



Full wwPDB X-ray Structure Validation Report ⓘ

Mar 6, 2026 – 11:58 PM UTC

PDB ID : 1UBL / pdb_00001ubl
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 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 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)	:	NOT EXECUTED
EDS	:	NOT EXECUTED
Percentile statistics	:	20250101.v01 (using entries in the PDB archive January 1st 2025)
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, RNA)	:	Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP)	:	2.49

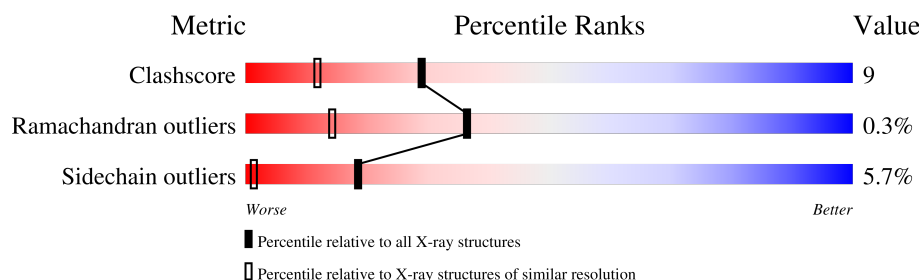
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 1.20 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	190562	1265 (1.20-1.20)
Ramachandran outliers	187476	1226 (1.20-1.20)
Sidechain outliers	187428	1226 (1.20-1.20)

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 $\leq 5\%$.

Note EDS was not executed.

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

The following table lists non-polymeric compounds, carbohydrate monomers and non-standard residues in protein, DNA, RNA chains that are outliers for geometric or electron-density-fit criteria:

Mol	Type	Chain	Res	Chirality	Geometry	Clashes	Electron density
5	MPD	S	2004	-	-	X	-

2 Entry composition [i](#)

There are 9 unique types of molecules in this entry. The entry contains 7116 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 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			

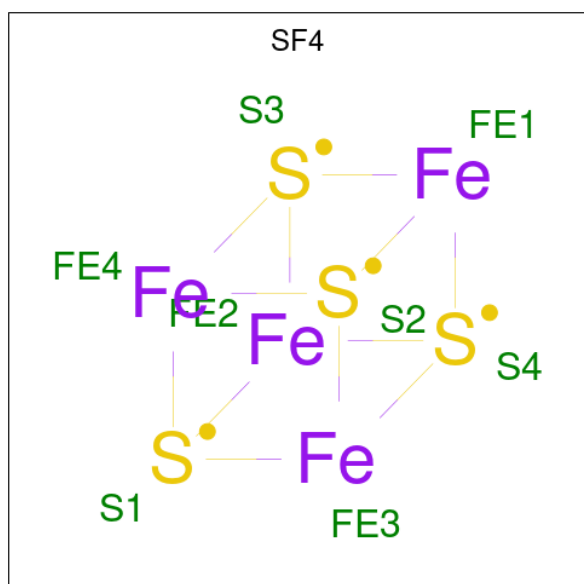
- Molecule 2 is a protein called Periplasmic [NiFe] hydrogenase Large subunit.

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:

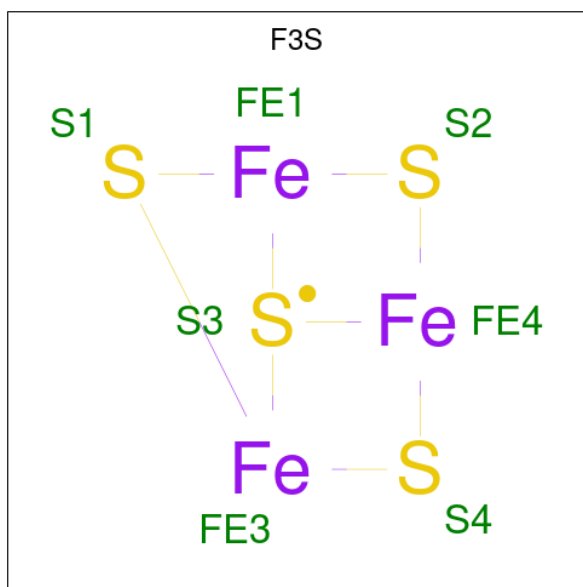
Chain	Residue	Modelled	Actual	Comment	Reference
L	514	LYS	ASN	SEE REMARK 999	UNP P21852
L	515	LEU	VAL	SEE REMARK 999	UNP P21852

- Molecule 3 is IRON/SULFUR CLUSTER (CCD ID: SF4) (formula: Fe₄S₄).



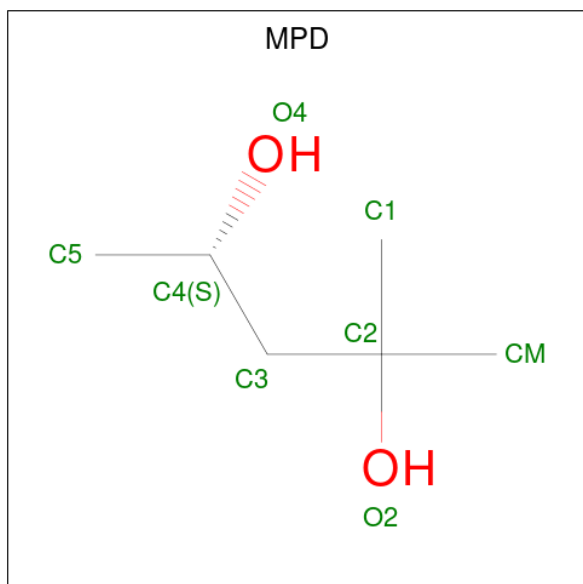
Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
3	S	1	Total	Fe	S	0	0
			8	4	4		
3	S	1	Total	Fe	S	0	0
			8	4	4		

- Molecule 4 is FE3-S4 CLUSTER (CCD ID: F3S) (formula: Fe_3S_4).



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

- Molecule 5 is (4S)-2-METHYL-2,4-PENTANEDIOL (CCD ID: MPD) (formula: $\text{C}_6\text{H}_{14}\text{O}_2$).

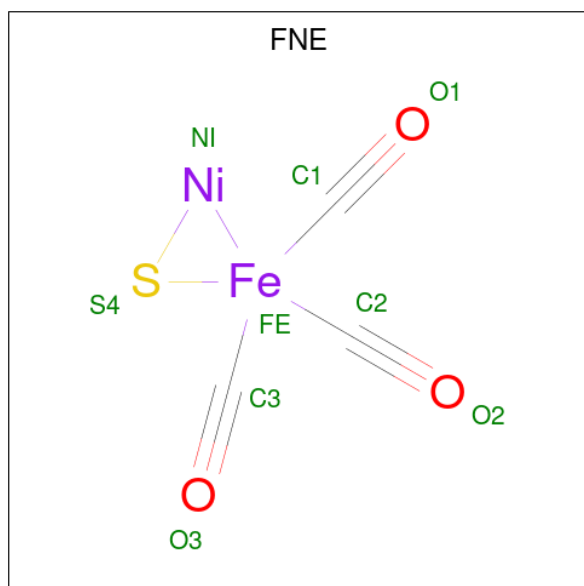


Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
5	S	1	Total	C	O	0	0
			8	6	2		
5	S	1	Total	C	O	0	0
			8	6	2		
5	S	1	Total	C	O	0	0
			8	6	2		
5	L	1	Total	C	O	0	0
			8	6	2		
5	L	1	Total	C	O	0	0
			8	6	2		

- Molecule 6 is MAGNESIUM ION (CCD ID: MG) (formula: Mg).

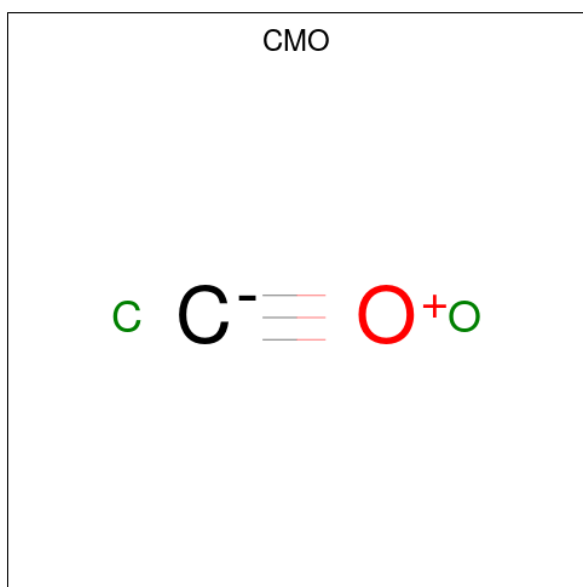
Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
6	L	1	Total	Mg	0	0
			1	1		

- Molecule 7 is (MU-SULPHIDO)-BIS(MU-CYS,S)-[TRICARBONYLIRON-DI-(CYS,S)NICKEL(II)](FE-NI) (CCD ID: FNE) (formula: C₃FeNiO₃S).



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

- Molecule 8 is CARBON MONOXIDE (CCD ID: CMO) (formula: CO).



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

- Molecule 9 is water.

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

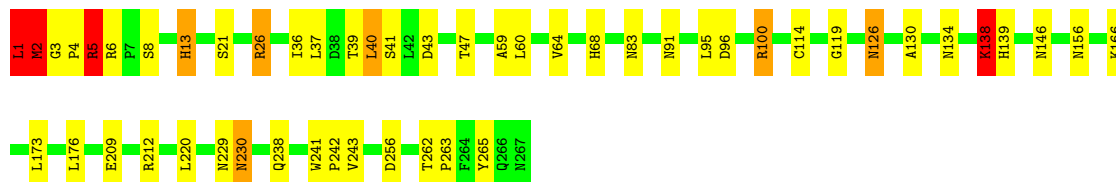
3 Residue-property plots

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. 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. 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.

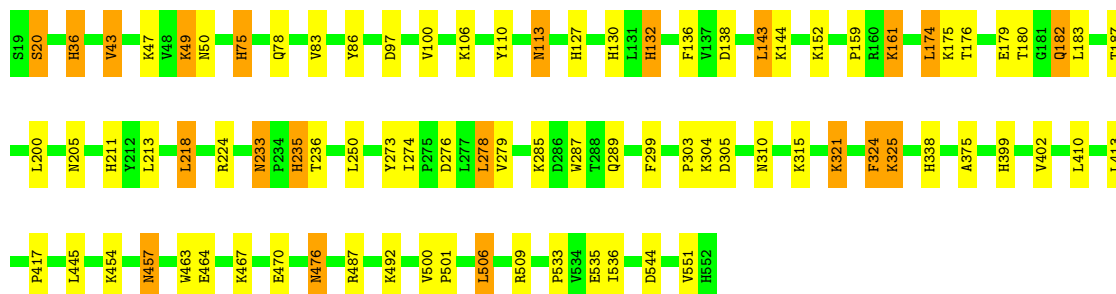
• Molecule 1: Periplasmic [NiFe] hydrogenase Small subunit

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 is therefore 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	CNS, 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: F3S, FNE, MPD, SF4, MG, CMO

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	0.96	1/2075 (0.0%)	1.44	16/2830 (0.6%)
2	L	0.93	1/4288 (0.0%)	1.39	28/5831 (0.5%)
All	All	0.94	2/6363 (0.0%)	1.41	44/8661 (0.5%)

All (2) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	S	126	ASN	C-O	5.49	1.26	1.23
2	L	75	HIS	ND1-CE1	5.48	1.38	1.32

All (44) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
2	L	182	GLN	OE1-CD-NE2	-10.84	111.76	122.60
1	S	2	MET	CA-C-N	10.10	137.73	121.87
1	S	2	MET	C-N-CA	10.10	137.73	121.87
1	S	5	ARG	CD-NE-CZ	-9.82	110.66	124.40
1	S	138	LYS	CA-CB-CG	9.21	132.51	114.10
2	L	136	PHE	CA-CB-CG	8.72	122.52	113.80
1	S	5	ARG	NE-CZ-NH1	-8.18	113.32	121.50
1	S	1	LEU	O-C-N	8.01	135.82	123.00
2	L	132	HIS	CB-CG-CD2	-7.88	120.96	131.20
2	L	506	LEU	CA-CB-CG	7.46	142.41	116.30
2	L	130	HIS	CA-CB-CG	-7.41	106.39	113.80
1	S	100	ARG	CD-NE-CZ	7.33	134.66	124.40
2	L	544	ASP	CA-CB-CG	7.26	119.86	112.60
2	L	36	HIS	CB-CG-CD2	-7.23	121.80	131.20
2	L	36	HIS	CB-CG-ND1	7.21	133.51	122.70
1	S	13	HIS	CB-CG-CD2	-7.19	121.85	131.20
2	L	218	LEU	CD1-CG-CD2	7.19	126.61	110.80

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Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	S	209	GLU	CB-CG-CD	7.08	124.63	112.60
2	L	235	HIS	CB-CG-CD2	-6.63	122.58	131.20
2	L	43	VAL	CB-CA-C	6.54	120.37	110.62
1	S	13	HIS	CB-CG-ND1	6.47	132.40	122.70
2	L	324	PHE	CA-CB-CG	-6.43	107.37	113.80
2	L	20	SER	CA-C-O	6.38	127.59	120.70
2	L	75	HIS	CB-CG-CD2	-6.34	122.96	131.20
2	L	457	ASN	CA-CB-CG	6.29	118.89	112.60
2	L	97	ASP	CA-CB-CG	6.18	118.78	112.60
1	S	212	ARG	NE-CZ-NH2	6.12	124.70	119.20
2	L	289	GLN	OE1-CD-NE2	5.91	128.51	122.60
2	L	287	TRP	CA-CB-CG	-5.84	102.50	113.60
2	L	132	HIS	CB-CG-ND1	5.75	131.33	122.70
1	S	212	ARG	NE-CZ-NH1	-5.75	115.75	121.50
2	L	551	VAL	CB-CA-C	-5.67	105.03	111.55
2	L	127	HIS	CA-CB-CG	-5.60	108.20	113.80
1	S	26	ARG	CG-CD-NE	-5.58	99.73	112.00
2	L	113	ASN	CA-CB-CG	5.47	118.07	112.60
2	L	75	HIS	CA-CB-CG	-5.31	108.49	113.80
2	L	476	ASN	OD1-CG-ND2	-5.26	117.34	122.60
1	S	47	THR	CA-C-N	-5.25	116.31	122.14
1	S	47	THR	C-N-CA	-5.25	116.31	122.14
1	S	138	LYS	CA-C-O	5.24	126.51	120.90
2	L	273	TYR	CA-C-N	-5.15	116.99	120.24
2	L	273	TYR	C-N-CA	-5.15	116.99	120.24
2	L	305	ASP	CA-CB-CG	5.04	117.64	112.60
2	L	83	VAL	N-CA-C	-5.02	106.17	110.74

There are no chirality outliers.

There are no planarity outliers.

5.2 Too-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 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	S	2019	0	1949	60	0
2	L	4177	0	4129	59	0

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Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
3	S	16	0	0	0	0
4	S	7	0	0	0	0
5	L	16	0	28	3	0
5	S	24	0	42	9	0
6	L	1	0	0	0	0
7	L	8	0	0	0	0
8	L	2	0	0	0	0
9	L	553	0	0	12	0
9	S	293	0	0	10	0
All	All	7116	0	6148	108	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 9.

All (108) 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:S:146:ASN:HD21	5:S:2004:MPD:H13	1.26	0.99
1:S:2:MET:HA	2:L:182:GLN:HG2	1.46	0.98
1:S:126:ASN:HD21	1:S:130:ALA:H	1.17	0.91
1:S:238:GLN:HE21	2:L:224:ARG:HH21	1.17	0.91
2:L:470:GLU:HG2	2:L:487:ARG:HD3	1.57	0.86
1:S:26:ARG:HH21	2:L:233:ASN:HD21	1.20	0.84
1:S:176:LEU:HD13	9:S:3183:HOH:O	1.82	0.80
1:S:39:THR:HG22	1:S:40:LEU:HD13	1.63	0.79
5:L:2010:MPD:HM3	9:L:3336:HOH:O	1.83	0.79
2:L:143:LEU:HD13	2:L:174:LEU:HD13	1.66	0.77
2:L:175:LYS:O	2:L:179:GLU:HG3	1.85	0.77
1:S:2:MET:SD	1:S:8:SER:HB2	2.25	0.77
2:L:78:GLN:HE21	2:L:86:TYR:H	1.32	0.75
1:S:1:LEU:HD21	1:S:59:ALA:O	1.88	0.73
1:S:2:MET:HG3	9:S:3299:HOH:O	1.89	0.72
1:S:60:LEU:O	1:S:64:VAL:HG22	1.89	0.72
2:L:176:THR:O	2:L:180:THR:HG23	1.92	0.69
1:S:134:ASN:HB2	5:S:2004:MPD:H12	1.74	0.68
1:S:146:ASN:ND2	5:S:2004:MPD:H13	2.04	0.68
1:S:1:LEU:HB3	2:L:187:THR:OG1	1.93	0.67
2:L:535:GLU:HB2	9:L:3669:HOH:O	1.95	0.66
1:S:256:ASP:HB3	9:S:3423:HOH:O	1.96	0.64
1:S:1:LEU:HG	2:L:187:THR:HG21	1.80	0.63
1:S:2:MET:HE2	1:S:3:GLY:H	1.64	0.62

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:S:156:ASN:HD21	1:S:230:ASN:HD21	1.45	0.61
1:S:13:HIS:HD2	9:S:3034:HOH:O	1.83	0.61
2:L:20:SER:HA	9:L:3707:HOH:O	2.01	0.60
1:S:238:GLN:NE2	2:L:224:ARG:HH21	1.95	0.60
2:L:310:ASN:O	2:L:315:LYS:HE3	2.03	0.59
1:S:230:ASN:HD22	1:S:230:ASN:H	1.51	0.58
2:L:100:VAL:HG13	2:L:464:GLU:O	2.02	0.58
2:L:211:HIS:HE1	9:L:3221:HOH:O	1.85	0.58
1:S:2:MET:HG2	1:S:43:ASP:OD1	2.04	0.57
2:L:100:VAL:HG11	2:L:463:TRP:CE3	2.38	0.57
1:S:26:ARG:HH21	2:L:233:ASN:ND2	1.97	0.57
2:L:454:LYS:HE3	9:L:3327:HOH:O	2.05	0.57
2:L:211:HIS:HD2	2:L:276:ASP:OD2	1.89	0.55
1:S:1:LEU:HD12	1:S:1:LEU:H3	1.71	0.55
2:L:36:HIS:HD2	9:L:3070:HOH:O	1.89	0.55
2:L:50:ASN:HD21	2:L:509:ARG:NH2	2.03	0.55
1:S:2:MET:HG2	1:S:8:SER:HB2	1.89	0.55
2:L:470:GLU:HG2	2:L:487:ARG:CD	2.34	0.55
1:S:229:ASN:HD22	1:S:230:ASN:H	1.55	0.55
1:S:1:LEU:HD22	1:S:43:ASP:HB3	1.88	0.54
1:S:5:ARG:HB2	9:L:3193:HOH:O	2.07	0.54
1:S:134:ASN:HB3	5:S:2004:MPD:H4	1.89	0.54
2:L:138:ASP:H	2:L:205:ASN:ND2	2.05	0.54
2:L:321:LYS:N	2:L:321:LYS:HD3	2.22	0.54
2:L:533:PRO:HB2	2:L:536:ILE:HD12	1.90	0.53
1:S:6:ARG:HB2	2:L:182:GLN:HE22	1.74	0.53
1:S:134:ASN:HD22	5:S:2004:MPD:H12	1.74	0.53
1:S:1:LEU:CG	2:L:187:THR:HG21	2.38	0.53
2:L:78:GLN:HE22	2:L:236:THR:H	1.58	0.52
1:S:134:ASN:CB	5:S:2004:MPD:H4	2.39	0.52
1:S:265:TYR:OH	2:L:75:HIS:HE1	1.92	0.52
2:L:106:LYS:HE3	2:L:110:TYR:CE1	2.44	0.52
2:L:100:VAL:HG11	2:L:463:TRP:HE3	1.74	0.51
2:L:399:HIS:HD2	2:L:402:VAL:H	1.57	0.51
1:S:13:HIS:HE1	1:S:21:SER:OG	1.92	0.51
2:L:299:PHE:H	2:L:476:ASN:ND2	2.09	0.51
1:S:2:MET:HB3	1:S:43:ASP:OD1	2.11	0.51
2:L:233:ASN:C	2:L:233:ASN:HD22	2.19	0.51
2:L:274:ILE:O	2:L:278:LEU:HD13	2.11	0.50
1:S:138:LYS:NZ	1:S:138:LYS:HB2	2.26	0.50
2:L:75:HIS:HD2	9:L:3074:HOH:O	1.94	0.49

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:S:139:HIS:H	1:S:139:HIS:CD2	2.31	0.49
1:S:241:TRP:CH2	1:S:243:VAL:HB	2.48	0.49
1:S:1:LEU:HD12	1:S:1:LEU:N	2.28	0.49
1:S:5:ARG:HB3	2:L:182:GLN:OE1	2.13	0.48
1:S:126:ASN:HD21	1:S:130:ALA:N	1.97	0.48
1:S:2:MET:CG	1:S:8:SER:HB2	2.44	0.48
2:L:106:LYS:HE3	2:L:110:TYR:HE1	1.78	0.48
2:L:113:ASN:HD21	2:L:303:PRO:HD2	1.78	0.48
2:L:399:HIS:CD2	2:L:402:VAL:H	2.32	0.47
1:S:39:THR:CG2	1:S:40:LEU:HD13	2.40	0.47
2:L:325:LYS:N	2:L:325:LYS:HE3	2.29	0.47
2:L:50:ASN:HD21	2:L:509:ARG:HH22	1.63	0.47
1:S:41:SER:HB2	2:L:182:GLN:NE2	2.30	0.47
1:S:134:ASN:CB	5:S:2004:MPD:H12	2.41	0.46
5:S:2004:MPD:H11	9:S:3119:HOH:O	2.14	0.46
2:L:492:LYS:HE3	9:L:3434:HOH:O	2.15	0.46
2:L:500:VAL:CG1	2:L:501:PRO:HD2	2.46	0.45
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:5:ARG:HG3	9:S:3799:HOH:O	2.17	0.45
1:S:5:ARG:HH11	1:S:5:ARG:HD3	1.24	0.45
2:L:78:GLN:NE2	2:L:235:HIS:HA	2.32	0.45
2:L:159:PRO:O	2:L:161:LYS:HE2	2.16	0.45
2:L:321:LYS:HD3	2:L:321:LYS:H	1.83	0.44
2:L:324:PHE:CD2	5:L:2006:MPD:H13	2.52	0.44
1:S:2:MET:HA	2:L:182:GLN:CG	2.33	0.43
1:S:83:ASN:ND2	9:S:3755:HOH:O	2.51	0.43
1:S:156:ASN:HD21	1:S:230:ASN:ND2	2.14	0.43
2:L:285:LYS:HE2	2:L:413:LEU:O	2.18	0.43
2:L:299:PHE:H	2:L:476:ASN:HD22	1.66	0.42
2:L:417:PRO:CB	5:L:2006:MPD:H4	2.50	0.42
2:L:536:ILE:HG13	9:L:3669:HOH:O	2.18	0.42
1:S:5:ARG:HD3	1:S:5:ARG:HA	1.34	0.41
1:S:139:HIS:HE1	9:S:3374:HOH:O	2.02	0.41
1:S:166:LYS:NZ	9:S:3738:HOH:O	2.54	0.41
1:S:1:LEU:HD13	9:S:3299:HOH:O	2.19	0.41
2:L:338:HIS:HB2	2:L:375:ALA:HB3	2.03	0.41
2:L:536:ILE:N	9:L:3669:HOH:O	2.50	0.41
1:S:230:ASN:HD22	1:S:230:ASN:N	2.16	0.41
1:S:114:CYS:HA	1:S:119:GLY:HA3	2.03	0.41
2:L:49:LYS:O	2:L:49:LYS:HG2	2.20	0.41

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:S:262:THR:HA	1:S:263:PRO:C	2.46	0.41
1:S:68:HIS:O	5:S:2007:MPD:H13	2.21	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	S	265/267 (99%)	258 (97%)	5 (2%)	2 (1%)	16	2
2	L	532/534 (100%)	518 (97%)	14 (3%)	0	100	100
All	All	797/801 (100%)	776 (97%)	19 (2%)	2 (0%)	36	14

All (2) Ramachandran outliers are listed below:

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

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	S	213/213 (100%)	200 (94%)	13 (6%)	17	1
2	L	438/438 (100%)	414 (94%)	24 (6%)	19	1

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Mol	Chain	Analysed	Rotameric	Outliers	Percentiles
All	All	651/651 (100%)	614 (94%)	37 (6%)	18 1

All (37) 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
1	S	95	LEU
1	S	138	LYS
1	S	173	LEU
1	S	220	LEU
1	S	230	ASN
1	S	242	PRO
2	L	43	VAL
2	L	47	LYS
2	L	49	LYS
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	183	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	279	VAL
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

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (29) such sidechains are listed below:

Mol	Chain	Res	Type
1	S	13	HIS
1	S	91	ASN
1	S	106	GLN
1	S	126	ASN
1	S	139	HIS
1	S	146	ASN
1	S	229	ASN
1	S	230	ASN
1	S	238	GLN
1	S	266	GLN
2	L	36	HIS
2	L	50	ASN
2	L	75	HIS
2	L	78	GLN
2	L	113	ASN
2	L	132	HIS
2	L	188	ASN
2	L	205	ASN
2	L	211	HIS
2	L	233	ASN
2	L	235	HIS
2	L	289	GLN
2	L	310	ASN
2	L	334	GLN
2	L	399	HIS
2	L	457	ASN
2	L	468	GLN
2	L	476	ASN
2	L	513	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 [i](#)

There are no oligosaccharides in this entry.

5.6 Ligand geometry [i](#)

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	$\# Z > 2$
4	F3S	S	1003	1	0,9,9	-	-	-		
5	MPD	L	2006	-	7,7,7	0.56	0	9,10,10	0.58	0
5	MPD	S	2004	-	7,7,7	0.77	0	9,10,10	1.01	1 (11%)
5	MPD	L	2010	-	7,7,7	0.47	0	9,10,10	0.79	0
5	MPD	S	2007	-	7,7,7	0.53	0	9,10,10	0.74	0
7	FNE	L	1004	8,2	3,7,9	1.91	2 (66%)	-		
3	SF4	S	1002	1	0,12,12	-	-	-		
5	MPD	S	2001	-	7,7,7	0.57	0	9,10,10	1.21	1 (11%)
3	SF4	S	1001	1	0,12,12	-	-	-		
8	CMO	L	1006	7	0,1,1	-	-	-		

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	F3S	S	1003	1	-	-	0/3/3/3
5	MPD	L	2006	-	-	4/5/5/5	-
5	MPD	S	2004	-	-	0/5/5/5	-
5	MPD	L	2010	-	-	1/5/5/5	-
5	MPD	S	2007	-	-	0/5/5/5	-
3	SF4	S	1002	1	-	-	0/6/5/5
5	MPD	S	2001	-	-	1/5/5/5	-
3	SF4	S	1001	1	-	-	0/6/5/5

All (2) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
7	L	1004	FNE	O3-C3	-2.38	1.11	1.16
7	L	1004	FNE	O1-C1	2.19	1.20	1.16

All (2) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
5	S	2001	MPD	CM-C2-C1	2.96	117.24	110.63
5	S	2004	MPD	O2-C2-CM	2.47	115.68	107.99

There are no chirality outliers.

All (6) torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
5	L	2006	MPD	C1-C2-C3-C4
5	L	2006	MPD	CM-C2-C3-C4
5	L	2006	MPD	O2-C2-C3-C4
5	L	2006	MPD	C2-C3-C4-O4
5	L	2010	MPD	C2-C3-C4-O4
5	S	2001	MPD	C1-C2-C3-C4

There are no ring outliers.

4 monomers are involved in 12 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
5	L	2006	MPD	2	0
5	S	2004	MPD	8	0
5	L	2010	MPD	1	0
5	S	2007	MPD	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

6.1 Protein, DNA and RNA chains

EDS was not executed - this section is therefore empty.

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

EDS was not executed - this section is therefore empty.

6.3 Carbohydrates

EDS was not executed - this section is therefore empty.

6.4 Ligands

EDS was not executed - this section is therefore empty.

6.5 Other polymers

EDS was not executed - this section is therefore empty.