Full wwPDB X-ray Structure Validation Report ⓘ

May 28, 2020 – 10:11 pm BST

PDB ID	:	2FIY
Title	:	The crystal structure of the FdhE protein from Pseudomonas aeruginosa
Authors	:	Zhang, R.; Evdokimova, E.; Savchenko, A.; Edwards, A.; Joachimiak, A.; Midwest Center for Structural Genomics (MCSG)
Deposited on	:	2005-12-30
Resolution	:	2.10 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:

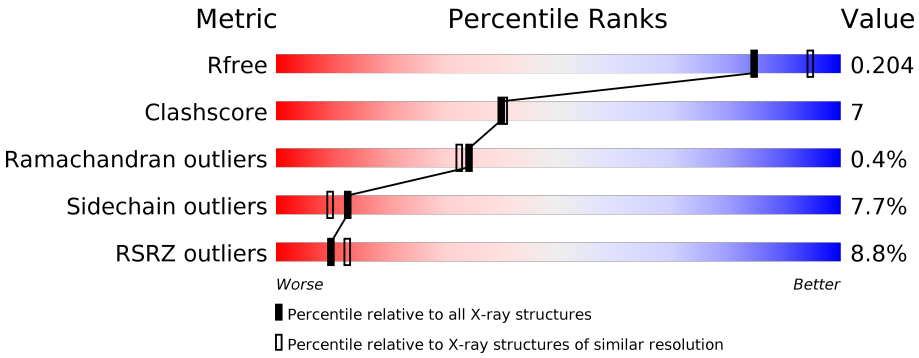
MolProbity	:	4.02b-467
Xtriage (Phenix)	:	1.13
EDS	:	2.11
Percentile statistics	:	20191225.v01 (using entries in the PDB archive December 25th 2019)
Refmac	:	5.8.0158
CCP4	:	7.0.044 (Gargrove)
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, RNA)	:	Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP)	:	2.11

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 2.10 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}	130704	5197 (2.10-2.10)
Clashscore	141614	5710 (2.10-2.10)
Ramachandran outliers	138981	5647 (2.10-2.10)
Sidechain outliers	138945	5648 (2.10-2.10)
RSRZ outliers	127900	5083 (2.10-2.10)

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 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% 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	309	8% 76% 14% • 8%
1	B	309	8% 77% 12% • 9%

2 Entry composition

There are 3 unique types of molecules in this entry. The entry contains 4738 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 Protein fdhE homolog.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	285	Total	C	N	O	S	0	0	0
			2202	1398	395	394	15			
1	B	281	Total	C	N	O	S	0	0	0
			2162	1377	389	381	15			

- Molecule 2 is FE (III) ION (three-letter code: FE) (formula: Fe).

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
2	B	3	Total	Fe	0	0
			3	3		
2	A	2	Total	Fe	0	0
			2	2		

- Molecule 3 is water.

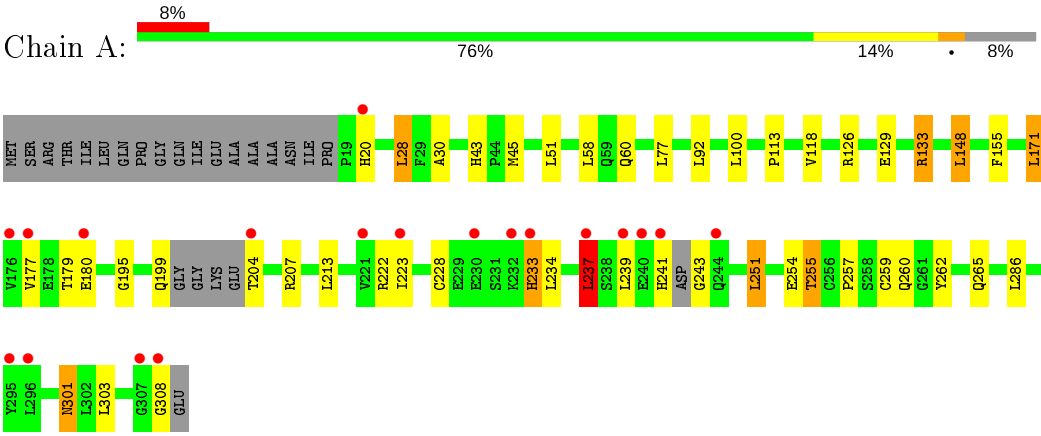
Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
3	A	216	Total	O	0	0
			216	216		
3	B	153	Total	O	0	0
			153	153		

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.

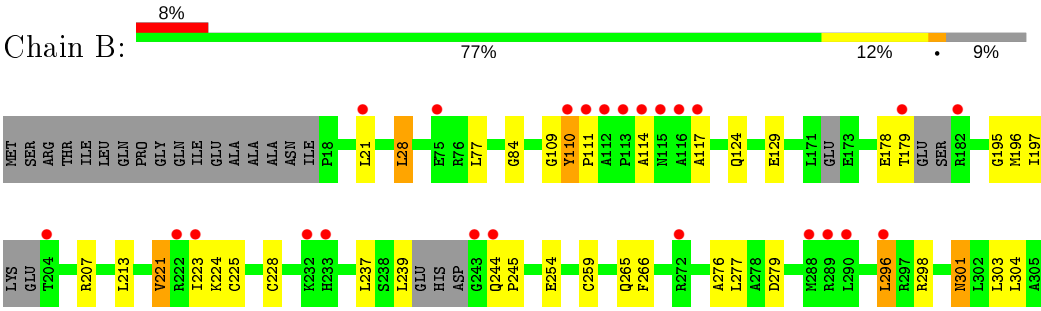
- Molecule 1: Protein fdhE homolog

Chain A:



- Molecule 1: Protein fdhE homolog

Chain B:



4 Data and refinement statistics (i)

Property	Value	Source
Space group	P 2 2 21	Depositor
Cell constants a, b, c, α, β, γ	46.26Å 96.62Å 140.62Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	96.67 – 2.10 45.69 – 2.10	Depositor EDS
% Data completeness (in resolution range)	99.6 (96.67-2.10) 99.6 (45.69-2.10)	Depositor EDS
R_{merge}	0.07	Depositor
R_{sym}	(Not available)	Depositor
$< I/\sigma(I) >$ [1]	3.47 (at 2.10Å)	Xtriage
Refinement program	REFMAC 5.2.0005	Depositor
R, R_{free}	0.197 , 0.243 0.205 , 0.204	Depositor DCC
R_{free} test set	1855 reflections (4.95%)	wwPDB-VP
Wilson B-factor (Å^2)	35.1	Xtriage
Anisotropy	0.391	Xtriage
Bulk solvent k_{sol}(e/Å^3), B_{sol}(Å^2)	0.36 , 53.4	EDS
L-test for twinning[2]	$< \|L\| > = 0.50$, $< L^2 > = 0.33$	Xtriage
Estimated twinning fraction	No twinning to report.	Xtriage
F_o,F_c correlation	0.94	EDS
Total number of atoms	4738	wwPDB-VP
Average B, all atoms (Å^2)	39.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 11.02% of the height of the origin peak. No significant pseudotranslation is detected.*

[1] Intensities estimated from amplitudes.

[2] Theoretical values of $< |L| >$, $< L^2 >$ for acentric reflections are 0.5, 0.333 respectively for untwinned datasets, and 0.375, 0.2 for perfectly twinned datasets.

5 Model quality

5.1 Standard geometry

Bond lengths and bond angles in the following residue types are not validated in this section: FE

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	0.56	1/2256 (0.0%)	0.76	4/3065 (0.1%)
1	B	0.45	0/2214	0.63	1/3007 (0.0%)
All	All	0.51	1/4470 (0.0%)	0.70	5/6072 (0.1%)

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
1	A	0	2

All (1) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	A	255	THR	C-O	-7.36	1.09	1.23

All (5) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(^{o})	Ideal(^{o})
1	A	133	ARG	NE-CZ-NH1	6.89	123.75	120.30
1	A	148	LEU	CA-CB-CG	6.64	130.57	115.30
1	A	237	LEU	CA-CB-CG	6.00	129.10	115.30
1	B	28	LEU	CA-CB-CG	5.91	128.89	115.30
1	A	133	ARG	NE-CZ-NH2	-5.86	117.37	120.30

There are no chirality outliers.

All (2) planarity outliers are listed below:

Mol	Chain	Res	Type	Group
1	A	171	LEU	Peptide
1	A	255	THR	Mainchain

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	2202	0	2176	40	0
1	B	2162	0	2146	22	0
2	A	2	0	0	1	0
2	B	3	0	0	0	0
3	A	216	0	0	11	0
3	B	153	0	0	1	0
All	All	4738	0	4322	62	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 7.

All (62) 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:180:GLU:O	3:A:422:HOH:O	1.93	0.86
1:A:207:ARG:HE	1:A:265:GLN:HE22	1.31	0.78
1:B:196:MET:HE1	1:B:276:ALA:HA	1.72	0.71
1:A:195:GLY:HA3	1:A:265:GLN:HE21	1.57	0.69
1:A:30:ALA:H	1:A:60:GLN:HE21	1.41	0.69
1:A:233:HIS:O	3:A:602:HOH:O	2.09	0.69
1:A:43:HIS:HD2	1:A:45:MET:H	1.43	0.65
1:A:20:HIS:ND1	3:A:557:HOH:O	2.29	0.64
1:B:244:GLN:HB2	1:B:245:PRO:HD2	1.78	0.64
1:B:207:ARG:HE	1:B:265:GLN:HE22	1.45	0.64
1:B:195:GLY:HA3	1:B:265:GLN:HE21	1.63	0.64
1:B:207:ARG:NH2	1:B:254:GLU:OE1	2.31	0.63
1:B:117:ALA:HB1	3:B:454:HOH:O	1.99	0.61
1:A:28:LEU:HG	3:A:430:HOH:O	2.04	0.58
1:A:28:LEU:C	1:A:28:LEU:HD12	2.23	0.58
1:A:237:LEU:HD11	1:A:286:LEU:HD11	1.85	0.57

Continued on next page...

Continued from previous page...

Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:237:LEU:CD1	1:A:286:LEU:HD11	2.33	0.57
1:A:237:LEU:HD12	1:A:290:LEU:HD21	1.88	0.56
1:B:301:ASN:HD22	1:B:303:LEU:H	1.53	0.56
1:B:109:GLY:C	1:B:111:PRO:HD3	2.26	0.55
1:B:110:TYR:N	1:B:111:PRO:HD3	2.20	0.55
1:B:197:ILE:HD12	1:B:197:ILE:N	2.21	0.55
1:B:195:GLY:O	1:B:196:MET:HE2	2.07	0.54
1:A:207:ARG:NE	1:A:265:GLN:HE22	2.05	0.53
1:A:234:LEU:HA	3:A:602:HOH:O	2.07	0.53
1:A:241:HIS:O	1:A:243:GLY:N	2.42	0.53
1:B:296:LEU:HD21	1:B:298:ARG:CZ	2.40	0.51
1:A:177:VAL:HG21	3:A:615:HOH:O	2.11	0.51
1:B:207:ARG:NE	1:B:265:GLN:HE22	2.09	0.50
1:A:113:PRO:HB2	1:A:118:VAL:HG13	1.93	0.50
1:A:43:HIS:CD2	1:A:45:MET:H	2.26	0.49
1:B:244:GLN:HB2	1:B:245:PRO:CD	2.42	0.49
1:A:308:GLY:HA3	3:A:464:HOH:O	2.13	0.48
1:B:196:MET:HE1	1:B:276:ALA:CA	2.42	0.48
1:A:126:ARG:NH1	3:A:601:HOH:O	2.39	0.47
1:A:259:CYS:O	1:A:260:GLN:HG2	2.14	0.47
1:A:301:ASN:HD22	1:A:303:LEU:H	1.62	0.47
1:A:172:GLU:HG3	1:A:175:ALA:HB2	1.97	0.47
1:A:207:ARG:NH2	1:A:254:GLU:OE1	2.48	0.46
1:A:301:ASN:HD22	1:A:301:ASN:C	2.18	0.46
1:A:237:LEU:CD1	1:A:290:LEU:HD21	2.47	0.45
1:A:257:PRO:CD	3:A:602:HOH:O	2.65	0.44
1:B:266:PHE:CE1	1:B:279:ASP:HB3	2.53	0.44
1:A:257:PRO:HD3	3:A:602:HOH:O	2.17	0.44
1:B:306:PRO:HA	1:B:307:GLY:HA2	1.80	0.44
1:B:84:GLY:HA2	1:B:178:GLU:HB2	2.00	0.44
1:A:262:TYR:CG	1:A:290:LEU:HD13	2.52	0.44
1:A:171:LEU:HA	1:A:172:GLU:CB	2.48	0.44
1:A:28:LEU:CG	3:A:430:HOH:O	2.63	0.44
1:A:129:GLU:O	1:A:133:ARG:HG3	2.18	0.43
1:B:307:GLY:HA2	1:B:308:GLY:HA3	1.81	0.43
1:A:259:CYS:HG	2:A:403:FE:FE	1.32	0.43
1:A:171:LEU:HA	1:A:172:GLU:HB3	2.00	0.43
1:A:207:ARG:HD2	1:A:222:ARG:HA	2.01	0.42
1:B:221:VAL:HG13	1:B:224:LYS:HD2	2.01	0.42
1:A:118:VAL:HG23	1:A:155:PHE:CZ	2.55	0.42
1:A:28:LEU:O	1:A:28:LEU:HD12	2.20	0.41

Continued on next page...

Continued from previous page...

Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:B:196:MET:CE	1:B:276:ALA:HB2	2.50	0.41
1:B:225:CYS:HB3	1:B:228:CYS:HB2	2.02	0.41
1:A:251:LEU:HD13	1:A:286:LEU:HD22	2.03	0.40
1:A:30:ALA:N	1:A:60:GLN:HE21	2.14	0.40
1:A:177:VAL:HG12	1:A:179:THR:H	1.87	0.40

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	279/309 (90%)	268 (96%)	10 (4%)	1 (0%)	34	32
1	B	271/309 (88%)	262 (97%)	8 (3%)	1 (0%)	34	32
All	All	550/618 (89%)	530 (96%)	18 (3%)	2 (0%)	34	32

All (2) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	233	HIS
1	B	114	ALA

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	223/242 (92%)	207 (93%)	16 (7%)	14 11
1	B	218/242 (90%)	200 (92%)	18 (8%)	11 7
All	All	441/484 (91%)	407 (92%)	34 (8%)	13 9

All (34) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	28	LEU
1	A	51	LEU
1	A	58	LEU
1	A	77	LEU
1	A	92	LEU
1	A	100	LEU
1	A	148	LEU
1	A	199	GLN
1	A	204	THR
1	A	213	LEU
1	A	223	ILE
1	A	228	CYS
1	A	237	LEU
1	A	239	LEU
1	A	251	LEU
1	A	301	ASN
1	B	21	LEU
1	B	28	LEU
1	B	77	LEU
1	B	110	TYR
1	B	124	GLN
1	B	129	GLU
1	B	179	THR
1	B	199	GLN
1	B	213	LEU
1	B	221	VAL
1	B	223	ILE
1	B	237	LEU
1	B	239	LEU
1	B	259	CYS
1	B	277	LEU
1	B	296	LEU
1	B	301	ASN
1	B	304	LEU

Some sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (13) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	23	GLN
1	A	43	HIS
1	A	60	GLN
1	A	83	HIS
1	A	199	GLN
1	A	265	GLN
1	A	273	HIS
1	A	301	ASN
1	B	23	GLN
1	B	43	HIS
1	B	260	GLN
1	B	265	GLN
1	B	301	ASN

5.3.3 RNA

There are no RNA molecules 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 5 ligands modelled in this entry, 5 are monoatomic - leaving 0 for Mogul analysis.

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.

No monomer is involved in short contacts.

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

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, 95^{th} 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	285/309 (92%)	0.76	24 (8%) 11 14	23, 33, 52, 58	0
1	B	281/309 (90%)	0.80	26 (9%) 8 11	33, 39, 53, 74	0
All	All	566/618 (91%)	0.78	50 (8%) 10 12	23, 37, 53, 74	0

All (50) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	308	GLY	9.1
1	B	112	ALA	7.2
1	A	177	VAL	7.1
1	B	223	ILE	6.2
1	A	307	GLY	5.9
1	B	114	ALA	5.6
1	A	244	GLN	5.2
1	A	204	THR	5.0
1	A	232	LYS	4.8
1	B	308	GLY	4.4
1	A	233	HIS	4.4
1	A	241	HIS	4.1
1	B	232	LYS	4.1
1	A	20	HIS	4.0
1	A	289	ARG	3.6
1	B	296	LEU	3.6
1	B	244	GLN	3.5
1	A	294	GLY	3.4
1	A	176	VAL	3.4
1	B	243	GLY	3.4
1	A	240	GLU	3.3
1	B	233	HIS	3.3
1	B	179	THR	3.3
1	A	239	LEU	3.3

Continued on next page...

Continued from previous page...

Mol	Chain	Res	Type	RSRZ
1	B	115	ASN	3.2
1	B	111	PRO	3.1
1	A	223	ILE	3.1
1	A	175	ALA	3.0
1	B	75	GLU	3.0
1	B	117	ALA	2.9
1	B	21	LEU	2.9
1	A	237	LEU	2.8
1	A	295	TYR	2.7
1	A	230	GLU	2.7
1	B	113	PRO	2.7
1	B	116	ALA	2.7
1	A	173	GLU	2.6
1	A	296	LEU	2.6
1	A	172	GLU	2.5
1	B	222	ARG	2.4
1	B	204	THR	2.3
1	B	289	ARG	2.2
1	A	221	VAL	2.1
1	B	288	MET	2.1
1	B	272	ARG	2.1
1	A	180	GLU	2.1
1	B	290	LEU	2.1
1	B	307	GLY	2.1
1	B	182	ARG	2.1
1	B	110	TYR	2.0

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. The B-factors column lists the minimum, median, 95^{th} 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
2	FE	A	403	1/1	0.92	0.08	58,58,58,58	0
2	FE	B	404	1/1	0.96	0.08	59,59,59,59	0
2	FE	B	405	1/1	0.96	0.05	65,65,65,65	0
2	FE	B	402	1/1	0.98	0.03	36,36,36,36	0
2	FE	A	401	1/1	0.98	0.03	32,32,32,32	0

6.5 Other polymers (i)

There are no such residues in this entry.