



wwPDB X-ray Structure Validation Summary Report ⓘ

Aug 22, 2026 – 04:07 am BST

PDB ID : 1E3D / pdb_00001e3d
Title : [NiFe] Hydrogenase from Desulfovibrio desulfuricans ATCC 27774
Authors : Matias, P.M.; Soares, C.M.; Saraiva, L.M.; Coelho, R.; Morais, J.; Le Gall, J.; Carrondo, M.A.
Deposited on : 2000-06-14
Resolution : 1.80 Å(reported)

This is a wwPDB X-ray Structure Validation Summary 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	:	1.8.4, CSD as541be (2020)
Xtriage (Phenix)	:	2.0
EDS	:	3.0
Percentile statistics	:	20250101.v01 (using entries in the PDB archive January 1st 2025)
CCP4	:	9.0.015 (Gargrove)
Density-Fitness	:	1.0.12
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, RNA)	:	Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP)	:	2.50

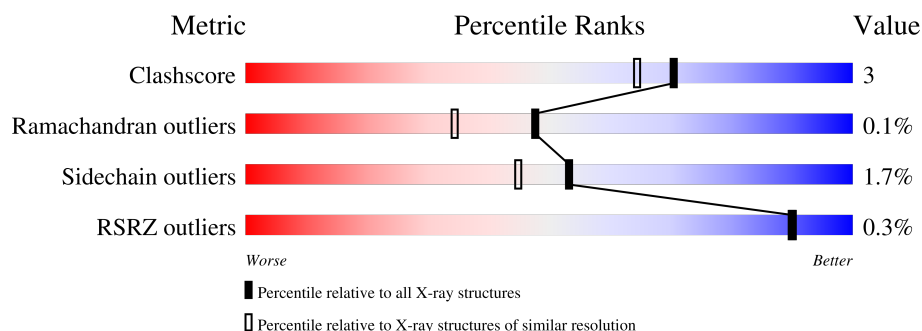
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 1.80 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	8479 (1.80-1.80)
Ramachandran outliers	187476	8391 (1.80-1.80)
Sidechain outliers	187428	8390 (1.80-1.80)
RSRZ outliers	180081	7663 (1.80-1.80)

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 $\leq 5\%$. 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	266	
1	C	266	
2	B	542	
2	D	542	

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
7	FNE	B	543	-	-	X	-
7	FNE	D	543	-	-	X	-

2 Entry composition [i](#)

There are 9 unique types of molecules in this entry. The entry contains 25867 atoms, of which 12022 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.

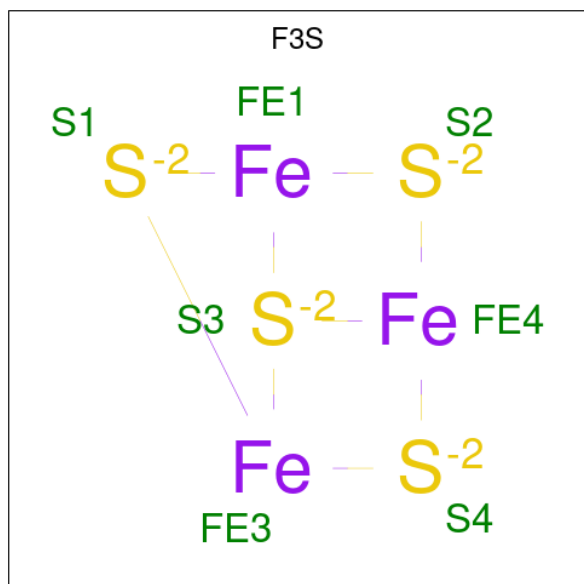
- Molecule 1 is a protein called [NiFe] hydrogenase small subunit.

Mol	Chain	Residues	Atoms						ZeroOcc	AltConf	Trace
1	A	262	Total	C	H	N	O	S	13	0	0
			3877	1257	1894	329	377	20			
1	C	262	Total	C	H	N	O	S	27	0	0
			3877	1257	1894	329	377	20			

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

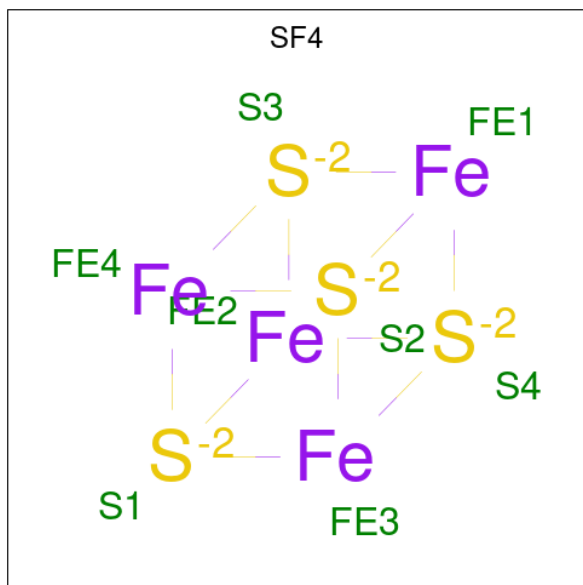
Mol	Chain	Residues	Atoms						ZeroOcc	AltConf	Trace
2	B	537	Total	C	H	N	O	S	84	4	0
			8331	2677	4124	734	775	21			
2	D	537	Total	C	H	N	O	S	42	2	0
			8309	2671	4110	734	775	19			

- Molecule 3 is FE3-S4 CLUSTER (CCD ID: F3S) (formula: Fe₃S₄).



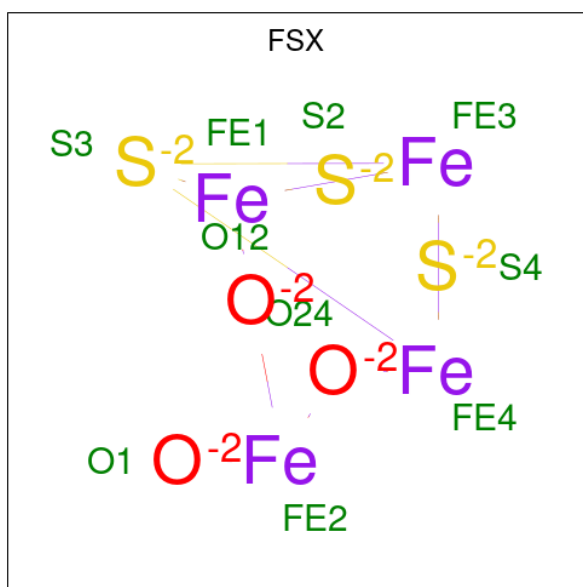
Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
3	A	1	Total	Fe	S	0	0
			7	3	4		
3	C	1	Total	Fe	S	0	0
			7	3	4		

- Molecule 4 is IRON/SULFUR CLUSTER (CCD ID: SF4) (formula: Fe_4S_4).



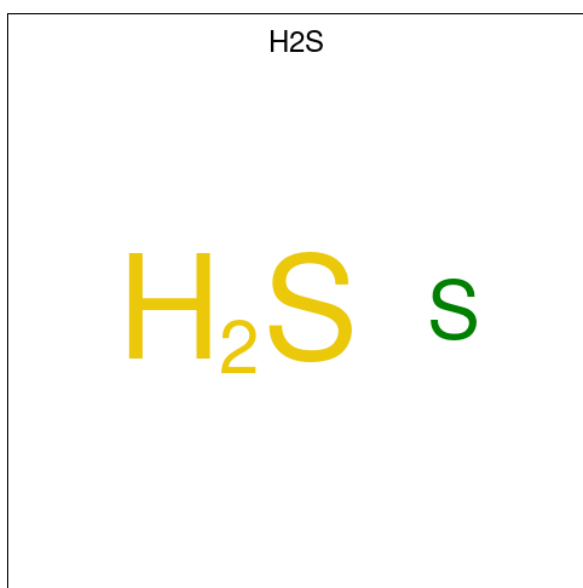
Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
4	A	1	Total	Fe	S	0	0
			8	4	4		
4	C	1	Total	Fe	S	0	0
			8	4	4		

- Molecule 5 is BIS-(MU-2-OXO),[(MU-3--SULFIDO)-BIS(MU-2--SULFIDO)-TRIS(CYS-S)-TRI-IRON] (AQUA)(GLU-O)IRON(II) (CCD ID: FSX) (formula: $\text{Fe}_4\text{O}_3\text{S}_3$).



Mol	Chain	Residues	Atoms				ZeroOcc	AltConf
5	A	1	Total	Fe	O	S	0	0
			10	4	3	3		
5	C	1	Total	Fe	O	S	0	0
			10	4	3	3		

- Molecule 6 is HYDROSULFURIC ACID (CCD ID: H2S) (formula: H₂S).



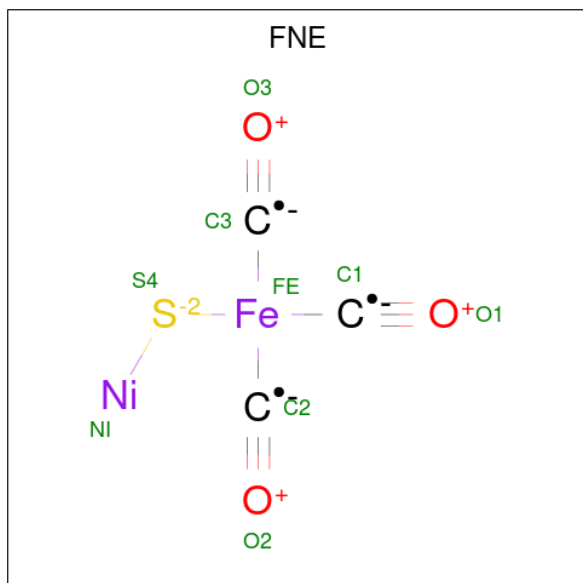
Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
6	A	1	Total	S	0	0
			1	1		
6	B	1	Total	S	0	0
			1	1		

Continued on next page...

Continued from previous page...

Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
6	C	1	Total S 1 1	0	0
6	D	1	Total S 1 1	0	0

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



Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
7	B	1	Total C Fe Ni O S 9 3 1 1 3 1	0	0
7	D	1	Total C Fe Ni O S 9 3 1 1 3 1	0	0

- Molecule 8 is MAGNESIUM ION (CCD ID: MG) (formula: Mg).

Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
8	B	1	Total Mg 1 1	0	0
8	D	1	Total Mg 1 1	0	0

- Molecule 9 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
9	A	248	Total 248	O 248	0	0
9	B	512	Total 512	O 512	0	0
9	C	226	Total 226	O 226	0	0
9	D	413	Total 413	O 413	0	0

- Molecule 1: [NiFe] hydrogenase small subunit



- | |
|------|
| ALA |
| LEU |
| THR |
| GLY |
| S5 |
| Y11 |
| C20 |
| D33 |
| T34 |
| L35 |
| P67 |
| E75 |
| Y86 |
| S110 |
| I111 |
| V142 |
| K143 |
| P148 |
| P151 |
| K169 |
| D173 |
| F205 |
| T261 |
| P262 |
| N266 |

- | | |
|-----|------|
| SER | GLI | VAL | THR | LVS | T6 | T7 | R8 | F48 | K56 | M08 | H17 | H120 | A138 | K142 | R150 | K151 | E186 | M190 | D191 | K214 | G220 | A221 | P224 | P242 | E243 | K246 | E250 | L251 | T252 | G253 | K254 | T253 | T273 | M287 | Y306 | F322 | F327 |
| | K338 | K339 | F344 | H351 | F352 | T353 | W363 | H390 | M405 | L406 | Q407 | P408 | E409 | L415 | M432 | L443 | D446 | Q447 | Q448 | D452 | S458 | A459 | R460 | G461 | V462 | R469 | H474 | W494 | Q497 | S506 | D524 | P535 | C536 | C539 | H542 | | |

- | SR | GLN | VAL | THR | LVS |
|------|------|------|------|------|
| T6 | P7 | R8 | K39 | K56 |
| C74 | S82 | H117 | H120 | L121 |
| K142 | E155 | L164 | V168 | E186 |
| M190 | Y202 | G220 | A221 | E238 |
| Y273 | G281 | M287 | G290 | W305 |
| Y306 | K307 | D313 | R314 | K315 |
| K326 | Y320 | T348 | M349 | P350 |
| T353 | F354 | T358 | P367 | Y386 |
| H390 | L393 | K394 | H400 | H405 |
| L415 | L426 | Q430 | D446 | Q447 |
| E451 | B459 | W490 | P491 | W494 |
| A511 | L512 | V513 | V524 | C536 |
| H542 | | | | |

4 Data and refinement statistics

Property	Value	Source
Space group	P 1 21 1	Depositor
Cell constants a, b, c, α , β , γ	64.09Å 169.98Å 72.62Å 90.00° 92.80° 90.00°	Depositor
Resolution (Å)	25.00 – 1.80 25.00 – 1.80	Depositor EDS
% Data completeness (in resolution range)	95.4 (25.00-1.80) 89.9 (25.00-1.80)	Depositor EDS
R_{merge}	0.07	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	2.45 (at 1.80Å)	Xtriage
Refinement program	SHELXL-97	Depositor
R, R_{free}	0.167 , 0.223 0.158 , (Not available)	Depositor DCC
R_{free} test set	No test flags present.	wwPDB-VP
Wilson B-factor (Å ²)	17.8	Xtriage
Anisotropy	0.101	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.41 , 66.9	EDS
L-test for twinning ²	$\langle L \rangle = 0.49$, $\langle L^2 \rangle = 0.32$	Xtriage
Estimated twinning fraction	0.035 for h,-k,-l	Xtriage
F_o, F_c correlation	0.96	EDS
Total number of atoms	25867	wwPDB-VP
Average B, all atoms (Å ²)	26.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 3.84% of the height of the origin peak. No significant pseudotranslation is detected.*

¹Intensities estimated from amplitudes.

²Theoretical values of $\langle |L| \rangle$, $\langle L^2 \rangle$ for acentric reflections are 0.5, 0.333 respectively for untwinned datasets, and 0.375, 0.2 for perfectly twinned datasets.

5 Model quality [i](#)

5.1 Standard geometry [i](#)

Bond lengths and bond angles in the following residue types are not validated in this section: FNE, FSX, SF4, F3S, MG, H2S

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	0.45	0/2035	1.28	9/2770 (0.3%)
1	C	0.45	0/2035	1.30	9/2770 (0.3%)
2	B	0.47	0/4337	1.34	22/5896 (0.4%)
2	D	0.45	0/4321	1.29	17/5876 (0.3%)
All	All	0.46	0/12728	1.31	57/17312 (0.3%)

There are no bond length outliers.

The worst 5 of 57 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
2	B	322	PHE	CA-C-N	13.26	141.62	122.66
2	B	322	PHE	C-N-CA	13.26	141.62	122.66
2	B	263	TYR	CA-C-N	-8.17	115.09	120.24
2	B	263	TYR	C-N-CA	-8.17	115.09	120.24
2	B	108	ASN	CA-CB-CG	7.67	120.28	112.60

There are no chirality outliers.

There are no planarity outliers.

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	1983	1894	1897	13	0
1	C	1983	1894	1897	8	0

Continued on next page...

Continued from previous page...

Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
2	B	4207	4124	4121	31	0
2	D	4199	4110	4111	32	0
3	A	7	0	0	0	0
3	C	7	0	0	0	0
4	A	8	0	0	0	0
4	C	8	0	0	0	0
5	A	10	0	0	0	0
5	C	10	0	0	0	0
6	A	1	0	0	0	0
6	B	1	0	0	0	0
6	C	1	0	0	0	0
6	D	1	0	0	0	0
7	B	9	0	0	3	0
7	D	9	0	0	4	0
8	B	1	0	0	0	0
8	D	1	0	0	0	0
9	A	248	0	0	6	0
9	B	512	0	0	8	0
9	C	226	0	0	1	0
9	D	413	0	0	10	0
All	All	13845	12022	12026	83	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 3.

The worst 5 of 83 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)
2:B:536[C]:CYS:SG	7:B:543:FNE:C3	2.63	0.86
2:B:186:GLU:HG3	9:B:2227:HOH:O	1.84	0.78
2:B:344:PHE:HB2	9:B:2372:HOH:O	1.89	0.72
2:D:426:LEU:O	2:D:430:GLN:HG3	1.89	0.72
2:D:56:LYS:HE3	9:D:2386:HOH:O	1.91	0.70

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	260/266 (98%)	246 (95%)	13 (5%)	1 (0%)	30	19
1	C	260/266 (98%)	252 (97%)	8 (3%)	0	100	100
2	B	540/542 (100%)	524 (97%)	16 (3%)	0	100	100
2	D	538/542 (99%)	519 (96%)	18 (3%)	1 (0%)	43	31
All	All	1598/1616 (99%)	1541 (96%)	55 (3%)	2 (0%)	48	34

All (2) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
2	D	221	ALA
1	A	67	PRO

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	210/212 (99%)	203 (97%)	7 (3%)	33	21
1	C	210/212 (99%)	206 (98%)	4 (2%)	50	41
2	B	444/444 (100%)	440 (99%)	4 (1%)	70	67
2	D	442/444 (100%)	435 (98%)	7 (2%)	55	47
All	All	1306/1312 (100%)	1284 (98%)	22 (2%)	53	45

5 of 22 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	C	169	LYS
2	D	82	SER
2	D	39	LYS
2	D	142	LYS
1	A	261	THR

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. 5 of 15 such sidechains are listed below:

Mol	Chain	Res	Type
2	D	204	GLN
2	D	405	ASN
2	D	284	ASN
2	D	448	GLN
2	D	351	HIS

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](#)

Of 14 ligands modelled in this entry, 4 are modelled with single atom and 2 are monoatomic - leaving 8 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	SF4	C	268	1	0,12,12	-	-	-		
4	SF4	A	268	1	0,12,12	-	-	-		
5	FSX	C	269	1	0,14,14	-	-	-		
3	F3S	C	267	1	0,9,9	-	-	-		
7	FNE	D	543	2	3,8,8	2.49	3 (100%)	-		
7	FNE	B	543	2	3,8,8	2.94	2 (66%)	-		
5	FSX	A	269	1	0,14,14	-	-	-		
3	F3S	A	267	1	0,9,9	-	-	-		

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	SF4	C	268	1	-	-	0/6/5/5
4	SF4	A	268	1	-	-	0/6/5/5
5	FSX	C	269	1	-	-	0/4/5/5
3	F3S	C	267	1	-	-	0/3/3/3
5	FSX	A	269	1	-	-	0/4/5/5
3	F3S	A	267	1	-	-	0/3/3/3

All (5) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
7	B	543	FNE	O2-C2	-4.15	1.09	1.16
7	D	543	FNE	O2-C2	-3.11	1.11	1.16
7	B	543	FNE	O1-C1	-2.68	1.12	1.16
7	D	543	FNE	O3-C3	-2.19	1.13	1.16
7	D	543	FNE	O1-C1	-2.05	1.13	1.16

There are no bond angle outliers.

There are no chirality outliers.

There are no torsion outliers.

There are no ring outliers.

2 monomers are involved in 7 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
7	D	543	FNE	4	0
7	B	543	FNE	3	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 [i](#)

6.1 Protein, DNA and RNA chains [i](#)

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	262/266 (98%)	-0.28	1 (0%) 88 89	14, 24, 42, 59	4 (1%)
1	C	262/266 (98%)	-0.25	1 (0%) 88 89	13, 24, 43, 60	6 (2%)
2	B	537/542 (99%)	-0.49	0 100 100	8, 21, 35, 52	13 (2%)
2	D	537/542 (99%)	-0.27	2 (0%) 88 89	9, 25, 43, 61	9 (1%)
All	All	1598/1616 (98%)	-0.34	4 (0%) 90 90	8, 24, 40, 61	32 (2%)

All (4) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	67	PRO	3.0
1	C	67	PRO	3.0
2	D	400	VAL	2.9
2	D	405	ASN	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 oligosaccharides 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, 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	RSCC	RSR	B-factors($\text{\AA}^2$)	Q<0.9
6	H2S	B	904	1/1	0.95	0.08	18,18,18,18	1
6	H2S	D	904	1/1	0.96	0.06	19,19,19,19	1
6	H2S	A	904	1/1	0.97	0.04	22,22,22,22	0
8	MG	D	901	1/1	0.97	0.04	17,17,17,17	0
4	SF4	C	268	8/8	0.98	0.05	16,18,19,20	0
4	SF4	A	268	8/8	0.99	0.02	19,21,22,24	0
6	H2S	C	904	1/1	0.99	0.03	23,23,23,23	0
3	F3S	A	267	7/7	0.99	0.03	15,17,18,18	0
7	FNE	D	543	9/9	0.99	0.04	15,16,19,23	1
8	MG	B	901	1/1	0.99	0.03	15,15,15,15	0
3	F3S	C	267	7/7	0.99	0.02	14,15,16,16	0
5	FSX	A	269	10/10	1.00	0.03	9,16,21,22	0
5	FSX	C	269	10/10	1.00	0.03	15,16,26,26	0
7	FNE	B	543	9/9	1.00	0.03	13,16,21,22	1

6.5 Other polymers [i](#)

There are no such residues in this entry.