



wwPDB X-ray Structure Validation Summary Report ⓘ

Mar 5, 2026 – 08:00 AM UTC

PDB ID : 2DE5 / pdb_00002de5
Title : Crystal structure of the electron transfer complex between oxygenase and ferredoxin in carbazole 1,9a-dioxygenase
Authors : Ashikawa, Y.; Nojiri, H.
Deposited on : 2006-02-08
Resolution : 1.90 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 : 4-5-2 with Phenix2.0
Mogul : 2022.3.0, CSD as543be (2022)
Xtriage (Phenix) : 2.0
EDS : 3.0
Percentile statistics : 20250101.v01 (using entries in the PDB archive January 1st 2025)
CCP4 : 9.0.010 (Gargrove)
Density-Fitness : 1.0.12
Ideal geometry (proteins) : Engh & Huber (2001)
Ideal geometry (DNA, RNA) : Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP) : 2.49

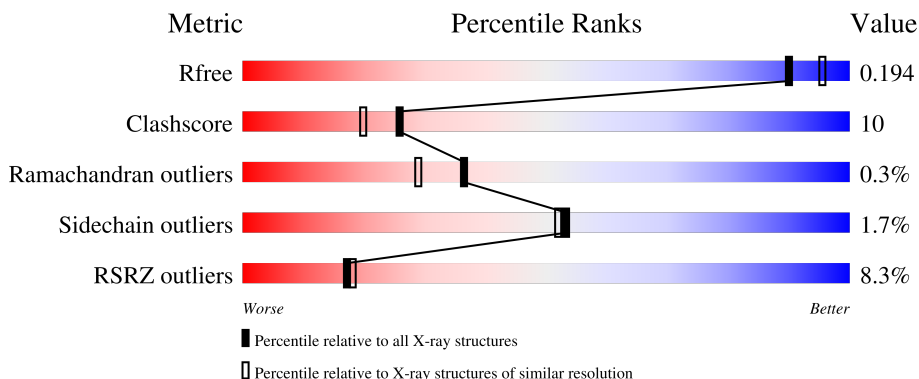
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION




The reported resolution of this entry is 1.90 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.



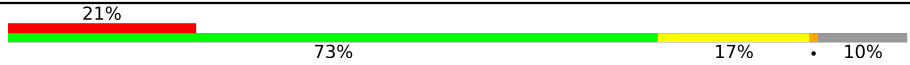
Metric	Whole archive (#Entries)	Similar resolution (#Entries, resolution range(Å))
R_{free}	180053	7789 (1.90-1.90)
Clashscore	190562	8410 (1.90-1.90)
Ramachandran outliers	187476	8333 (1.90-1.90)
Sidechain outliers	187428	8333 (1.90-1.90)
RSRZ outliers	180081	7790 (1.90-1.90)

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 $\leq 5\%$. 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	392	 4% 77% 21% ..
1	B	392	 8% 78% 20% ..
1	C	392	 6% 77% 21% ..
2	D	115	 14% 78% 11% .. 9%
2	E	115	 10% 68% 24% 8%

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Mol	Chain	Length	Quality of chain
2	F	115	 <p>A horizontal bar chart representing the quality of chain. The bar is divided into four segments: a red segment on the left labeled '21%', a large green segment labeled '73%', a yellow segment labeled '17%', and a small grey segment on the far right labeled '10%'.</p>

2 Entry composition

There are 5 unique types of molecules in this entry. The entry contains 12842 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 terminal oxygenase component of carbazole.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
1	A	389	3136	2004	535	583	14	0	0	0
1	B	389	3136	2004	535	583	14	0	0	0
1	C	389	3136	2004	535	583	14	0	0	0

There are 24 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	385	LEU	-	expression tag	GB 28201207
A	386	GLU	-	expression tag	GB 28201207
A	387	HIS	-	expression tag	GB 28201207
A	388	HIS	-	expression tag	GB 28201207
A	389	HIS	-	expression tag	GB 28201207
A	390	HIS	-	expression tag	GB 28201207
A	391	HIS	-	expression tag	GB 28201207
A	392	HIS	-	expression tag	GB 28201207
B	385	LEU	-	expression tag	GB 28201207
B	386	GLU	-	expression tag	GB 28201207
B	387	HIS	-	expression tag	GB 28201207
B	388	HIS	-	expression tag	GB 28201207
B	389	HIS	-	expression tag	GB 28201207
B	390	HIS	-	expression tag	GB 28201207
B	391	HIS	-	expression tag	GB 28201207
B	392	HIS	-	expression tag	GB 28201207
C	385	LEU	-	expression tag	GB 28201207
C	386	GLU	-	expression tag	GB 28201207
C	387	HIS	-	expression tag	GB 28201207
C	388	HIS	-	expression tag	GB 28201207
C	389	HIS	-	expression tag	GB 28201207
C	390	HIS	-	expression tag	GB 28201207
C	391	HIS	-	expression tag	GB 28201207

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Chain	Residue	Modelled	Actual	Comment	Reference
C	392	HIS	-	expression tag	GB 28201207

- Molecule 2 is a protein called ferredoxin component of carbazole.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
2	D	105	Total	C	N	O	S	0	0	0
			776	489	130	150	7			
2	E	106	Total	C	N	O	S	0	0	0
			785	494	132	152	7			
2	F	104	Total	C	N	O	S	0	0	0
			768	483	129	149	7			

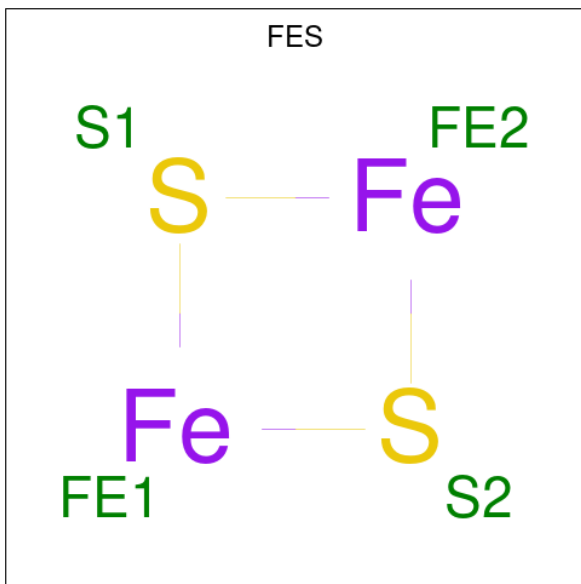
There are 24 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
D	108	LEU	-	expression tag	GB 27228521
D	109	GLU	-	expression tag	GB 27228521
D	110	HIS	-	expression tag	GB 27228521
D	111	HIS	-	expression tag	GB 27228521
D	112	HIS	-	expression tag	GB 27228521
D	113	HIS	-	expression tag	GB 27228521
D	114	HIS	-	expression tag	GB 27228521
D	115	HIS	-	expression tag	GB 27228521
E	108	LEU	-	expression tag	GB 27228521
E	109	GLU	-	expression tag	GB 27228521
E	110	HIS	-	expression tag	GB 27228521
E	111	HIS	-	expression tag	GB 27228521
E	112	HIS	-	expression tag	GB 27228521
E	113	HIS	-	expression tag	GB 27228521
E	114	HIS	-	expression tag	GB 27228521
E	115	HIS	-	expression tag	GB 27228521
F	108	LEU	-	expression tag	GB 27228521
F	109	GLU	-	expression tag	GB 27228521
F	110	HIS	-	expression tag	GB 27228521
F	111	HIS	-	expression tag	GB 27228521
F	112	HIS	-	expression tag	GB 27228521
F	113	HIS	-	expression tag	GB 27228521
F	114	HIS	-	expression tag	GB 27228521
F	115	HIS	-	expression tag	GB 27228521

- Molecule 3 is FE (II) ION (CCD ID: FE2) (formula: Fe).

Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
3	A	1	Total Fe 1 1	0	0
3	B	1	Total Fe 1 1	0	0
3	C	1	Total Fe 1 1	0	0

- Molecule 4 is FE2/S2 (INORGANIC) CLUSTER (CCD ID: FES) (formula: Fe₂S₂).



Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
4	A	1	Total Fe S 4 2 2	0	0
4	B	1	Total Fe S 4 2 2	0	0
4	C	1	Total Fe S 4 2 2	0	0
4	D	1	Total Fe S 4 2 2	0	0
4	E	1	Total Fe S 4 2 2	0	0
4	F	1	Total Fe S 4 2 2	0	0

- Molecule 5 is water.

Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
5	A	333	Total O 333 333	0	0

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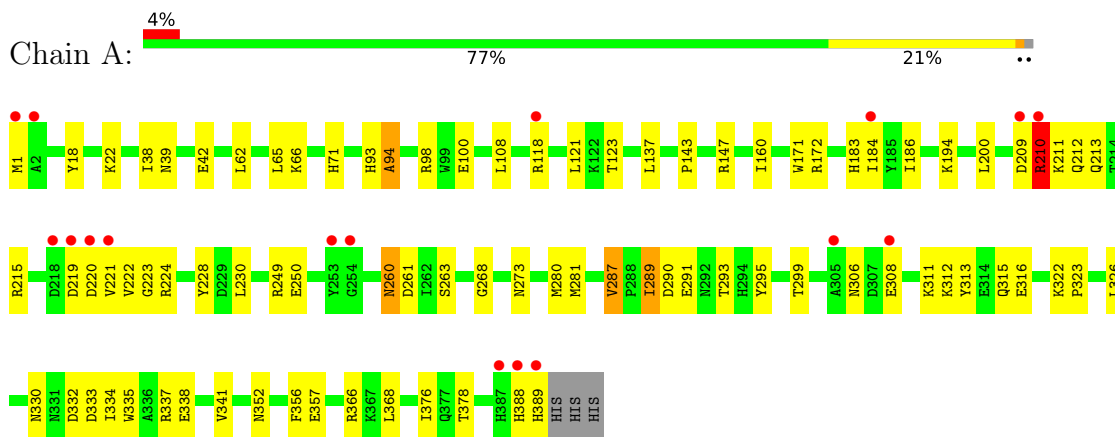
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Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
5	B	318	Total 318	O 318	0	0
5	C	298	Total 298	O 298	0	0
5	D	34	Total 34	O 34	0	0
5	E	44	Total 44	O 44	0	0
5	F	51	Total 51	O 51	0	0

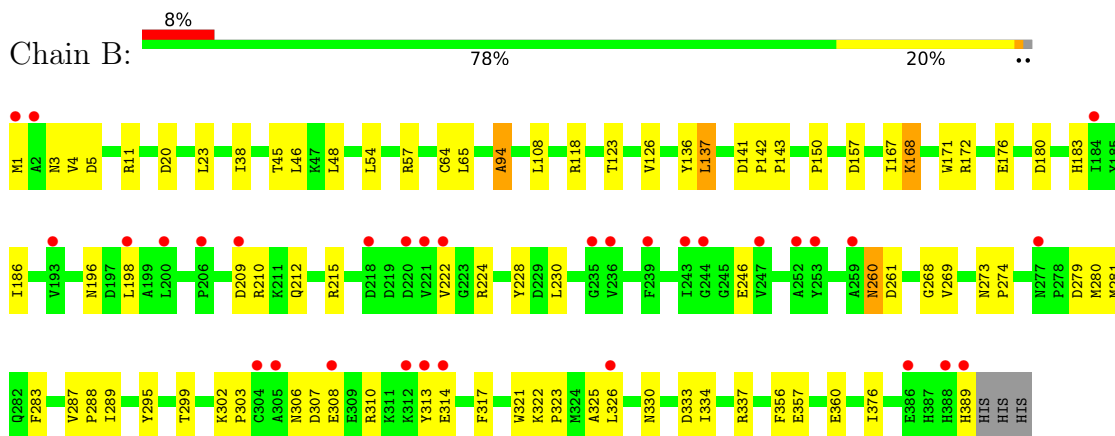
3 Residue-property plots [i](#)

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 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.

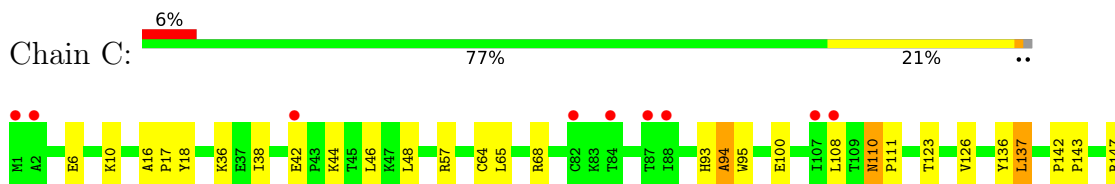
- Molecule 1: terminal oxygenase component of carbazole

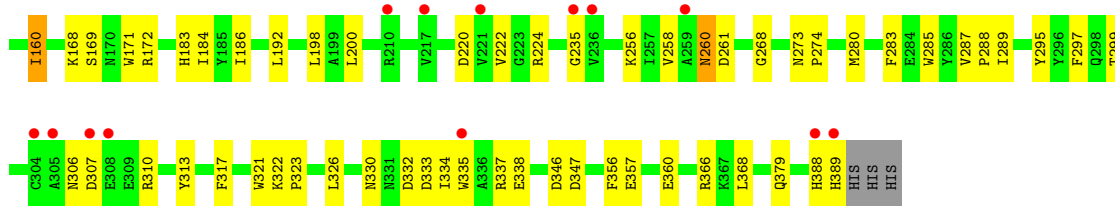


- Molecule 1: terminal oxygenase component of carbazole

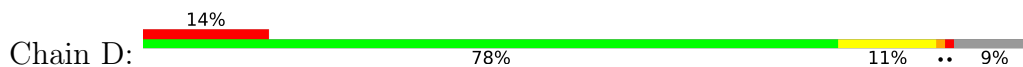


- Molecule 1: terminal oxygenase component of carbazole

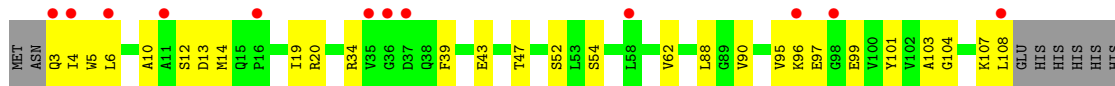




• Molecule 2: ferredoxin component of carbazole



• Molecule 2: ferredoxin component of carbazole



HIS

• Molecule 2: ferredoxin component of carbazole



LEU
GLU
HIS
HIS
HIS
HIS
HIS

4 Data and refinement statistics

Property	Value	Source
Space group	P 1 21 1	Depositor
Cell constants a, b, c, α , β , γ	98.09Å 89.83Å 104.91Å 90.00° 103.79° 90.00°	Depositor
Resolution (Å)	44.92 – 1.90 44.92 – 1.90	Depositor EDS
% Data completeness (in resolution range)	99.7 (44.92-1.90) 99.9 (44.92-1.90)	Depositor EDS
R_{merge}	(Not available)	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	2.34 (at 1.90Å)	Xtrriage
Refinement program	CNS 1.1	Depositor
R, R_{free}	0.199 , 0.233 (Not available) , 0.194	Depositor DCC
R_{free} test set	6975 reflections (5.02%)	wwPDB-VP
Wilson B-factor (Å ²)	31.0	Xtrriage
Anisotropy	0.042	Xtrriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.37 , 45.5	EDS
L-test for twinning ²	$\langle L \rangle = 0.49$, $\langle L^2 \rangle = 0.32$	Xtrriage
Estimated twinning fraction	No twinning to report.	Xtrriage
F_o, F_c correlation	0.96	EDS
Total number of atoms	12842	wwPDB-VP
Average B, all atoms (Å ²)	38.0	wwPDB-VP

Xtrriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 4.12% of the height of the origin peak. No significant pseudotranslation is detected.*

¹Intensities estimated from amplitudes.

²Theoretical 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: FES, FE2

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	0.38	0/3221	0.89	8/4372 (0.2%)
1	B	0.36	0/3221	0.88	7/4372 (0.2%)
1	C	0.37	0/3221	0.86	8/4372 (0.2%)
2	D	0.32	0/792	0.84	1/1077 (0.1%)
2	E	0.32	0/801	0.82	1/1089 (0.1%)
2	F	0.32	0/784	0.85	2/1066 (0.2%)
All	All	0.36	0/12040	0.87	27/16348 (0.2%)

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
2	F	0	1

There are no bond length outliers.

The worst 5 of 27 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	289	ILE	N-CA-C	-7.99	104.08	111.67
1	A	287	VAL	N-CA-C	7.17	115.01	107.76
1	B	289	ILE	N-CA-C	-7.10	104.93	111.67
2	F	43	GLU	N-CA-C	-6.61	101.18	110.50
1	C	357	GLU	N-CA-C	6.43	121.98	111.37

There are no chirality outliers.

All (1) planarity outliers are listed below:

Mol	Chain	Res	Type	Group
2	F	20	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	3136	0	3042	62	0
1	B	3136	0	3042	58	0
1	C	3136	0	3042	55	0
2	D	776	0	756	15	0
2	E	785	0	764	23	0
2	F	768	0	745	13	0
3	A	1	0	0	0	0
3	B	1	0	0	0	0
3	C	1	0	0	0	0
4	A	4	0	0	1	0
4	B	4	0	0	0	0
4	C	4	0	0	1	0
4	D	4	0	0	0	0
4	E	4	0	0	0	0
4	F	4	0	0	0	0
5	A	333	0	0	7	0
5	B	318	0	0	6	0
5	C	298	0	0	7	0
5	D	34	0	0	1	0
5	E	44	0	0	0	0
5	F	51	0	0	3	0
All	All	12842	0	11391	221	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 10.

The worst 5 of 221 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:C:235:GLY:HA3	5:C:581:HOH:O	1.68	0.92
1:C:65:LEU:HD23	1:C:123:THR:HG22	1.60	0.82

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:C:6:GLU:O	1:C:10:LYS:HG2	1.80	0.82
1:B:23:LEU:HG	5:B:594:HOH:O	1.80	0.79
1:A:290:ASP:OD1	1:A:293:THR:HG22	1.83	0.77

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	387/392 (99%)	367 (95%)	18 (5%)	2 (0%)	24 16
1	B	387/392 (99%)	365 (94%)	21 (5%)	1 (0%)	36 29
1	C	387/392 (99%)	371 (96%)	15 (4%)	1 (0%)	36 29
2	D	103/115 (90%)	94 (91%)	8 (8%)	1 (1%)	12 5
2	E	104/115 (90%)	99 (95%)	5 (5%)	0	100 100
2	F	102/115 (89%)	100 (98%)	2 (2%)	0	100 100
All	All	1470/1521 (97%)	1396 (95%)	69 (5%)	5 (0%)	36 29

All (5) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	C	268	GLY
1	A	268	GLY
1	B	268	GLY
2	D	107	LYS
1	A	71	HIS

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	336/339 (99%)	331 (98%)	5 (2%)	57	56
1	B	336/339 (99%)	331 (98%)	5 (2%)	57	56
1	C	336/339 (99%)	329 (98%)	7 (2%)	47	44
2	D	83/93 (89%)	81 (98%)	2 (2%)	43	38
2	E	84/93 (90%)	83 (99%)	1 (1%)	63	63
2	F	82/93 (88%)	81 (99%)	1 (1%)	63	63
All	All	1257/1296 (97%)	1236 (98%)	21 (2%)	53	52

5 of 21 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	C	356	PHE
2	D	107	LYS
2	F	7	LYS
2	D	108	LEU
1	C	379	GLN

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. 5 of 20 such sidechains are listed below:

Mol	Chain	Res	Type
1	C	119	GLN
1	C	389	HIS
2	E	15	GLN
2	E	3	GLN
1	A	372	HIS

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 oligosaccharides in this entry.

5.6 Ligand geometry [i](#)

Of 9 ligands modelled in this entry, 3 are monoatomic - leaving 6 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
4	FES	F	201	2	0,4,4	-	-	-		
4	FES	B	401	1	0,4,4	-	-	-		
4	FES	A	401	1	0,4,4	-	-	-		
4	FES	D	201	2	0,4,4	-	-	-		
4	FES	E	201	2	0,4,4	-	-	-		
4	FES	C	401	1	0,4,4	-	-	-		

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
4	FES	F	201	2	-	-	0/1/1/1
4	FES	B	401	1	-	-	0/1/1/1
4	FES	A	401	1	-	-	0/1/1/1
4	FES	D	201	2	-	-	0/1/1/1
4	FES	E	201	2	-	-	0/1/1/1
4	FES	C	401	1	-	-	0/1/1/1

There are no bond length outliers.

There are no bond angle outliers.

There are no chirality outliers.

There are no torsion outliers.

There are no ring outliers.

2 monomers are involved in 2 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
4	A	401	FES	1	0
4	C	401	FES	1	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, 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	389/392 (99%)	0.23	17 (4%) 39 41	21, 31, 51, 64	0
1	B	389/392 (99%)	0.59	32 (8%) 17 18	20, 35, 56, 64	0
1	C	389/392 (99%)	0.49	22 (5%) 29 31	25, 34, 51, 65	0
2	D	105/115 (91%)	1.05	16 (15%) 5 5	25, 47, 61, 65	0
2	E	106/115 (92%)	1.10	12 (11%) 10 10	28, 44, 57, 60	0
2	F	104/115 (90%)	1.32	24 (23%) 2 2	28, 44, 59, 63	0
All	All	1482/1521 (97%)	0.59	123 (8%) 17 18	20, 35, 57, 65	0

The worst 5 of 123 RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	1	MET	9.1
1	B	1	MET	6.6
2	E	108	LEU	6.4
1	C	1	MET	6.1
1	C	2	ALA	5.5

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 oligosaccharides 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. 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	RSCC	RSR	B-factors(Å ²)	Q<0.9
3	FE2	A	501	1/1	0.98	0.11	43,43,43,43	0
3	FE2	B	501	1/1	0.98	0.11	54,54,54,54	0
4	FES	C	401	4/4	0.98	0.05	28,29,29,29	0
4	FES	A	401	4/4	0.99	0.03	24,25,25,26	0
4	FES	B	401	4/4	0.99	0.03	20,21,22,22	0
3	FE2	C	501	1/1	0.99	0.12	43,43,43,43	0
4	FES	D	201	4/4	0.99	0.03	27,27,27,28	0
4	FES	E	201	4/4	0.99	0.04	29,30,30,31	0
4	FES	F	201	4/4	0.99	0.05	26,26,29,30	0

6.5 Other polymers [i](#)

There are no such residues in this entry.