit, mitochondrial

Chain A:



- Molecule 2: Succinate dehydrogenase [ubiquinone] iron-sulfur subunit, mitochondrial

Chain B:



- Molecule 3: Succinate dehydrogenase cytochrome b560 subunit, mitochondrial

Chain C:



- Molecule 4: Succinate dehydrogenase [ubiquinone] cytochrome b small subunit, mitochondrial

Chain D:



4 Data and refinement statistics

Property	Value	Source
Space group	P 21 21 21	Depositor
Cell constants a, b, c, α , β , γ	71.12Å 84.12Å 293.56Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	47.49 – 3.40 47.49 – 3.40	Depositor EDS
% Data completeness (in resolution range)	98.2 (47.49-3.40) 98.2 (47.49-3.40)	Depositor EDS
R_{merge}	0.13	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	2.37 (at 3.40Å)	Xtriage
Refinement program	REFMAC 5.5.0102	Depositor
R, R_{free}	0.250 , 0.299 0.252 , 0.299	Depositor DCC
R_{free} test set	1251 reflections (5.36%)	DCC
Wilson B-factor (Å ²)	81.3	Xtriage
Anisotropy	0.027	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.29 , 25.9	EDS
Estimated twinning fraction	No twinning to report.	Xtriage
L-test for twinning	$\langle L \rangle = 0.49$, $\langle L^2 \rangle = 0.32$	Xtriage
Outliers	0 of 24598 reflections	Xtriage
F_o, F_c correlation	0.89	EDS
Total number of atoms	8661	wwPDB-VP
Average B, all atoms (Å ²)	89.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 3.36% of the height of the origin peak. No significant pseudotranslation is detected.*

¹Intensities estimated from amplitudes.

5 Model quality

5.1 Standard geometry

Bond lengths and bond angles in the following residue types are not validated in this section: SF4, F3S, FES, EPH, HEM, JMP, FAD

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	0.32	0/4828	0.49	0/6531
2	B	0.32	0/1964	0.49	0/2648
3	C	0.33	0/1091	0.45	0/1483
4	D	0.30	0/784	0.45	0/1066
All	All	0.32	0/8667	0.49	0/11728

There are no bond length outliers.

There are no bond angle outliers.

There are no chirality outliers.

There are no planarity outliers.

5.2 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 hydrogens added by MolProbity. The Clashes column lists the number of clashes within the asymmetric unit, and the number in parentheses is this value normalized per 1000 atoms of the molecule in the chain. The Symm-Clashes column gives symmetry related clashes, in the same way as for the Clashes column.

Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
1	A	4729	0	0	10	0
2	B	1922	0	0	3	0
3	C	1064	0	0	1	0
4	D	765	0	0	0	0
5	A	53	0	31	7	0
6	B	4	0	0	0	0
7	B	8	0	0	1	0
8	B	7	0	0	0	0

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Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
9	C	43	0	30	1	0
10	D	44	0	53	0	0
11	C	22	0	16	1	0
All	All	8661	0	130	16	0

Clashscore is defined as the number of clashes calculated for the entry per 1000 atoms (including hydrogens) of the entry. The overall clashscore for this entry is 2.

The worst 5 of 16 close contacts within the same asymmetric unit are listed below.

Atom-1	Atom-2	Distance(Å)	Clash(Å)
1:A:57:HIS:NE2	5:A:700:FAD:HM82	1.28	1.40
1:A:57:HIS:CE1	5:A:700:FAD:HM82	1.62	1.35
1:A:57:HIS:CD2	1:A:57:HIS:O	2.35	0.79
1:A:57:HIS:CE1	5:A:700:FAD:C8M	2.57	0.79
1:A:57:HIS:NE2	5:A:700:FAD:C8	2.49	0.75

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	611/622 (98%)	568 (93%)	40 (6%)	3 (0%)	38 87
2	B	237/252 (94%)	216 (91%)	20 (8%)	1 (0%)	43 90
3	C	136/140 (97%)	130 (96%)	6 (4%)	0	100 100
4	D	100/103 (97%)	95 (95%)	4 (4%)	1 (1%)	22 78
All	All	1084/1117 (97%)	1009 (93%)	70 (6%)	5 (0%)	38 87

All (5) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	29	GLY
1	A	516	TRP

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Mol	Chain	Res	Type
2	B	164	CYS
1	A	260	GLY
4	D	95	ASP

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	499/506 (99%)	474 (95%)	25 (5%)	34	79
2	B	214/220 (97%)	198 (92%)	16 (8%)	19	64
3	C	117/118 (99%)	114 (97%)	3 (3%)	59	91
4	D	76/76 (100%)	72 (95%)	4 (5%)	32	77
All	All	906/920 (98%)	858 (95%)	48 (5%)	32	77

5 of 48 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	556	LYS
2	B	39	ASN
4	D	63	ASN
1	A	561	GLU
1	A	597	LEU

Some sidechains can be flipped to improve hydrogen bonding and reduce clashes. There are no such sidechains identified.

5.3.3 RNA ⓘ

There are no RNA chains 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 carbohydrates in this entry.

5.6 Ligand geometry

7 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$
5	FAD	A	700	1	58,58,58	1.07	5 (8%)	85,89,89	1.99	13 (15%)
6	FES	B	302	2	0,4,4	0.00	-	0,4,4	0.00	-
7	SF4	B	303	2	12,12,12	4.17	12 (100%)	0,24,24	0.00	-
8	F3S	B	304	2	3,9,9	18.78	3 (100%)	0,15,15	0.00	-
11	JMP	C	1201	-	23,23,23	1.46	2 (8%)	31,31,31	0.98	1 (3%)
9	HEM	C	1305	3,4	49,50,50	2.31	16 (32%)	46,82,82	2.15	7 (15%)
10	EPH	D	1306	-	42,43,48	2.06	7 (16%)	46,48,53	2.06	10 (21%)

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
5	FAD	A	700	1	-	0/34/50/50	0/1/6/6
6	FES	B	302	2	-	0/0/4/4	0/0/1/1
7	SF4	B	303	2	-	0/0/48/48	0/0/5/5
8	F3S	B	304	2	-	0/0/24/24	0/0/3/3
11	JMP	C	1201	-	-	0/16/16/16	0/2/2/2
9	HEM	C	1305	3,4	-	0/14/114/114	0/0/8/8
10	EPH	D	1306	-	1/1/4/14	0/47/47/52	0/0/0/0

The worst 5 of 45 bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
8	B	304	F3S	S3-FE1	-19.10	2.20	2.33
8	B	304	F3S	S3-FE4	-18.97	2.20	2.33
8	B	304	F3S	S3-FE3	-18.26	2.21	2.33
10	D	1306	EPH	C31-C30	-8.57	1.51	1.55
11	C	1201	JMP	C3-C2	6.08	1.50	1.40

The worst 5 of 31 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
5	A	700	FAD	N3A-C2A-N1A	-11.20	119.35	128.71
10	D	1306	EPH	C14-C15-C16	-9.91	111.56	126.73
9	C	1305	HEM	C3B-C4B-NB	-8.72	107.76	114.00
9	C	1305	HEM	C4D-ND-C1D	7.02	112.35	105.16
5	A	700	FAD	C2-N1-C10	6.06	121.08	114.98

All (1) chirality outliers are listed below:

Mol	Chain	Res	Type	Atom
10	D	1306	EPH	C2

There are no torsion outliers.

There are no ring outliers.

5.7 Other polymers ⓘ

There are no such residues in this entry.

5.8 Polymer linkage issues

There are no chain breaks in this entry.

6 Fit of model and data ⓘ

6.1 Protein, DNA and RNA chains ⓘ

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, 95th 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 ²)	Q<0.9
1	A	613/622 (98%)	0.12	3 (0%)	88 61	65, 86, 121, 137	0
2	B	239/252 (94%)	0.07	2 (0%)	83 49	64, 80, 112, 130	0
3	C	138/140 (98%)	0.03	2 (1%)	72 35	72, 89, 125, 137	0
4	D	102/103 (99%)	-0.10	0	100 100	73, 91, 116, 138	0
All	All	1092/1117 (97%)	0.08	7 (0%)	84 55	64, 86, 120, 138	0

The worst 5 of 7 RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
3	C	82	LEU	2.8
2	B	11	ILE	2.6
1	A	622	TYR	2.6
1	A	398	GLU	2.5
3	C	81	CYS	2.3

6.2 Non-standard residues in protein, DNA, RNA chains ⓘ

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

6.3 Carbohydrates ⓘ

There are no carbohydrates in this entry.

6.4 Ligands ⓘ

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, 95th 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	RSR	LLDF	B-factors(\AA^2)	Q<0.9
10	EPH	D	1306	44/49	0.65	4.48	116,121,128,128	0
9	HEM	C	1305	43/43	0.27	2.23	80,81,82,82	0
5	FAD	A	700	53/53	0.45	0.90	71,72,73,74	0
11	JMP	C	1201	22/22	0.24	-0.00	74,75,75,76	0
8	F3S	B	304	7/7	0.18	-0.63	74,75,75,75	0
7	SF4	B	303	8/8	0.18	-1.34	64,64,65,65	0
6	FES	B	302	4/4	0.21	-1.57	59,59,59,60	0

6.5 Other polymers ⓘ

There are no such residues in this entry.