



Full wwPDB X-ray Structure Validation Report ⓘ

Mar 9, 2026 – 12:44 AM UTC

PDB ID : 1RW4 / pdb_00001rw4
Title : Nitrogenase Fe protein l127 deletion variant
Authors : Sen, S.; Igarashi, R.; Smith, A.; Johnson, M.K.; Seefeldt, L.C.; Peters, J.W.
Deposited on : 2003-12-15
Resolution : 2.50 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

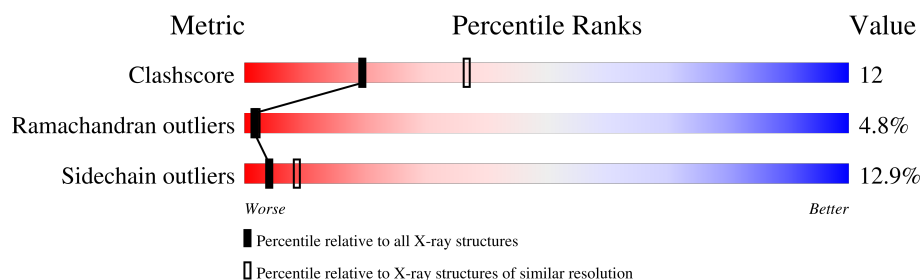
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 2.50 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	6492 (2.50-2.50)
Ramachandran outliers	187476	6378 (2.50-2.50)
Sidechain outliers	187428	6380 (2.50-2.50)

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	A	272	 62% 28% 6%

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
2	SF4	A	290	-	-	X	-

2 Entry composition [i](#)

There are 4 unique types of molecules in this entry. The entry contains 2159 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.

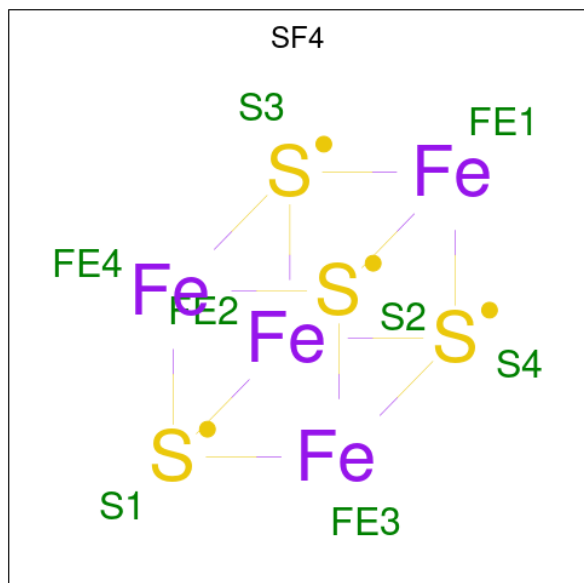
- Molecule 1 is a protein called Nitrogenase iron protein 1.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
1	A	271	2050	1279	350	401	20	0	0	0

There are 2 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	0	MET	-	cloning artifact	UNP P00459
A	?	-	LEU	deletion	UNP P00459

- Molecule 2 is IRON/SULFUR CLUSTER (CCD ID: SF4) (formula: Fe_4S_4).



Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
			Total	Fe	S		
2	A	1	4	2	2	0	0

- Molecule 3 is GLYCEROL (CCD ID: GOL) (formula: $\text{C}_3\text{H}_8\text{O}_3$).



Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
3	A	1	Total	C	O	0	0
			6	3	3		

- Molecule 4 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
4	A	99	Total	O	0	0
			99	99		

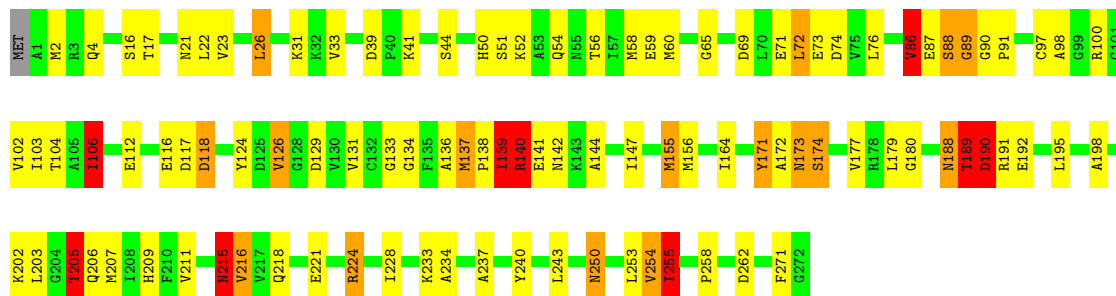
3 Residue-property plots [i](#)

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. 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: Nitrogenase iron protein 1

Chain A: 



4 Data and refinement statistics

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

Property	Value	Source
Space group	C 2 2 21	Depositor
Cell constants a, b, c, α , β , γ	70.78Å 133.09Å 61.08Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	8.00 – 2.50	Depositor
% Data completeness (in resolution range)	(Not available) (8.00-2.50)	Depositor
R_{merge}	(Not available)	Depositor
R_{sym}	(Not available)	Depositor
Refinement program	X-PLOR, X-PLOR	Depositor
R, R_{free}	0.220 , 0.272	Depositor
Estimated twinning fraction	No twinning to report.	Xtriage
Total number of atoms	2159	wwPDB-VP
Average B, all atoms (Å ²)	57.0	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: GOL, SF4

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	0.94	5/2074 (0.2%)	1.72	36/2792 (1.3%)

All (5) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	A	50	HIS	CD2-NE2	-6.58	1.30	1.37
1	A	209	HIS	CD2-NE2	-5.83	1.31	1.37
1	A	106	ILE	CA-CB	5.77	1.61	1.54
1	A	189	THR	CA-CB	5.74	1.63	1.53
1	A	255	ILE	CA-CB	5.57	1.59	1.53

All (36) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	174	SER	N-CA-C	10.15	126.43	110.70
1	A	173	ASN	CA-CB-CG	8.18	120.78	112.60
1	A	224	ARG	N-CA-C	8.05	122.55	112.24
1	A	216	VAL	CB-CA-C	-7.59	100.97	112.05
1	A	255	ILE	CB-CA-C	7.46	119.84	111.04
1	A	155	MET	CA-CB-CG	7.34	128.78	114.10
1	A	205	THR	CB-CA-C	-6.81	105.88	114.40
1	A	207	MET	N-CA-C	-6.61	98.42	108.67
1	A	39	ASP	CA-CB-CG	6.46	119.06	112.60
1	A	39	ASP	CA-C-N	6.45	126.67	119.32
1	A	39	ASP	C-N-CA	6.45	126.67	119.32
1	A	255	ILE	N-CA-CB	-6.42	103.73	111.31
1	A	117	ASP	CA-CB-CG	6.34	118.94	112.60
1	A	254	VAL	N-CA-CB	-6.17	102.11	112.47
1	A	255	ILE	O-C-N	-6.17	117.49	121.37
1	A	190	ASP	N-CA-C	6.16	123.93	110.80

Continued on next page...

Continued from previous page...

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	21	ASN	CB-CG-ND2	6.13	125.60	116.40
1	A	69	ASP	CA-CB-CG	6.11	118.71	112.60
1	A	155	MET	CB-CA-C	-6.04	101.14	110.81
1	A	117	ASP	N-CA-C	5.83	120.99	111.37
1	A	129	ASP	N-CA-C	5.71	119.86	113.01
1	A	250	ASN	N-CA-C	5.71	118.60	110.10
1	A	17	THR	CA-CB-OG1	-5.67	101.09	109.60
1	A	224	ARG	CB-CG-CD	-5.67	98.25	111.30
1	A	86	VAL	CB-CA-C	-5.64	101.81	110.50
1	A	215	ASN	CA-CB-CG	5.59	118.19	112.60
1	A	118	ASP	CA-CB-CG	-5.58	107.02	112.60
1	A	21	ASN	OD1-CG-ND2	-5.57	117.03	122.60
1	A	215	ASN	OD1-CG-ND2	-5.53	117.08	122.60
1	A	211	VAL	CA-C-N	5.50	125.48	120.03
1	A	211	VAL	C-N-CA	5.50	125.48	120.03
1	A	139	ILE	CB-CG1-CD1	-5.40	102.45	113.80
1	A	144	ALA	CA-C-O	5.33	128.13	120.51
1	A	188	ASN	CA-CB-CG	5.21	117.81	112.60
1	A	144	ALA	N-CA-C	5.16	121.80	110.80
1	A	216	VAL	O-C-N	5.02	126.97	121.90

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	A	2050	0	2061	48	0
2	A	4	0	0	2	0
3	A	6	0	8	1	0
4	A	99	0	0	1	0
All	All	2159	0	2069	48	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 12.

All (48) 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:97:CYS:HB3	2:A:290:SF4:S2	1.93	1.07
1:A:100:ARG:HB2	2:A:290:SF4:S2	2.08	0.92
1:A:72:LEU:HG	1:A:112:GLU:HB3	1.72	0.71
1:A:56:THR:HG22	1:A:87:GLU:HB3	1.75	0.68
1:A:215:ASN:H	1:A:215:ASN:HD22	1.45	0.62
1:A:137:MET:HG2	1:A:140:ARG:NH1	2.14	0.62
1:A:137:MET:HG2	1:A:140:ARG:HH11	1.66	0.60
1:A:218:GLN:HA	1:A:221:GLU:HG2	1.85	0.58
1:A:141:GLU:HG3	1:A:142:ASN:H	1.69	0.57
1:A:103:ILE:HD11	1:A:134:GLY:HA2	1.87	0.56
1:A:136:ALA:O	1:A:139:ILE:HG22	2.05	0.56
1:A:103:ILE:HG12	1:A:137:MET:HG3	1.89	0.55
1:A:198:ALA:O	1:A:202:LYS:HD3	2.08	0.54
1:A:255:ILE:HG22	4:A:573:HOH:O	2.07	0.54
1:A:54:GLN:HE21	1:A:87:GLU:HG2	1.73	0.54
1:A:195:LEU:HD13	1:A:271:PHE:CD1	2.44	0.52
1:A:215:ASN:H	1:A:215:ASN:ND2	2.10	0.50
1:A:147:ILE:O	1:A:179:LEU:HD12	2.12	0.50
1:A:203:LEU:HD23	1:A:258:PRO:HA	1.93	0.50
1:A:171:TYR:H	1:A:171:TYR:HD1	1.60	0.49
1:A:100:ARG:O	1:A:104:THR:HG22	2.13	0.48
1:A:60:MET:SD	1:A:74:ASP:O	2.72	0.48
1:A:71:GLU:HB3	1:A:74:ASP:OD2	2.14	0.47
1:A:188:ASN:ND2	1:A:192:GLU:HB2	2.28	0.47
1:A:234:ALA:O	1:A:237:ALA:HB3	2.15	0.47
1:A:71:GLU:HG2	1:A:72:LEU:N	2.30	0.46
1:A:137:MET:HA	1:A:140:ARG:HD2	1.97	0.46
1:A:228:ILE:HD11	1:A:240:TYR:HB2	1.97	0.46
1:A:90:GLY:HA2	1:A:91:PRO:HD2	1.77	0.45
1:A:76:LEU:HD13	1:A:86:VAL:HG22	1.98	0.44
1:A:206:GLN:HE22	1:A:250:ASN:ND2	2.14	0.44
1:A:155:MET:HE3	1:A:156:MET:HE3	1.99	0.44
1:A:88:SER:HB2	1:A:89:GLY:H	1.62	0.43
1:A:131:VAL:HG23	1:A:164:ILE:HG23	2.00	0.43
1:A:23:VAL:HG13	1:A:33:VAL:HG11	2.01	0.43
1:A:26:LEU:O	1:A:31:LYS:HB2	2.18	0.43
1:A:22:LEU:HD13	1:A:243:LEU:HG	2.00	0.43
1:A:97:CYS:HB2	3:A:501:GOL:H32	2.01	0.43
1:A:52:LYS:HG2	1:A:224:ARG:NH2	2.34	0.42
1:A:180:GLY:HA2	1:A:253:LEU:HD23	2.01	0.42
1:A:102:VAL:O	1:A:106:ILE:HG23	2.19	0.42

Continued on next page...

Continued from previous page...

Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:4:GLN:HE21	1:A:124:TYR:HE2	1.68	0.42
1:A:58:MET:SD	1:A:104:THR:HG23	2.60	0.41
1:A:52:LYS:HG2	1:A:224:ARG:HH22	1.84	0.41
1:A:56:THR:OG1	1:A:59:GLU:HB2	2.20	0.41
1:A:91:PRO:HD2	1:A:98:ALA:HB2	2.01	0.41
1:A:179:LEU:HG	1:A:205:THR:HG21	2.03	0.41
1:A:139:ILE:HD11	1:A:147:ILE:HG12	2.03	0.41

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	269/272 (99%)	228 (85%)	28 (10%)	13 (5%)	2 2

All (13) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	172	ALA
1	A	189	THR
1	A	133	GLY
1	A	139	ILE
1	A	190	ASP
1	A	126	VAL
1	A	2	MET
1	A	89	GLY
1	A	116	GLU
1	A	173	ASN
1	A	65	GLY
1	A	140	ARG
1	A	138	PRO

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	217/218 (100%)	189 (87%)	28 (13%)	4 9

All (28) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	16	SER
1	A	26	LEU
1	A	41	LYS
1	A	44	SER
1	A	51	SER
1	A	72	LEU
1	A	73	GLU
1	A	86	VAL
1	A	88	SER
1	A	106	ILE
1	A	118	ASP
1	A	126	VAL
1	A	137	MET
1	A	139	ILE
1	A	140	ARG
1	A	171	TYR
1	A	174	SER
1	A	177	VAL
1	A	189	THR
1	A	190	ASP
1	A	191	ARG
1	A	205	THR
1	A	215	ASN
1	A	216	VAL
1	A	233	LYS
1	A	254	VAL
1	A	255	ILE
1	A	262	ASP

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (4) such

sidechains are listed below:

Mol	Chain	Res	Type
1	A	4	GLN
1	A	173	ASN
1	A	188	ASN
1	A	206	GLN

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](#)

2 ligands are modelled in this entry.

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	$\# Z > 2$
2	SF4	A	290	1,3	0,2,12	-	-	-		
3	GOL	A	501	2	5,5,5	0.37	0	5,5,5	0.32	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
3	GOL	A	501	2	-	2/4/4/4	-

There are no bond length outliers.

There are no bond angle outliers.

There are no chirality outliers.

All (2) torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
3	A	501	GOL	O1-C1-C2-O2
3	A	501	GOL	C1-C2-C3-O3

There are no ring outliers.

2 monomers are involved in 3 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
2	A	290	SF4	2	0
3	A	501	GOL	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.