



wwPDB X-ray Structure Validation Summary Report

Oct 2, 2014 – 05:27 PM EDT

PDB ID : 4P1C
Title : CRYSTAL STRUCTURE OF THE TOLUENE 4-MONOOXYGENASE HYDROXYLASE-FERREDOXINC7S, C84A, C85A VARIANT ELECTRON-TRANSFER COMPLEX
Authors : Acheson, J.F.; Fox, B.G.
Deposited on : 2014-02-26
Resolution : 2.40 Å(reported)

This is a wwPDB validation summary report for a publicly released PDB entry.
We welcome your comments at validation@mail.wwpdb.org
A user guide is available at <http://wwpdb.org/ValidationPDFNotes.html>

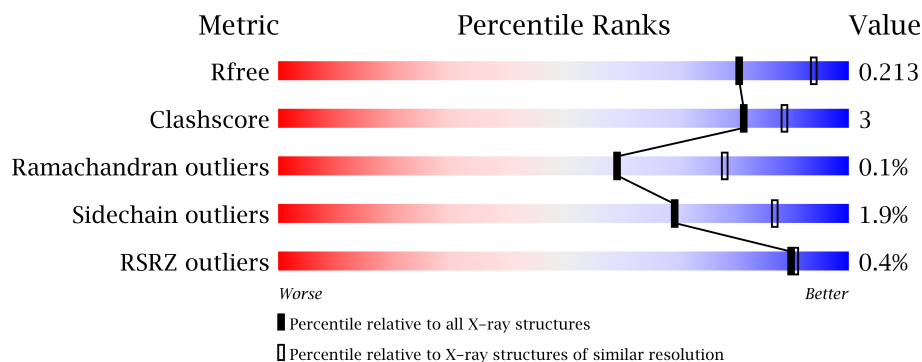
The following versions of software and data (see [references](#)) were used in the production of this report:

MolProbity : 4.02b-467
Mogul : 1.16 November 2013
Xtriage (Phenix) : dev-1439
EDS : stable23828
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) : stable23828

1 Overall quality at a glance

The reported resolution of this entry is 2.40 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	2207 (2.40-2.40)
Clashscore	79885	2789 (2.40-2.40)
Ramachandran outliers	78287	2736 (2.40-2.40)
Sidechain outliers	78261	2737 (2.40-2.40)
RSRZ outliers	66119	2210 (2.40-2.40)

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	490	<div><div></div><div><div></div><div></div><div></div><div></div></div></div>
1	D	490	<div><div></div><div><div></div><div></div><div></div><div></div></div></div>
2	B	305	<div><div></div><div><div></div><div></div><div></div><div></div></div></div>
2	E	305	<div><div></div><div><div></div><div></div><div></div><div></div></div></div>
3	C	82	<div><div></div><div><div></div><div></div><div></div><div></div></div></div>
3	F	82	<div><div></div><div><div></div><div></div><div></div><div></div></div></div>
4	H	111	<div><div></div><div><div></div><div></div><div></div><div></div></div></div>
4	I	111	<div><div></div><div><div></div><div></div><div></div><div></div></div></div>

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

Mol	Type	Chain	Res	Geometry	Electron density
6	PEG	A	503	-	X
6	PEG	D	503	-	X

2 Entry composition

There are 8 unique types of molecules in this entry. The entry contains 16762 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 Toluene-4-monooxygenasesystem protein A.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	490	Total	C	N	O	S	0	0	0
			4030	2584	681	743	22			
1	D	490	Total	C	N	O	S	0	0	0
			4030	2584	681	743	22			

There are 4 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	336	TRP	LEU	see remark 999	UNP Q00456
A	337	TYR	ASP	see remark 999	UNP Q00456
D	336	TRP	LEU	see remark 999	UNP Q00456
D	337	TYR	ASP	see remark 999	UNP Q00456

- Molecule 2 is a protein called Toluene-4-monooxygenasesystem protein E.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
2	B	305	Total	C	N	O	S	0	0	0
			2528	1601	438	474	15			
2	E	305	Total	C	N	O	S	0	0	0
			2528	1601	438	474	15			

- Molecule 3 is a protein called Toluene-4-monooxygenasesystem protein B.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
3	C	82	Total	C	N	O	S	1	0	0
			654	412	117	121	4			
3	F	82	Total	C	N	O	S	2	0	0
			654	412	117	121	4			

- Molecule 4 is a protein called Toluene-4-monooxygenasesystem ferredoxin subunit.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
4	H	111	Total	C	N	O	S	0	0	0
			851	533	137	177	4			
4	I	111	Total	C	N	O	S	3	1	0
			854	535	138	177	4			

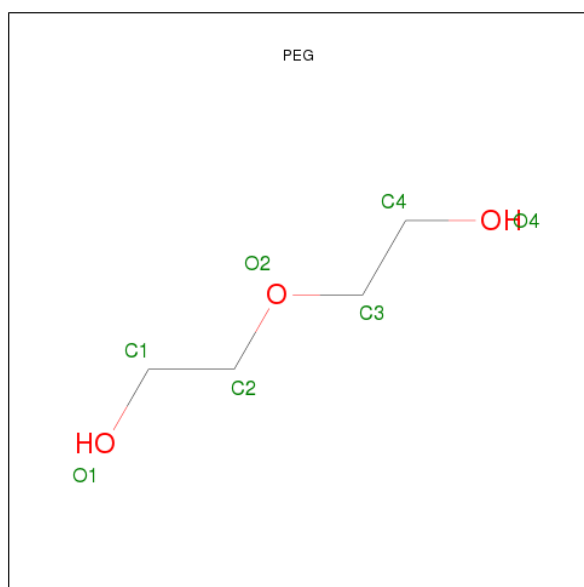
There are 6 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
H	7	SER	CYS	engineered mutation	UNP Q00458
H	84	ALA	CYS	engineered mutation	UNP Q00458
H	85	ALA	CYS	engineered mutation	UNP Q00458
I	7	SER	CYS	engineered mutation	UNP Q00458
I	84	ALA	CYS	engineered mutation	UNP Q00458
I	85	ALA	CYS	engineered mutation	UNP Q00458

- Molecule 5 is FE (III) ION (three-letter code: FE) (formula: Fe).

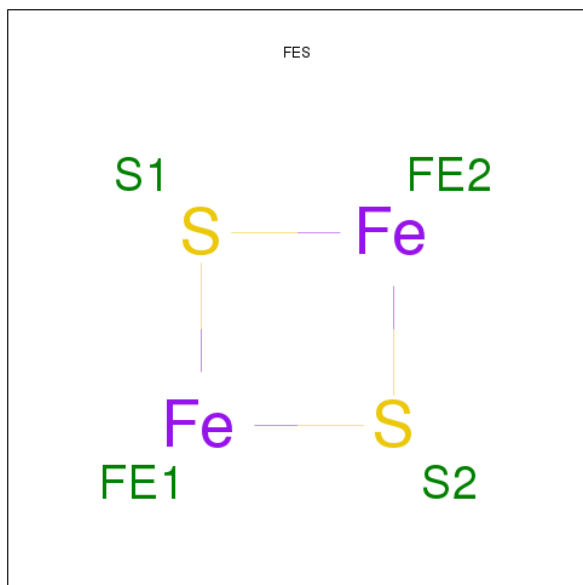
Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
5	A	2	Total Fe 2 2	0	0
5	D	2	Total Fe 2 2	0	0

- Molecule 6 is DI(HYDROXYETHYL)ETHER (three-letter code: PEG) (formula: C₄H₁₀O₃).



Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
6	A	1	Total	C	O	0	0
			5	3	2		
6	D	1	Total	C	O	0	0
			7	4	3		

- Molecule 7 is FE2/S2 (INORGANIC) CLUSTER (three-letter code: FES) (formula: Fe₂S₂).



Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
7	H	1	Total	Fe	S	0	0
			4	2	2		
7	I	1	Total	Fe	S	0	0
			4	2	2		

- Molecule 8 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
8	A	172	Total	O	0	0
			172	172		
8	B	78	Total	O	0	0
			78	78		
8	C	23	Total	O	0	0
			23	23		
8	D	154	Total	O	0	0
			154	154		
8	E	99	Total	O	0	0
			99	99		
8	F	6	Total	O	0	0
			6	6		

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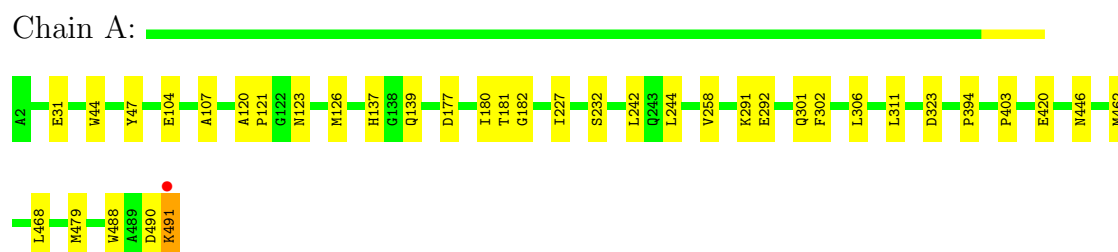
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Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
8	H	38	Total 38	O 38	0	0
8	I	39	Total 39	O 39	0	0

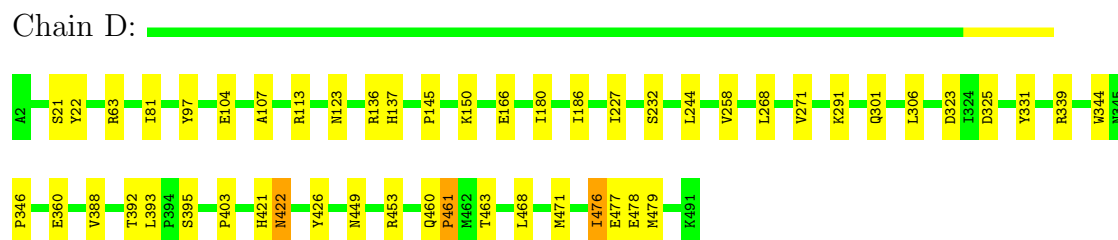
3 Residue-property plots

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.

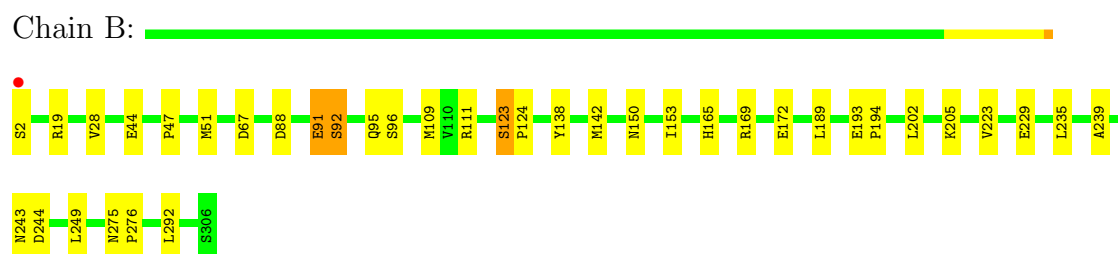
- Molecule 1: Toluene-4-monooxygenasesystem protein A



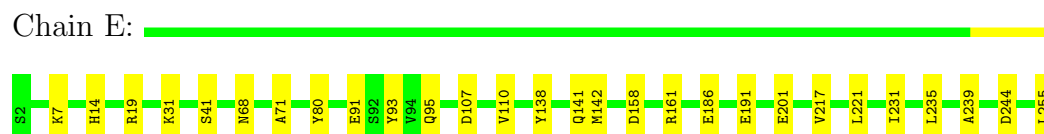
- Molecule 1: Toluene-4-monooxygenasesystem protein A



- Molecule 2: Toluene-4-monooxygenasesystem protein E



- Molecule 2: Toluene-4-monooxygenasesystem protein E



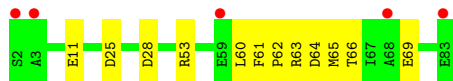
- Molecule 3: Toluene-4-monooxygenasesystem protein B





- Molecule 3: Toluene-4-monooxygenasesystem protein B

Chain F:



- Molecule 4: Toluene-4-monooxygenasesystem ferredoxin subunit

Chain H:



- Molecule 4: Toluene-4-monooxygenasesystem ferredoxin subunit

Chain I:



4 Data and refinement statistics

Property	Value	Source
Space group	P 21 21 21	Depositor
Cell constants a, b, c, α , β , γ	95.23Å 106.35Å 213.42Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	47.69 – 2.40 47.69 – 2.37	Depositor EDS
% Data completeness (in resolution range)	95.1 (47.69-2.40) 89.5 (47.69-2.37)	Depositor EDS
R_{merge}	(Not available)	Depositor
R_{sym}	0.13	Depositor
$\langle I/\sigma(I) \rangle$ ¹	1.82 (at 2.37Å)	Xtriage
Refinement program	PHENIX (PHENIX.REFINE: DEV_1184)	Depositor
R, R_{free}	0.153 , 0.215 0.152 , 0.213	Depositor DCC
R_{free} test set	3897 reflections (5.03%)	DCC
Wilson B-factor (Å ²)	25.1	Xtriage
Anisotropy	0.444	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.36 , 13.7	EDS
Estimated twinning fraction	No twinning to report.	Xtriage
L-test for twinning	$\langle L \rangle = 0.48$, $\langle L^2 \rangle = 0.31$	Xtriage
Outliers	0 of 83432 reflections	Xtriage
F_o, F_c correlation	0.95	EDS
Total number of atoms	16762	wwPDB-VP
Average B, all atoms (Å ²)	20.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 3.38% 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: PEG, FE, FES

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	0.52	2/4159 (0.0%)	0.54	0/5648
1	D	0.62	4/4159 (0.1%)	0.56	1/5648 (0.0%)
2	B	0.69	3/2603 (0.1%)	0.60	2/3537 (0.1%)
2	E	0.57	2/2603 (0.1%)	0.52	0/3537
3	C	0.57	0/666	0.60	0/902
3	F	0.60	0/666	0.65	1/902 (0.1%)
4	H	0.45	0/870	0.54	0/1182
4	I	0.57	0/879	0.60	0/1193
All	All	0.59	11/16605 (0.1%)	0.56	4/22549 (0.0%)

The worst 5 of 11 bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	A	292	GLU	CD-OE1	-7.44	1.17	1.25
1	A	292	GLU	CD-OE2	-7.04	1.18	1.25
2	E	191	GLU	CD-OE2	-6.82	1.18	1.25
2	B	91	GLU	CD-OE2	-6.40	1.18	1.25
2	B	44	GLU	CD-OE1	-5.73	1.19	1.25

All (4) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
2	B	123	SER	C-N-CD	5.88	140.74	128.40
3	F	61	PHE	C-N-CD	5.56	140.07	128.40
1	D	460	GLN	C-N-CD	5.15	139.21	128.40
2	B	124	PRO	CA-N-CD	-5.02	104.47	111.50

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	4030	0	3786	19	0
1	D	4030	0	3786	30	0
2	B	2528	0	2408	21	0
2	E	2528	0	2408	17	0
3	C	654	0	649	4	0
3	F	654	0	649	11	0
4	H	851	0	792	3	0
4	I	854	0	797	5	0
5	A	2	0	0	0	0
5	D	2	0	0	0	0
6	A	5	0	4	1	0
6	D	7	0	9	1	0
7	H	4	0	0	0	0
7	I	4	0	0	0	0
8	A	172	0	0	0	0
8	B	78	0	0	0	0
8	C	23	0	0	0	0
8	D	154	0	0	0	0
8	E	99	0	0	0	0
8	F	6	0	0	1	0
8	H	38	0	0	0	0
8	I	39	0	0	0	0
All	All	16762	0	15288	100	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 3.

The worst 5 of 100 close contacts within the same asymmetric unit are listed below.

Atom-1	Atom-2	Distance(Å)	Clash(Å)
3:F:62:PRO:HD2	3:F:65:MET:CE	1.78	1.12
3:F:62:PRO:HD2	3:F:65:MET:HE2	1.10	1.06
2:E:19:ARG:NH2	4:I:10:ASP:OD1	2.15	0.78
1:A:491:LYS:H	1:A:491:LYS:HD3	1.51	0.76
3:F:62:PRO:CD	3:F:65:MET:CE	2.61	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	488/490 (100%)	470 (96%)	17 (4%)	1 (0%)	56	74
1	D	488/490 (100%)	468 (96%)	20 (4%)	0	100	100
2	B	303/305 (99%)	299 (99%)	4 (1%)	0	100	100
2	E	303/305 (99%)	297 (98%)	6 (2%)	0	100	100
3	C	80/82 (98%)	76 (95%)	4 (5%)	0	100	100
3	F	80/82 (98%)	77 (96%)	3 (4%)	0	100	100
4	H	109/111 (98%)	103 (94%)	6 (6%)	0	100	100
4	I	110/111 (99%)	104 (94%)	5 (4%)	1 (1%)	25	35
All	All	1961/1976 (99%)	1894 (97%)	65 (3%)	2 (0%)	59	78

All (2) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
4	I	110	ALA
1	A	490	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	415/415 (100%)	406 (98%)	9 (2%)	64	83
1	D	415/415 (100%)	406 (98%)	9 (2%)	64	83

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Mol	Chain	Analysed	Rotameric	Outliers	Percentiles	
2	B	276/276 (100%)	270 (98%)	6 (2%)	64	83
2	E	276/276 (100%)	275 (100%)	1 (0%)	95	98
3	C	73/73 (100%)	71 (97%)	2 (3%)	57	78
3	F	73/73 (100%)	72 (99%)	1 (1%)	78	92
4	H	93/93 (100%)	92 (99%)	1 (1%)	84	94
4	I	94/93 (101%)	91 (97%)	3 (3%)	51	72
All	All	1715/1714 (100%)	1683 (98%)	32 (2%)	69	87

5 of 32 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
2	B	235	LEU
1	D	63	ARG
4	I	10	ASP
3	C	59	GLU
1	D	123	ASN

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 ⓘ

Of 8 ligands modelled in this entry, 4 are monoatomic - leaving 4 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	$\# Z > 2$
6	PEG	A	503	5	3,4,6	0.69	0	2,3,5	0.45	0
6	PEG	D	503	5	6,6,6	0.44	0	5,5,5	0.34	0
7	FES	H	201	4	0,4,4	0.00	-	0,4,4	0.00	-
7	FES	I	201	4	0,4,4	0.00	-	0,4,4	0.00	-

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
6	PEG	A	503	5	-	0/2/2/4	0/0/0/0
6	PEG	D	503	5	-	0/4/4/4	0/0/0/0
7	FES	H	201	4	-	0/0/4/4	0/1/1/1
7	FES	I	201	4	-	0/0/4/4	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.

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	490/490 (100%)	-0.56	1 (0%) 93 94	8, 15, 28, 48	0
1	D	490/490 (100%)	-0.53	0 100 100	9, 17, 32, 49	0
2	B	305/305 (100%)	-0.52	1 (0%) 91 92	11, 22, 39, 53	0
2	E	305/305 (100%)	-0.60	0 100 100	8, 18, 34, 60	0
3	C	82/82 (100%)	-0.47	0 100 100	10, 20, 30, 43	1 (1%)
3	F	82/82 (100%)	0.34	5 (6%) 21 18	17, 37, 51, 59	2 (2%)
4	H	111/111 (100%)	-0.41	0 100 100	10, 18, 35, 44	0
4	I	111/111 (100%)	-0.16	0 100 100	8, 19, 39, 42	0
All	All	1976/1976 (100%)	-0.48	7 (0%) 90 90	8, 18, 37, 60	3 (0%)

The worst 5 of 7 RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	491	LYS	3.9
2	B	2	SER	3.1
3	F	59	GLU	3.1
3	F	2	SER	2.9
3	F	3	ALA	2.8

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(Å ²)	Q<0.9
6	PEG	A	503	5/7	0.22	2.74	26,29,35,40	0
6	PEG	D	503	7/7	0.23	2.17	18,21,28,38	7
5	FE	A	502	1/1	0.15	-0.25	25,25,25,25	0
7	FES	H	201	4/4	0.09	-0.67	10,11,11,12	0
7	FES	I	201	4/4	0.08	-0.76	9,11,11,13	0
5	FE	A	501	1/1	0.12	-1.43	19,19,19,19	0
5	FE	D	501	1/1	0.14	-2.53	18,18,18,18	0
5	FE	D	502	1/1	0.13	-2.54	24,24,24,24	0

6.5 Other polymers

There are no such residues in this entry.