



Full wwPDB X-ray Structure Validation Report ⓘ

Feb 28, 2014 – 01:16 AM GMT

PDB ID : 1UBL
Title : Three-dimensional Structure of The Carbon Monoxide Complex of [NiFe]hydrogenase From Desulfovibrio vulgaris Miyazaki F
Authors : Ogata, H.; Mizoguchi, Y.; Mizuno, N.; Miki, K.; Adachi, S.; Yasuoka, N.; Yagi, T.; Yamauchi, O.; Hirota, S.; Higuchi, Y.
Deposited on : 2003-04-04
Resolution : 1.20 Å(reported)

This is a full wwPDB validation 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>

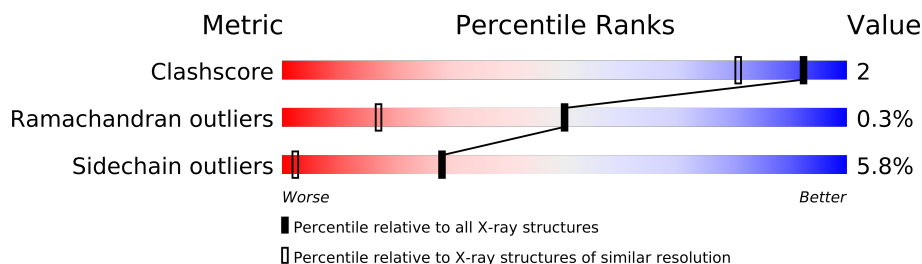
The following versions of software and data (see [references](#)) were used in the production of this report:

MolProbity : 4.02b-467
Mogul : 1.15 2013
Xtriage (Phenix) : NOT EXECUTED
EDS : NOT EXECUTED
Percentile statistics : 21963
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 1.20 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))
Clashscore	79885	1158 (1.26-1.14)
Ramachandran outliers	78287	1106 (1.26-1.14)
Sidechain outliers	78261	1104 (1.26-1.14)

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.

Note EDS was not executed.

Mol	Chain	Length	Quality of chain
1	S	267	
2	L	534	

2 Entry composition

There are 9 unique types of molecules in this entry. The entry contains 7116 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 Periplasmic [NiFe] hydrogenase Small subunit.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	S	267	Total	C	N	O	S	0	0	0
			2019	1282	342	378	17			

- Molecule 2 is a protein called Periplasmic [NiFe] hydrogenase Large subunit.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
2	L	534	Total	C	N	O	S	0	0	0
			4177	2674	725	763	15			

There are 2 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
L	514	LYS	ASN	SEE REMARK 999	UNP P21852
L	515	LEU	VAL	SEE REMARK 999	UNP P21852

- Molecule 3 is MAGNESIUM ION (three-letter code: MG) (formula: Mg).

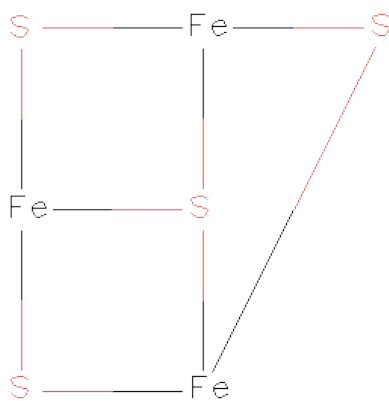
Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
3	L	1	Total	Mg	0	0
			1	1		

- Molecule 4 is IRON/SULFUR CLUSTER (three-letter code: SF4) (formula: Fe₄S₄).



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

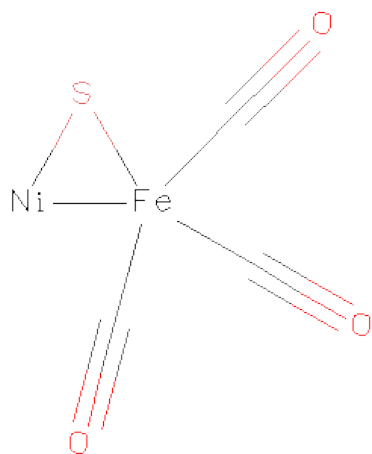
- Molecule 5 is FE3-S4 CLUSTER (three-letter code: F3S) (formula: Fe_3S_4).



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

- Molecule 6 is (MU-SULPHIDO)-BIS(MU-CYS,S)-[TRICARBONYLIRON-DI-(CYS,S)NIC

KEL(II)](FE-NI) (three-letter code: FNE) (formula: $\text{C}_3\text{FeNiO}_3\text{S}$).



Mol	Chain	Residues	Atoms					ZeroOcc	AltConf
6	L	1	Total	C	Fe	Ni	O	0	0
			8	3	1	1	3		

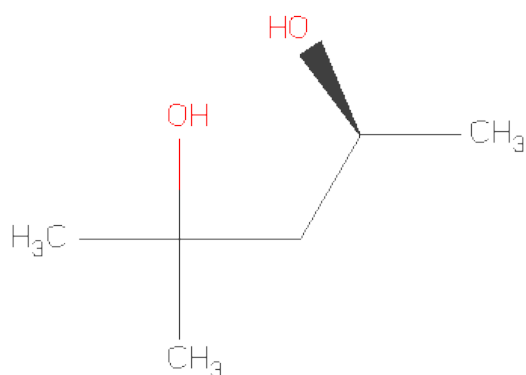
- Molecule 7 is CARBON MONOXIDE (three-letter code: CMO) (formula: CO).



Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
7	L	1	Total	C	O	0	0
			2	1	1		

- Molecule 8 is (4S)-2-METHYL-2,4-PENTANEDIOL (three-letter code: MPD) (formula:

C₆H₁₄O₂).



Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
8	S	1	Total	C	O	0	0
			8	6	2		
8	S	1	Total	C	O	0	0
			8	6	2		
8	L	1	Total	C	O	0	0
			8	6	2		
8	S	1	Total	C	O	0	0
			8	6	2		
8	L	1	Total	C	O	0	0
			8	6	2		

- Molecule 9 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
9	L	553	Total	O	0	0
			553	553		
9	S	293	Total	O	0	0
			293	293		

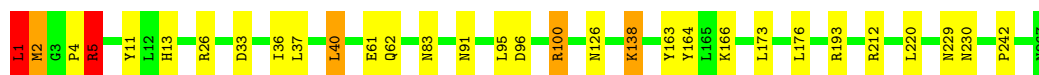
3 Residue-property plots

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.

Note EDS was not executed.

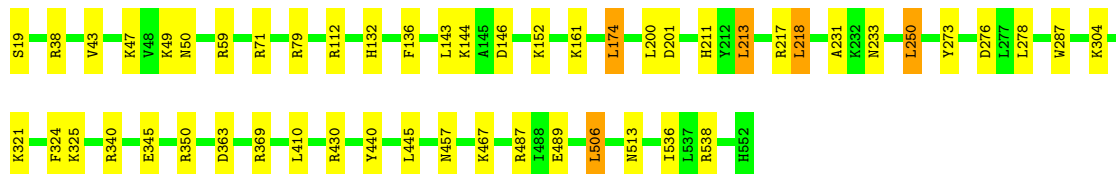
- Molecule 1: Periplasmic [NiFe] hydrogenase Small subunit

Chain S: 



- Molecule 2: Periplasmic [NiFe] hydrogenase Large subunit

Chain L: 



4 Data and refinement statistics

Xtriage (Phenix) and EDS were not executed - this section will therefore be incomplete.

Property	Value	Source
Space group	P 21 21 21	Depositor
Cell constants a, b, c, α , β , γ	97.81Å 125.50Å 66.59Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	20.00 – 1.20	Depositor
% Data completeness (in resolution range)	89.1 (20.00-1.20)	Depositor
R_{merge}	0.08	Depositor
R_{sym}	(Not available)	Depositor
Refinement program	SHELXL-97	Depositor
R, R_{free}	0.117 , 0.161	Depositor
Estimated twinning fraction	No twinning to report.	Xtriage
Total number of atoms	7116	wwPDB-VP
Average B, all atoms (Å ²)	20.0	wwPDB-VP

5 Model quality

5.1 Standard geometry

Bond lengths and bond angles in the following residue types are not validated in this section: CMO, MPD, SF4, MG, FNE, F3S

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	S	0.76	0/2075	1.33	23/2830 (0.8%)
2	L	0.74	0/4288	1.28	36/5831 (0.6%)
All	All	0.75	0/6363	1.30	59/8661 (0.7%)

There are no bond length outliers.

All (59) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	S	5	ARG	NE-CZ-NH1	-13.97	113.32	120.30
2	L	506	LEU	CA-CB-CG	11.79	142.41	115.30
2	L	71	ARG	NE-CZ-NH2	-9.74	115.43	120.30
2	L	369	ARG	NE-CZ-NH1	9.34	124.97	120.30
1	S	5	ARG	CD-NE-CZ	-9.24	110.66	123.60
1	S	212	ARG	NE-CZ-NH1	-9.10	115.75	120.30
2	L	430	ARG	NE-CZ-NH1	8.99	124.80	120.30
2	L	340	ARG	NE-CZ-NH2	-8.99	115.81	120.30
1	S	212	ARG	NE-CZ-NH2	8.81	124.70	120.30
1	S	138	LYS	CA-CB-CG	8.69	132.51	113.40
2	L	79	ARG	NE-CZ-NH2	-8.55	116.02	120.30
2	L	273	TYR	CB-CG-CD1	8.30	125.98	121.00
2	L	59	ARG	NE-CZ-NH2	-8.22	116.19	120.30
1	S	1	LEU	O-C-N	8.20	135.82	122.70
1	S	163	TYR	CB-CG-CD1	7.96	125.78	121.00
1	S	100	ARG	CD-NE-CZ	7.90	134.66	123.60
2	L	201	ASP	CB-CG-OD1	7.73	125.26	118.30
1	S	193	ARG	NE-CZ-NH2	-7.70	116.45	120.30
1	S	11	TYR	CB-CG-CD1	7.64	125.59	121.00
1	S	164	TYR	CB-CG-CD2	-7.41	116.55	121.00
1	S	163	TYR	CG-CD1-CE1	7.41	127.23	121.30
2	L	59	ARG	NE-CZ-NH1	7.38	123.99	120.30

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Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	S	2	MET	C-N-CA	7.35	137.73	122.30
1	S	100	ARG	NE-CZ-NH1	6.72	123.66	120.30
2	L	146	ASP	CB-CG-OD2	-6.55	112.41	118.30
1	S	100	ARG	NE-CZ-NH2	-6.47	117.07	120.30
2	L	218	LEU	CB-CG-CD2	-6.40	100.12	111.00
2	L	250	LEU	CA-CB-CG	6.39	130.00	115.30
2	L	38	ARG	NE-CZ-NH2	-6.30	117.15	120.30
2	L	363	ASP	CB-CG-OD1	-6.18	112.74	118.30
2	L	213	LEU	CB-CG-CD1	6.14	121.44	111.00
1	S	33	ASP	CB-CG-OD1	6.11	123.80	118.30
2	L	345	GLU	OE1-CD-OE2	-6.07	116.01	123.30
2	L	287	TRP	CA-CB-CG	-5.90	102.50	113.70
2	L	538	ARG	NE-CZ-NH2	-5.87	117.37	120.30
1	S	26	ARG	CG-CD-NE	-5.75	99.73	111.80
2	L	350	ARG	NE-CZ-NH2	-5.69	117.45	120.30
2	L	217	ARG	NE-CZ-NH2	-5.69	117.46	120.30
1	S	1	LEU	CA-C-N	-5.53	105.03	117.20
2	L	489	GLU	OE1-CD-OE2	-5.52	116.68	123.30
2	L	250	LEU	CB-CG-CD1	5.51	120.38	111.00
2	L	324	PHE	CB-CG-CD1	-5.46	116.98	120.80
2	L	440	TYR	CB-CG-CD2	5.45	124.27	121.00
1	S	193	ARG	NE-CZ-NH1	5.43	123.01	120.30
2	L	369	ARG	NE-CZ-NH2	-5.42	117.59	120.30
2	L	218	LEU	CD1-CG-CD2	5.37	126.61	110.50
2	L	231	ALA	N-CA-CB	5.29	117.51	110.10
2	L	146	ASP	CB-CG-OD1	5.25	123.02	118.30
1	S	40	LEU	CA-CB-CG	5.25	127.36	115.30
2	L	136	PHE	CB-CG-CD2	-5.16	117.19	120.80
1	S	11	TYR	CB-CG-CD2	-5.13	117.92	121.00
2	L	273	TYR	CB-CG-CD2	-5.13	117.92	121.00
1	S	61	GLU	OE1-CD-OE2	-5.13	117.15	123.30
2	L	136	PHE	CB-CG-CD1	5.12	124.38	120.80
2	L	174	LEU	CA-CB-CG	5.11	127.05	115.30
2	L	112	ARG	NE-CZ-NH1	5.11	122.85	120.30
1	S	176	LEU	CB-CG-CD1	5.07	119.62	111.00
2	L	71	ARG	NE-CZ-NH1	5.05	122.82	120.30
2	L	487	ARG	NE-CZ-NH2	-5.01	117.79	120.30

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	S	2019	0	0	5	0
2	L	4177	0	0	5	0
3	L	1	0	0	0	0
4	S	16	0	0	0	0
5	S	7	0	0	0	0
6	L	8	0	0	0	0
7	L	2	0	0	0	0
8	L	16	0	0	1	0
8	S	24	0	0	0	0
9	L	553	0	0	3	0
9	S	293	0	0	3	0
All	All	7116	0	0	11	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.

All (11) close contacts within the same asymmetric unit are listed below.

Atom-1	Atom-2	Distance(Å)	Clash(Å)
2:L:19:SER:OG	2:L:19:SER:O	2.29	0.51
8:L:2006:MPD:O4	8:L:2006:MPD:O2	2.29	0.51
2:L:467:LYS:NZ	9:L:3745:HOH:O	2.50	0.45
1:S:96:ASP:OD2	1:S:100:ARG:NH2	2.50	0.45
1:S:1:LEU:N	1:S:62:GLN:OE1	2.50	0.44
1:S:13:HIS:CD2	9:S:3034:HOH:O	2.71	0.44
2:L:536:ILE:N	9:L:3669:HOH:O	2.50	0.44
1:S:83:ASN:ND2	9:S:3755:HOH:O	2.51	0.43
1:S:166:LYS:NZ	9:S:3738:HOH:O	2.54	0.41
2:L:513:ASN:ND2	9:L:3320:HOH:O	2.53	0.41
2:L:211:HIS:CD2	2:L:276:ASP:OD2	2.73	0.41

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	S	265/267 (99%)	258 (97%)	5 (2%)	2 (1%)	27	4
2	L	532/534 (100%)	518 (97%)	14 (3%)	0	100	100
All	All	797/801 (100%)	776 (97%)	19 (2%)	2 (0%)	50	17

All (2) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	S	4	PRO
1	S	5	ARG

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	S	213/213 (100%)	198 (93%)	15 (7%)	21	1
2	L	438/438 (100%)	415 (95%)	23 (5%)	32	3
All	All	651/651 (100%)	613 (94%)	38 (6%)	28	2

All (38) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	S	1	LEU
1	S	2	MET
1	S	5	ARG
1	S	36	ILE
1	S	37	LEU
1	S	40	LEU
1	S	91	ASN

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Mol	Chain	Res	Type
1	S	95	LEU
1	S	126	ASN
1	S	138	LYS
1	S	173	LEU
1	S	220	LEU
1	S	229	ASN
1	S	230	ASN
1	S	242	PRO
2	L	43	VAL
2	L	47	LYS
2	L	49	LYS
2	L	50	ASN
2	L	132	HIS
2	L	143	LEU
2	L	144	LYS
2	L	152	LYS
2	L	161	LYS
2	L	174	LEU
2	L	200	LEU
2	L	213	LEU
2	L	218	LEU
2	L	233	ASN
2	L	250	LEU
2	L	278	LEU
2	L	304	LYS
2	L	321	LYS
2	L	325	LYS
2	L	410	LEU
2	L	445	LEU
2	L	457	ASN
2	L	506	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 ⓘ

Of 11 ligands modelled in this entry, 1 is monoatomic - leaving 10 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	FNE	L	1004	2,7	6,7,9	7.02	5 (83%)	0,9,15	0.00	-
7	CMO	L	1006	6	0,1,1	0.00	-	0,0,0	0.00	-
8	MPD	L	2006	-	7,7,7	0.48	0	10,10,10	0.50	0
8	MPD	L	2010	-	7,7,7	0.43	0	10,10,10	0.66	0
4	SF4	S	1001	1	12,12,12	134.57	11 (91%)	0,24,24	0.00	-
4	SF4	S	1002	1	12,12,12	135.74	8 (66%)	0,24,24	0.00	-
5	F3S	S	1003	1	3,9,9	3.53	3 (100%)	0,15,15	0.00	-
8	MPD	S	2001	-	7,7,7	0.53	0	10,10,10	1.18	1 (10%)
8	MPD	S	2004	-	7,7,7	0.66	0	10,10,10	0.82	1 (10%)
8	MPD	S	2007	-	7,7,7	0.47	0	10,10,10	0.74	0

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	FNE	L	1004	2,7	-	0/0/9/18	0/0/0/1
7	CMO	L	1006	6	-	0/0/0/0	0/0/0/0
8	MPD	L	2006	-	-	0/5/5/5	0/0/0/0
8	MPD	L	2010	-	-	0/5/5/5	0/0/0/0
4	SF4	S	1001	1	-	0/0/48/48	0/0/5/5
4	SF4	S	1002	1	-	0/0/48/48	0/0/5/5
5	F3S	S	1003	1	-	0/0/24/24	0/0/3/3
8	MPD	S	2001	-	-	0/5/5/5	0/0/0/0

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Mol	Type	Chain	Res	Link	Chirals	Torsions	Rings
8	MPD	S	2004	-	-	0/5/5/5	0/0/0/0
8	MPD	S	2007	-	-	0/5/5/5	0/0/0/0

All (27) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
4	S	1002	SF4	S2-FE4	245.45	3.98	2.33
4	S	1001	SF4	S2-FE4	242.84	3.96	2.33
4	S	1002	SF4	S3-FE2	239.35	3.94	2.33
4	S	1001	SF4	S1-FE3	234.45	3.90	2.33
4	S	1002	SF4	S1-FE3	230.63	3.88	2.33
4	S	1001	SF4	S4-FE1	229.48	3.87	2.33
4	S	1001	SF4	S3-FE2	224.51	3.84	2.33
4	S	1002	SF4	S4-FE1	224.19	3.84	2.33
6	L	1004	FNE	C2-FE	15.49	1.93	1.78
4	S	1001	SF4	S2-FE1	-13.98	2.23	2.33
4	S	1001	SF4	S1-FE2	-7.02	2.28	2.33
4	S	1002	SF4	S3-FE4	-6.67	2.28	2.33
4	S	1002	SF4	S2-FE1	-5.77	2.29	2.33
6	L	1004	FNE	C1-FE	5.54	1.83	1.78
4	S	1002	SF4	S4-FE3	-5.06	2.29	2.33
4	S	1001	SF4	S3-FE4	-4.35	2.30	2.33
4	S	1001	SF4	S2-FE3	3.95	2.35	2.33
5	S	1003	F3S	S3-FE3	-3.90	2.30	2.33
4	S	1001	SF4	S1-FE4	3.58	2.35	2.33
5	S	1003	F3S	S3-FE1	-3.36	2.31	2.33
5	S	1003	F3S	S3-FE4	-3.31	2.31	2.33
4	S	1002	SF4	S1-FE2	-3.06	2.31	2.33
6	L	1004	FNE	C3-FE	2.90	1.81	1.78
6	L	1004	FNE	O1-C1	2.86	1.20	1.16
6	L	1004	FNE	O3-C3	-2.82	1.11	1.16
4	S	1001	SF4	S4-FE3	-2.36	2.31	2.33
4	S	1001	SF4	S4-FE2	-2.09	2.31	2.33

All (2) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
8	S	2001	MPD	CM-C2-C1	3.22	117.24	110.11
8	S	2004	MPD	O2-C2-CM	2.04	115.68	107.98

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 ⓘ

EDS was not executed - this section will therefore be empty.

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

EDS was not executed - this section will therefore be empty.

6.3 Carbohydrates ⓘ

EDS was not executed - this section will therefore be empty.

6.4 Ligands ⓘ

EDS was not executed - this section will therefore be empty.

6.5 Other polymers ⓘ

EDS was not executed - this section will therefore be empty.